EUROPEAN
COMMISSION

Brussels, 7.6.2018
SWD(2018) 307 final

PART 2/3

COMMISSION STAFF WORKING DOCUMENT

IMPACT ASSESSMENT

Accompanying the document

Proposals for a

REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL establishing Horizon Europe – the Framework Programme for Research and Innovation, laying down its rules for participation and dissemination

DECISION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on establishing the specific programme implementing Horizon Europe – the Framework Programme for Research and Innovation

COUNCIL REGULATION establishing the Research and Training Programme of the European Atomic Energy Community for the period 2021-2025 complementing Horizon Europe – the Framework Programme for Research and Innovation

{COM(2018) 435 final} - {COM(2018) 436 final} - {COM(2018) 437 final} -
{SEC(2018) 291 final} - {SWD(2018) 308 final} - {SWD(2018) 309 final}

Annexes

Annex 1: Procedural information

1 Lead DG(s), Decide Planning, CWP Reference

The Impact Assessment of the future Framework Programme for Research and Innovation is the result of a collective work carried out under the leadership of DG RTD with the R&I-family DGs, including AGRI, CNECT, EAC, ENER, GROW, HOME, JRC, MOVE.

CWP Reference: COM(2017) 650 final

2 Organisation and timing

This Impact Assessment has benefited from co-creation with the following working groups: the internal RTD IA Penholder Group, the RTD Indicator task team, the informal R&I IA working group. The work was steered at senior management level through discussions at the R&I-family DG meetings, as well as at the Inter-Service Steering Group on Horizon Europe (including the R&I-family and BUDG, CLIMA, COMP, DIGIT, ECFIN, ENV, EMPL, MARE, REGIO, SJ, SANTE, SG, TRADE). In addition, workshops open to all services were held on indicators with external experts and on synergies between the Framework Programme and other EU programmes.

The following milestones constitute the bulk of the general chronology of the Impact Assessment:

Date	Activity
10 January 2018	Launch of Cluster Stakeholder Consultation (8 weeks)
17 January 2018	Upstream meeting with RSB
19 January 2018	1st Informal R&I-family meeting
2 February 2018	2nd Informal R&I-family meeting
16 February 2018	3rd Informal R&I-family meeting
21 February 2018	Workshop with experts on indicators
27 February 2018	First formal ISSG meeting chaired by SG
2 March 2018	4th Informal R&I-family meeting
6 March 2018	R&I DG meeting
9 March 2018	End of cluster consultation
19 March 2018	Second formal ISSG meeting chaired by SG
21 March 2018	Submission to the RSB
11 April 2018	RSB meeting
26 April 2018	Third ISSG meeting on the legal proposal
4 May 2018	Launch of ISC (duration: until 16 May 2018)
8 May 2018	Fourth ISSG meeting
7 June 2018	Adoption

3 Consultation of the Regulatory Scrutiny Board

The Regulatory Scrutiny Board (RSB) gave a positive opinion (with reservations) to a draft version of this impact assessment. The main text and annexes were adjusted following the recommendations of the RSB. In particular, significant work was conducted to ensure consistency between challenges, objectives, structure and impacts. All revisions were done to ensure that the assessment relies on a solid methodology that meets the RSB standards. The Board's recommendations covered the following key aspects.

(1) The report does not sufficiently describe the balance between the new three pillars of the programme. It does not spell out the rationale, risks, and implications of the proposed structure and priorities. This applies in particular to the Global Challenges pillar (pillar 2).

1 Pillar structure and objectives	
The report should better explain and justify its proposed three pillars' structure.	Text revised in section 3.1.
It should clearly explain how FP9 objectives will differ from Horizon 2020.	Text revised in section 2.3 to address this point.
It should better derive the proposed changes to the current structure of Horizon 2020 from lessons learned and stakeholders' input. This is particularly relevant for the second pillar on Global Challenges where the exact scope and implications of the proposed structure should be substantiated.	New text added in 3.1. Boxes with stakeholders' inputs added throughout the text, in particular for each design novelty. Sections in annex on stakeholder consultation revised.
The report should also confirm that the strengthened emphasis on innovation and support to close-to-market initiatives will not happen at the expense of basic research. In this respect, the report should clarify how the concerns expressed by stakeholders on the need for a balanced integration of social sciences and humanities is taken on board.	New text added in 3.1.
In that respect, an indication of the expected breakdown of resources across the different pillars and within each pillar would provide useful information on the "centre(s) of gravity" of the future programme.	New text added in 3.1.

(2) The report does not show the rationale and value added of the additional structures and initiatives for the next framework programme, such as the European Innovation Council or the "R&I missions".

2 Proposed novelties	
The report should better demonstrate that the proposed novelties build on sound foundations and will effectively address key challenges identified for the next framework programme. It should transparently present possible risks and trade-offs associated with the introduction of these new instruments.	Text revised in the introduction of 3.2. References added overall and for the different novelties. All sections on novelties reinforced in order to strengthen their rationale and added value. New sections "what are the risks?" added for each design novelty.
In the case of the European Innovation Council, the report should better analyse its structure, governance, beneficiaries, optimal scale and functioning. It should better demonstrate that the EIC addresses a legitimate unmet demand from innovators that cannot be met more efficiently and competently through other means or existing structures such as the EU Institute for Innovation and Technology (EIT) or the Joint Research Centre. It should describe how it builds on the experience of providing support to innovative SMEs.	Main text and annex revised for EIC. Section on blended financed updated. Structure of EIC clarified. Governance, beneficiaries and functioning detailed in the annex. Optimal scale covered by providing figures on the equity funding gap.

It should explain its complementarity with the EIT and other instruments in existing programmes supporting various stages and forms of innovation.	
The report should also better position the concept of "R&I missions" in the overall proposed structure of the programme and explain whether they will replace the current "focus areas", how "R&I missions" differ from and/or intend to build on them. The report should more convincingly explain how the overall governance and practical organisation of the "R&I missions" will deliver on the expected societal engagement and ownership, while ensuring timely progress and tangible impacts. The report should clarify the expected interaction between "R&I missions" and the EU regulatory framework.	Text added on overarching approach of missions in section 3.1. Missions section & annex revised accordingly.
The report should also provide safeguards and mitigation measures protecting against potential risks associated with its proposed bottom up approach to supporting innovation, in particular in terms of respect of EU values, ethical approach and conflicts of interest. It should strengthen the case for publicly supporting close-to-market initiatives with high long-term profit potential by explaining how citizens and public authorities will reap the benefits of such high-risk public investments.	Sections on risks added for each design novelty, including EIC. Section and + annex on EIC revised accordingly

(3) The report does not convincingly demonstrate that the new programme will effectively streamline its delivery mechanisms, including the partnerships landscape.

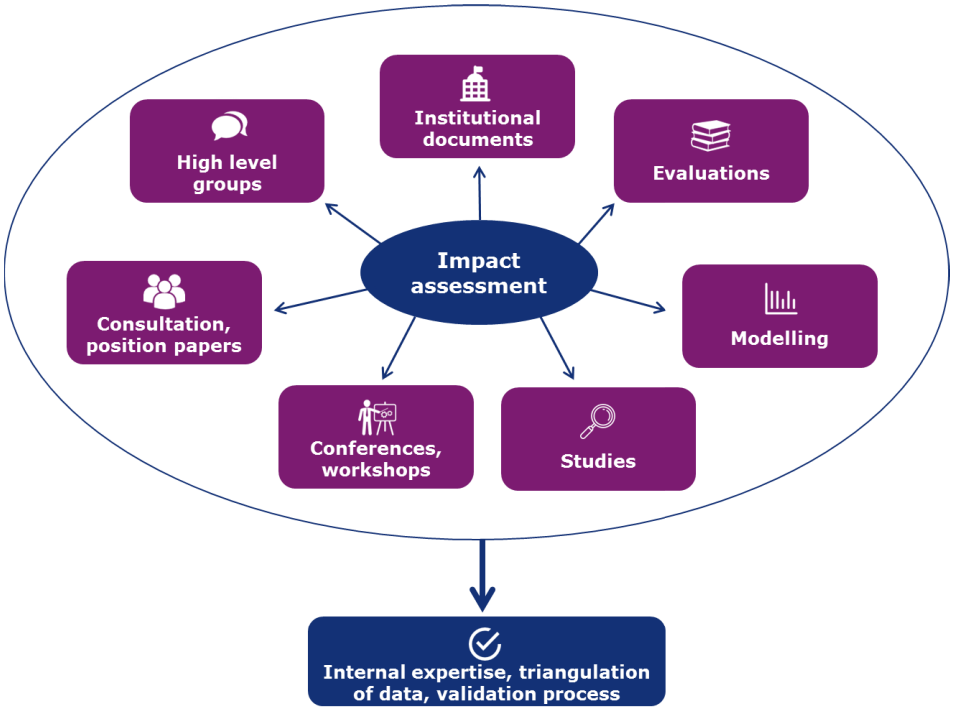
3 Simplification, notably rationalisation of partnerships	
The delivery mechanisms should more clearly emphasise the simplification proposed in the various instruments that will serve to implement the next framework programme. This concerns notably the rationalisation of the partnerships landscape for which the programme should more clearly state its ambitions. Currently the report does not demonstrate, in many instances, that FP9 will be less burdensome and less costly for the beneficiaries. A mapping of instruments used in the current and proposed in the new programme could usefully illustrate such simplification efforts	Simplification aspect reinforced throughout the text. Section and annex on partnerships revised. Revisions in section 4 in several places. Table with continued and discontinued instruments added in section 4.

4 Latest MFF developments, notably synergies	
The report should reflect the latest developments, as they become known, concerning the overall Multiannual Financial Framework. Notably in the area of synergies across programmes, it should provide more tangible elements on concrete measures to ensure that they are fully exploited. This concerns for instance the interfacing with the Digital Europe Programme, InvestEU, and the European University Networks in Erasmus+.	Section and annex on synergies revised.

Other	
The Board notes that this impact assessment will eventually be complemented with specific budgetary arrangements and may be substantially amended in line with the final policy choices of the Commission's MFF proposal.	Box in 1.1.1 added. The impact assessment does not make any budget assumption (except for the baseline scenario in the economic models), therefore no drastic change was required after the MFF proposal related to the amount itself. Sections on synergies revised.

4 Evidence, sources and quality

Figure 1 Evidence used for the impact assessment



Findings from previous evaluations are used throughout the document. The impact assessment is strongly guided by the results from the interim evaluation of Horizon 2020 and related evaluations, which include:

- **European Commission (2017), Interim evaluation of Horizon 2020, Staff Working Document (SWD). The interim evaluation of Horizon 2020 (major reference used throughout the impact assessment)**
- European Commission (2017), Interim Evaluation of the Joint Undertakings (JUs) operating under Horizon 2020, Staff Working Document (SWD).
- European Commission (2017), Interim evaluation of the European Institute of Innovation and Technology (EIT), Staff Working Document (SWD).
- European Commission (2017), FET Flagships – Interim evaluation.
- Joint Research Centre Implementation Review 2017: In the context of the Interim Evaluation of Horizon 2020. DG JRC, July 2017.

For this impact assessment, several references are made in particular to the recommendations and findings of the High Level Group chaired by Pascal Lamy. The mandate of this High Level Group was to provide advice on how to maximise the impact of the EU's investment in research and innovation. Reports from high level groups used for this impact assessment include:

- **LAB – FAB – APP: Investing in the European future we want, Report of the independent High Level Group on maximising the impact of EU Research & Innovation Programmes, July 2017.**
- Funding - Awareness - Scale - Talent (FAST): Europe is back: Accelerating Breakthrough Innovation, Full set of recommendations from the Independent High-Level Group of Innovators on establishing a European Innovation Council, 2018.
- Mission-Oriented Research and Innovation in the European Union: A problem-solving approach to fuel innovation-led growth, by Mariana Mazzucato. February 2018.

- Mission-Oriented Research and Innovation: Assessing the impact of a mission-oriented research and innovation approach. Study coordinated by the Joint Institute for Innovation Policy, February 2018.
- Mission-Oriented Research and Innovation Policy: A RISE Perspective, February 2018.
- Open Innovation, Open Science, Open to the World, Reflections of the Research, Innovation and Science Policy Experts (RISE), March 2017.
- High Level Group; Towards a Mission-Oriented Research and Innovation Policy in the European Union: An ESIR Memorandum, December 2017.

Several documents produced by the Commission and other institutions were used, including:

- Committee of the Regions (2017), CoR Opinion SEDEC-VI/026, Local and Regional Dimension of the Horizon 2020 Programme and the New Framework Programme for Research and Innovation.
- Council of the European Union (2017), From the Interim Evaluation of Horizon 2020 towards the ninth Framework Programme - Council conclusions.
- European Commission (2017), Reflection paper on the future of EU finances.
- European Commission (2017), The economic rationale for public R&I funding and its impact, Policy Brief Series.
- European Commission (2018), Communication on the Horizon 2020 Interim Evaluation, COM(2018)2 final.
- European Parliament (2017), REPORT on the assessment of Horizon 2020 implementation in view of its interim evaluation and the Framework Programme 9 proposal, EP T8-0253/2017.
- European Economic and Social Committee (2016), EESC information report INT/807, Horizon 2020 (evaluation).
- European Research Area and Innovation Committee (2017), ERAC Opinion on the Interim Evaluation of Horizon 2020 and preparations for the next Framework Programme, ERAC 1207/17.

In addition to the existing literature of studies and reports related to research and innovation, external studies were launched in the context of this impact assessment on specific issues:

- On economic modelling: Seureco (2018), Support for assessment of socio-economic and environmental impacts (SEEI) of European R&I programme.
- On the impact of missions: Mission-Oriented Research and Innovation: assessing the impact of a mission-oriented research and innovation approach. The Joint Institute for Innovation Policy, Joanneum Research, Tecnalia, TNO, VTT, the Danish Technological Institute, and Valdani Vicari & Associati (2018).
- On Future and Emerging Technologies: Beckert B., et al. (2018), Visionary and Collaborative Research in Europe, Pathways to impact of use-inspired basic research, Fraunhofer Institute for Systems and Innovation Research, Austrian Institute of Technology.
- On foresight: Ricci, A. et al. (2017), Beyond the Horizon: Foresight in Support of the Preparation of the European Union's Future Policies in Research and Innovation.
- On EU added value: PPMI (2017), Assessment of the Union Added Value and the Economic Impact of the EU Framework Programmes (FP7, Horizon 2020).

Various consultation methods and tools were used (see Annex 2), including events, conferences, workshops.

The quantification of the overall expected impact of the Programme relies on economic modelling (see Annex 5). Internal and external expertise was mobilised:

- Results from the NEMESIS model were produced by an external contractor (Seureco). DG JRC and DG ECFIN were part of the committee steering the related study to ensure the quality of the results.
- Results from the QUEST model were produced by DG ECFIN.
- Results from the RHOMOLO model were produced by DG JRC.

Internal expertise was used to ensure the overall quality of the impact assessment by triangulating these different sources of information, organising several meetings and participatory workshops with experts from the Commission on dedicated topics and ensuring continuous exchanges between Commission services. The approach and results have been discussed and validated during senior management and inter-service meetings.

Annex 2: Stakeholder consultation

1 Objectives

The aim of stakeholder consultations was to seek the views of EU Research and Innovation (R&I) stakeholders on the key elements of the design of the post 2020 EU programme for R&I. The results of the stakeholder consultation feed into the Impact Assessment for the programme and help to shape the drafting of the legal text.

Previous stakeholder consultations used for this impact assessment include the following:

- the Horizon 2020 Stakeholder Consultation completed in January 2017 organised in the context of the Interim evaluation of Horizon 2020 (3,500 responses and 300 position papers)[1];
- the European Innovation Council Call for ideas completed in April 2016 (1,000 respondents and 100 position papers)[2].

2 Target groups

In preparation to the stakeholder consultation activities a mapping of the key stakeholders was carried out. They mainly include the EU and global umbrella organisations and institutions relevant to the EU R&I policy field and the decision-making process. The consultations were, however, also meant to reach citizens in general and involve them in the discussion on the future of R&I in Europe.

3 Consultation methods and tools

A mix of consultation activities came in different moments of the Impact Assessment work to ensure stakeholder views are systematically accounted for in the design of Horizon Europe.

To tailor for different information needs, consultation activities ranged from stakeholder conferences and events, to expert groups, an on-line consultation, workshops, meetings and seminars and analysis of the position papers.

Table 1 Consultation process

	I. Preparatory phase			II. Assessment and design phase		III. Validation phase
	Q1-2017	Q2-2017	Q3-2017	Q4-2017	Q1-2018	Q2-2018
3.1 Conferences and events						
▪ Research & Innovation – Shaping our Future						
▪ European Research Excellence: Impact and value for society						
3.2 Expert groups						

[1] http://ec.europa.eu/research/evaluations/index_en.cfm?pg=h2020interim_stakeholder
[2] https://ec.europa.eu/research/eic/index.cfm

▪ HLG on maximising the impact of European research and innovation programmes						
▪ EIC HLG of Innovators						
▪ Report on mission-oriented approach						
3.3 On-line consultation						
▪ Cluster-based public stakeholder consultation						
▪ Call for feedback on missions						
3.4. Workshops, meetings and seminars						
▪ Simplification workshop						

3.1 Conferences and events

The aim of conferences and events was to gather input from a larger number of stakeholders through direct interaction.

A conference *"Research & Innovation – Shaping our Future"*[3] organised on 3 July 2017 brought together policymakers from EU institutions, stakeholders and interested actors to discuss the role of research and innovation for Europe's future. Pascal Lamy, the chair of the High Level Group on maximising the impact of European research and innovation programmes, presented the Group's vision and recommendations for the future, based on the results of the interim evaluation of Horizon 2020. Other visionary speakers included captains of industry, researchers and innovators at the frontier of progress, politicians and movers and shakers in society but also young people. More than 600 stakeholders from 40 different countries and almost 5000 online viewers from 49 countries actively engaged in the discussion on the future of EU R&I programme by asking 229 questions and submitting 7,788 votes to polls through special IT tool Sli.do. The Commission also followed the discussions at various events organised by different entities.

A conference *"European Research Excellence: Impact and value for society"*[4] organised by Estonian Presidency aimed to influence the debate on European research policy in the lead-up to the next Framework Programme. The outcome of the EU Presidency Conference was presented in a final declaration, the Tallinn Call for Action. The Conference brought together internationally-outstanding scientists and policymakers from many EU countries, as well as a range of stakeholders from academia, business, and civil society.

3.2 Expert groups

In September 2016 the European Commission mandated the *High Level Group on maximising the impact of European research and innovation programmes* to provide advice on how to maximise the impact of the EU's investment in research and innovation based on the results of the interim evaluation of Horizon 2020. The High Level Group concluded with 11 recommendations for the future EU R&I programme presented in the report "*LAB – FAB – APP: Investing in the European future we want*"[5] in July 2017.

European Innovation Council High Level Group of Innovators was set up in January 2017 and mandated to support the European Commission in developing the European Innovation Council

[3] http://ec.europa.eu/research/conferences/2017/shaping-our-future/index.cfm
[4] https://www.eu2017.ee/political-meetings/european-research-excellence-impact-and-value-society
[5] https://ec.europa.eu/research/evaluations/index.cfm?pg=hlg

(EIC). The report "*Europe is back: Accelerating breakthrough innovation*"[6] with 14 recommendations was adopted in January 2018.

Following the recommendations of the Lamy report on missions, an external expert was appointed to advise the Commission on the mission-oriented approach. In February 2018, Prof Mariana Mazzucato presented a report "*Mission-Oriented Research & Innovation in the European Union - A problem-solving approach to fuel innovation-led growth*"[7] in which she recommends five key criteria for the selection of missions at EU level.

3.3 On-line consultations

The aim of web-based consultations was to gather inputs from a broad range of stakeholders. It included on one hand consultation with unlimited access to everybody who wished to contribute – cluster-based public consultation and on the other hand targeted consultation – call for feedback on missions.

- Cluster-based public consultation

Target group: citizens and stakeholders

Timing: January - March (8 weeks) 2018

The public consultation – launched through the Commission's central public consultation website[8] - on EU funds in the area of investment, research & innovation, SMEs and single market was launched as a mandatory element of the stakeholder consultation. It included both closed and open questions and queried on the policy challenges, subsidiarity and added value, objectives of the programmes and obstacles to reach them, scope for simplification and synergy between the programmes. Stakeholder had also a chance to submit their position papers on the design of the post 2020 EU programmes. The consultation period was shortened to 8 weeks, as compared to the standard 12 weeks, given the tight timing of the new programmes preparations.

- Call for feedback on missions

Target group: citizens and stakeholders

Timing: February – April 2018

In the report prepared by Prof Mazzucato on mission-oriented R&I[9], five criteria for setting up the missions were suggested. A call for feedback on these recommended criteria was launched[10]. Besides stakeholders' views on the criteria for mission, as a new feature of the Framework Programme, the respondents were also asked for suggestions of concrete missions. However, information on the topics for concrete missions will be used in the future, not for the purpose of this consultation.

[6] https://ec.europa.eu/info/news/high-level-group-innovators-offer-key-recommendations-european-innovation-council-2018-jan-24_en
[7] https://ec.europa.eu/info/news/bold-science-meet-big-challenges-independent-report-calls-mission-oriented-eu-research-and-innovation-2018-feb-22_en
[8] https://ec.europa.eu/info/consultations/public-consultation-eu-funds-area-investment-research-innovation-smes-and-single-market_en
[9] https://ec.europa.eu/info/news/bold-science-meet-big-challenges-independent-report-calls-mission-oriented-eu-research-and-innovation-2018-feb-22_en
[10] https://ec.europa.eu/eusurvey/runner/482a79de-3fad-17e1-c60d-2e4418c1a95d

3.4 Workshops, meetings and seminars

Stakeholder workshop on ideas for further simplification of the implementation of the R&I Framework Programmes was organised by the Commission on 20 October 2017[11]. The main objective of the workshop was to have a discussion with practitioners at working level on the technical details of the processes, documentation and guidance for R&I grant implementation. Representatives of the main European research stakeholder umbrella organisations were invited to participate on site and the meeting was also web-streamed to allow for broader remote contribution. The programme of the workshop was built upon the conclusions of the Conference on Performance and Further Simplification hosted by Commissioner Moedas in February 2017, and the recommendations of the Lamy Report.

3.5 Position papers

Various stakeholders expressed their views on the post 2020 EU programme for R&I by submitting their position papers. More than 300 position papers have been submitted, either ad-hoc or as a response to the cluster-based public stakeholder consultation.

The EU institutions also expressed their views on the post 2020 EU programme for R&I adopting the reports based on the results of the interim evaluation of Horizon 2020:

- Competitiveness Council Conclusions From the Interim Evaluation of Horizon 2020 towards the ninth Framework Programme adopted on 1 December 2017[12];
- ERAC Opinion[13] of 7 July 2017 on the Interim Evaluation of Horizon 2020 and preparations for the next Framework Programme (FP);
- European Parliament (EP) resolution of 13 June 2017 on the assessment of Horizon 2020 implementation in view of its interim evaluation and the Framework Programme 9 proposal[14];
- Opinion of the European Economic and Social Committee of 20 October 2016 on the mid-term evaluation of Horizon 2020[15] and an information report of 16 January 2017 on Horizon 2020 (evaluation)[16];
- Opinion of the Committee of Regions on local and regional dimension of the Horizon 2020 Programme and the new Framework Programme for Research and Innovation of 12 July 2017[17].

4 Methodology and tools used to process the data

Information collected during the consultation was analysed depending on the consultation method. Reports from the conferences, workshops and expert groups were prepared and published. All

[11] http://ec.europa.eu/research/participants/data/ref/h2020/other/events/2017-10-20/final-report_en.pdf
[12] http://www2.consilium.europa.eu/en/press/press-releases/2017/12/01/interim-evaluation-of-horizon-2020-council-adopts-conclusions/#
[13] ERAC 1207/17.
[14] http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//TEXT+TA+P8-TA-2017-0253+0+DOC+XML+V0//EN
[15] http://www.eesc.europa.eu/en/our-work/opinions-information-reports/opinions/mid-term-evaluation-horizon-2020
[16] http://www.eesc.europa.eu/en/our-work/opinions-information-reports/information-reports/horizon-2020-evaluation
[17] http://cor.europa.eu/en/activities/opinions/pages/opinion-factsheet.aspx?OpinionNumber=CDR%20854/2017

relevant stakeholder input, including the results of the on-line consultations as well as the position papers, were carefully analysed against the key issues identified in the process of the impact assessment preparations.

5 Results of the stakeholder consultation

5.1 Conferences and events

The conference *"Research & Innovation – Shaping our Future"* (3 July 2017) opened the discussion with stakeholders on the future of R&I. At this early stage in the process, stakeholders expressed first views regarding the missions underlying that transparency in setting up the missions is of utmost importance and highlighting the role of society and citizens.

Stakeholders were also asked to summarise their vision for the future R&I programme and the responses focused on such key concepts like jobs, SMEs and impact.

At the conference organised by the Estonian Presidency on 12 October 2017, *"European Research Excellence: Impact and value for society"*, the key message on the importance of R&I for the future was translated into three priorities: 1) Ensure investment in research and innovation; 2) Increase the impact of R&I investments; 3) Build trust between research and society, and within the R&I system. It was followed by a number of more concrete actions addressed to different groups from policymakers to researchers to increase public and political support for R&I.

5.2 Expert groups

In the preparation of the next Programme, the Commission sought information and assistance from different expert groups. The *High Level Group on maximising the impact of European research and*

innovation programmes prepared 11 recommendations which triggered the discussion on the R&I future. Stakeholders reflected upon many of them in their position papers:

- Prioritise research and innovation in EU and national budgets
- Build a true EU innovation policy that creates future markets
- Educate for the future and invest in people who will make the change
- Design the EU R&I programme for greater impact
- Adopt a mission-oriented, impact-focused approach to address global challenges
- Rationalise the EU funding landscape and achieve synergy with structural funds
- Simplify further
- Mobilise and involve citizens
- Better align EU and national R&I investment
- Make international R&I cooperation a trademark of EU research and innovation
- Capture and better communicate impact

In order to collect information on a way forward regarding the breakthrough innovation the *European Innovation Council High Level Group of Innovators* was set up and developed 14 recommendations to support single innovators turning disruptive/breakthrough science and technology into market-creating innovations grouped into four factors that hold back breakthrough and deep tech innovation in Europe:

- Funding: empower the innovator, simplify, incentivise private investment,
- Awareness: champion innovators, communicate success,
- Scale: build the camp, leverage European ecosystems,
- Talent: connect people, create prestige for innovators.

A new concept of missions suggested in the Lamy report was further elaborated in the report "*Mission-Oriented Research & Innovation in the European Union - A problem-solving approach to fuel innovation-led growth"* prepared by an expert in the area, prof. Mariana Mazzucato. Five criteria for the selection of the missions were identified:

- EU R&I missions should be bold, inspirational with wide societal relevance**;**
- EU R&I missions should have a clear direction: should be targeted, measureable and time-bound**;**
- EU R&I missions should have ambitious but realistic research & innovation actions
- EU R&I missions should be cross-disciplinary, cross-sectoral and cross-actor
- EU R&I missions should foster multiple, bottom-up solutions

The stakeholders were asked to rate the importance of these criteria in a special *Call for feedback* open until 3 April in which 1200 responses submitted. The overall picture is that respondents agreed to the criteria and measures for implementing mission proposed by Prof Mazzucato, and agreed to consult citizens on the choice of missions.

5.3 Workshops, meetings and seminars

Key messages from dialogue with stakeholders on simplification coming from the workshop on that issue of key importance for participants, especially new ones, were as follows:

- Support to the existing funding model, with a single funding rate per project and a flat rate for the indirect costs;
- Cautious regarding a broad extension of the simplified cost options, such as the Lump Sum pilot in Horizon 2020, or the use of unit costs for personnel costs; clear preference for continuation of cost reimbursement;

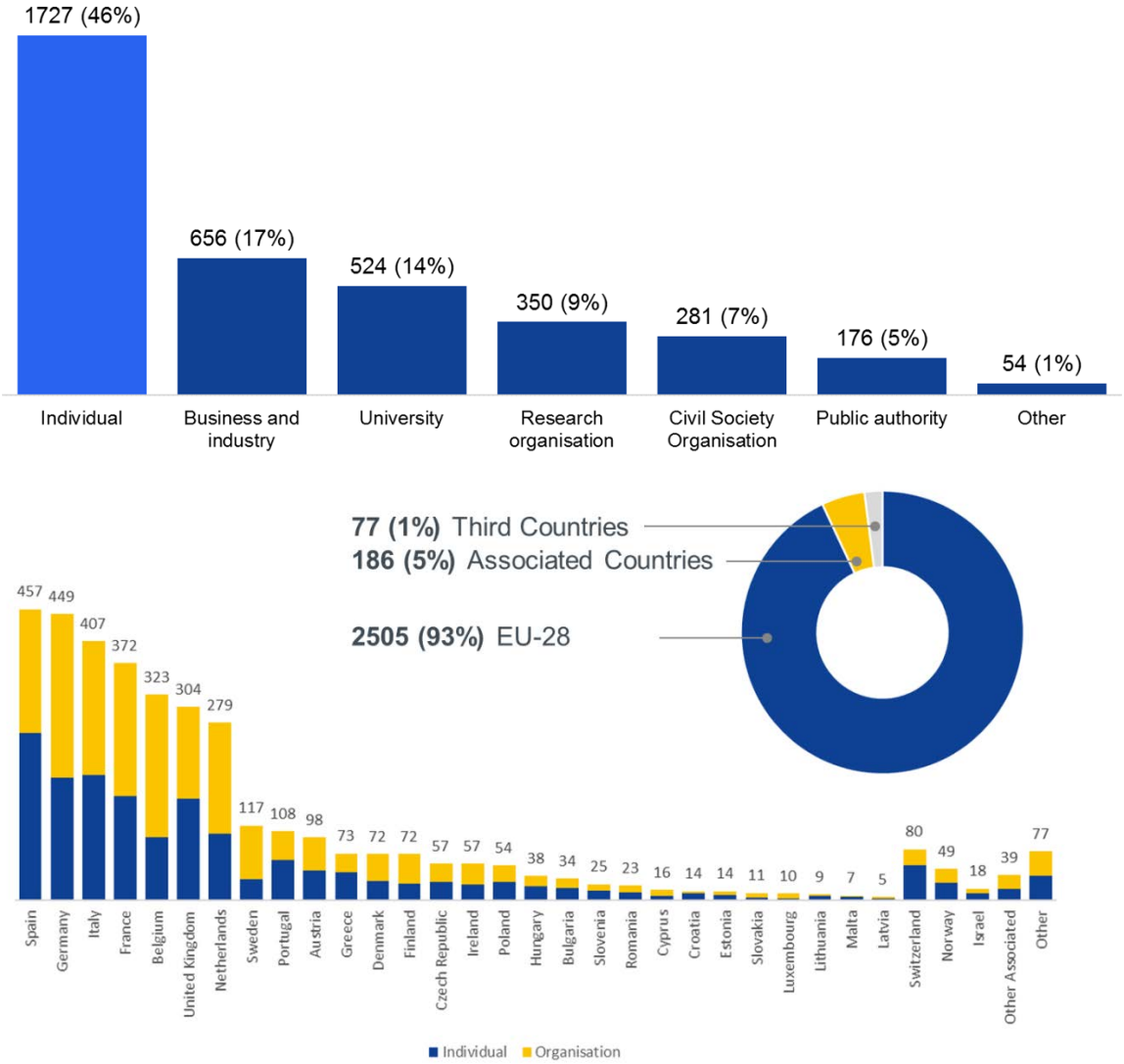
- Request for broader acceptance of usual cost-accounting practices and for the introduction of the single audit principle/cross-reliance on audits;
- Further shortening of the Time to Grant, simplified project reporting and improvements to the submission and evaluation processes;
- Improve projects reporting in order to increase the quality of dissemination and exploitation.

5.4 Online consultation, including the public consultation on *EU funds in the area of investment, research & innovation, SMEs and single market*

More than 4000 responses were submitted to the cluster-based public consultation on EU funds in the area of investment, research & innovation, SMEs and single market. **94% of respondents referred to the EU support for R&I**. These respondents are subject of the further analysis below.

Almost half of respondents (46%) replied to the consultation in individual capacity followed by business and industry representatives (17%) and universities (14%). 93% of respondents were from EU Member States, 5% from associated countries and 1% from third countries. Respondents came from 70 different countries.

Figure 2 Respondents to cluster-based public consultation



Some 90% (3,414) of cluster survey respondents reported having experience with the Horizon 2020 program. Those respondents who reported having experience with Horizon 2020 also reported

having experience with European Structural and Investment funds (22%), EU Health Programme (9%) and COSME (8.%).

The Commission has preliminarily identified a number of policy challenges that the programmes/funds in the area of investment, research & innovation, SMEs and single market could address. The three most important policy challenges in view of respondents are:

- "Fostering R&I across the EU": 97% of respondents consider this very or rather important policy challenge. The absolute majority of those who submitted position papers also implicitly acknowledge R&I as an important policy priority for Europe. Stakeholders consider that R&I play a fundamental role in forming European identity.
- "Supporting education, skills and training": 93% of respondents consider this very or rather important policy challenge.
- "Ensuring a clean and healthy environment and the protection of natural resources": 90% of respondents consider this a very or rather important policy challenge.

Some 61% of respondents believe that "fostering R&I across the EU" has so far been fully or fairly well addressed policy challenge while 35% consider it has been addressed to some extent only. Among other challenges, stakeholders consider that provision of smooth circulation of goods and support to capital flows and investments are well addressed. However, stakeholder responses suggest that more can be done to address unemployment and social disparities: only 14% of respondents consider that this challenge is fairly well addressed, while 40% are of the opinion that it has been addressed to some extent only and 21% believe that it has not been addressed at all.

According to vast majority of stakeholders, "too complex procedures leading to high administrative burden and delays" is the main obstacle preventing the current programme from achieving its objectives. Regional public authorities in particular agree with this statement. The other obstacles noted were: "lack of flexibility to react to unforeseen circumstances", "insufficient synergies between the EU programmes/funds" and "difficulty of combining EU action with other public interventions and private finance".

Generally, stakeholders agree that fewer, clearer, shorter rules, alignment of rules between EU funds and better feedback to applicants are the most important simplification factors.

The majority of respondents (88%) believe that the current programme adds value, to a large or fairly good extent, compared to what Member States could achieve at national, regional and/or local level. Public regional authorities, universities and civil society organisations appear to be slightly more positive in this regard.

Collaboration and cooperation is the most often given example of the EU added value of EU programmes and funds over efforts of Member States. Research organisations, national public authorities and individuals more frequently referenced collaboration and cooperation compared to other stakeholders. Business and industry, other stakeholders and individuals on the other hand more frequently discussed maximising competition. Meanwhile, international organisations, universities and regional public authorities more frequently than other stakeholders noted that increased mobility is an added value of EU programmes and funds. Stakeholders consider also new markets, various networks and partnerships, pooling of resources and increased visibility as factors that provide considerable added value to EU programmes and funds.

5.5 Position papers[18]

Stakeholders expressed their views also in more than 300 position papers submitted either ad-hoc or to the cluster-based public consultation. All the EU institutions reflected upon the next Framework

[18] Griniece, E. (2018), Synthesis of stakeholder input for Horizon Europe and European Commission analysis.

Programme as well, often in the context of the interim evaluation of Horizon 2020. Most common views from stakeholders are as follows:

- Three-pillar structure should be kept, though better links between pillars are needed

The vast majority of stakeholders are satisfied with the current three-pillar structure of the Framework Programme and wish to see either a complete replication or small modifications to the existing architecture. The main criticisms relate to the lack of coherence and links between the pillars that hamper coverage of the whole knowledge chain. Some say that the societal challenges pillar should become more prominent and more relevant, taking into account the current pressing socio-economic issues. The suggestion was also made to rename the "Industrial Leadership" pillar to "Innovation Leadership", giving it a more cross-cutting outlook.

- Successful individual researchers' schemes (ERC, MSCA) need increased budget

The European Research Council (ERC) and Marie Skłodowska-Curie Actions (MSCA) are widely appreciated and many voices stress that these two schemes should be strengthened with a budget increase.

- The Future and Emerging Technology (FET) actions should be strengthened

The majority of stakeholders praise the FET schemes as an important set of instruments that should be strengthened in the future. The bottom-up principle of FET is recognised as a strong point. Suggestions are made to ensure better links with other R&I instruments such as the EIC and EIT. The main concerns are related to the serious oversubscription, particularly to FET Open scheme, hence a more strategic approach is needed when defining the FET priority areas and budgetary allocation for individual calls.

- Key Enabling Technologies (KETs)

Those stakeholders commenting noted that KETs play a vital role in Europe's industrial competitiveness and ability to tackle societal challenges and should hence continue to play a central role in the forthcoming Horizon Europe. Some stakeholders and Member States call for a separate programme part oriented on KETs.

- Grants to remain the main funding model, complemented by dedicated financial instruments

An overwhelming majority of stakeholders stress that grants should remain the main funding mode under the next Framework Programme, as the only acceptable funding instrument for public and non-profit entities as well as certain economically non-viable R&D areas (in the short-term) despite the huge socioeconomic impact they may have (in the long term). It is also widely shared that any loan-based funding should not be introduced to the detriment of grant-based funding. At the same time, some stakeholders say that financial instruments could be introduced as a very useful complementary funding. This is especially the case for close-to-market activities in areas where the possible scalability of innovations does not correlate to the very high expectations of the venture capital funding or where periods between research and market success are very long.

Industry representatives, though, caution that proposals to give more flexibility to applicants to choose from a portfolio of instruments provided and to have innovative blending of grant, loan and equity- based forms of investment require careful consideration. For close-to-market activities (above TRL8), blended instruments with additional loan funding can be useful, but attention should be paid to maintaining clear and simple processes as well as avoiding higher bureaucracy both for public and private sectors.

- Stronger emphasis for curiosity-driven research is needed

A significant share of stakeholders call for a stronger focus on bottom-up curiosity-driven calls to adapt better to the emerging societal needs. The need for more bottom-up approach was particularly

referred in relation to the EIC and mission-orientation. One third of respondents flag the need to ensure an adequate balance between top-down themes for societal challenges and a bottom-up supply of ideas to address them.

- Use synergies with the Structural Funds to incentivise the widening of FP participation

Almost half of stakeholders, mainly Member States, universities and research organisations, commented on the "Spreading excellence and widening participation" part of Horizon 2020. Many Member States, from different parts of the European Union and with different experience and performance in the Framework Programme, call for increased support to and/or dedicated instruments to address the "spreading excellence" objective (Croatia, Czech Republic, Cyprus, Estonia, France, Germany, Hungary, Italy, Lithuania, Poland, Portugal, Slovakia, Slovenia and Sweden). 'Widening participation' objective as an important aspect for the design of Horizon Europe is highlighted also by Belgium, Ireland and Spain, yet they place more noticeable emphasis on the need to incentivise Member States' own investments and efforts in capacity building or national/regional research and innovation ecosystems. At the same time two Member States express strong support to excellence as priority over any geographical considerations (Denmark and Finland).

The most debated aspect is the proposition to introduce geographical quotas for participation in Horizon Europe. A dominating view is though that this would not bring the required effects, but only distort the excellence-based principle of the Framework Programme. Among the most frequently cited means to spread excellence are synergies with the ESI funds through a ring-fenced budget dedicated to the "widening" objective, continued support to existing mechanisms (Teaming, Twinning, ERA-Chairs, COST, NCP networks), a return phase for intra-European MSCA fellowships, EIT KIC Regional Innovation scheme and targeted measures to promote pockets of excellence in low R&I performing countries. At the same time there are also voices on the need to incentivise Member States' investments and efforts in capacity building of national/regional research and innovation ecosystems. The Commission's initiative to launch Policy Support Facility (PSF) has been commended as a good step in this direction.

- Smaller scale collaborative projects are important for widening, originality and creativity

An overwhelming majority of stakeholders commenting on the size of projects support a justified balance between big and small-scale projects. The budget threshold stakeholders consider as an indicator for a small collaborative project ranges from less than EUR 3 million to less than EUR 8 million. It was reasoned that small and medium-sized collaborative projects offer good prospects for the participation of junior researchers and newcomers (such as start-ups and young companies) particularly from Member States which have, up to now, been involved to a lesser extent. Smaller projects may also be much better starting point for exploring promising lines of enquiry, engaging in riskier research and thus incentivising originality and creativity.

- Define R&I missions as ambitious but feasible high-impact objectives

Around half of the submitted position papers included references to mission-orientation of Horizon Europe. Almost all stakeholders either clearly support mission-orientation or indirectly acknowledge this as a possible future scenario. Only a few concerns were noted mainly that the focus on the selected missions might be done at the expense of curiosity-driven fundamental research.

In general, stakeholders consider that tangible missions that underpin the overall political objectives could enhance visibility and create a more strongly engaging narrative of the Framework Programme. One proposition is to define missions "*as ambitious but feasible, high-impact objectives, embedded within a challenge-based approach*". Missions should be limited in number, easy to communicate and have a concrete budget and timeline. They should have a breakthrough or transformative potential and a clear EU added value. Cross-sectoral and cross-disciplinary collaboration should be at the core of mission approach.

In terms of programming and implementation modalities, stakeholders consider that R&I missions should be formulated in an open manner and underpinned by non-prescriptive calls. There is widespread acknowledgement on the need to engage wider society in identifying the most relevant missions within broader societal challenges. Coordination mechanisms should be put in place to support any synergies between the projects contributing to the same mission.

All EU Institutions stress the importance of getting citizens more involved and maximising impact from the Framework Programme. The Committee of the Regions is very explicit in encouraging the adoption of a new, complementary approach based on missions. ERAC and the Council point to the need to deliver better and continued outreach to society, and call for exploring a mission-oriented approach.

- Citizens should be better involved through tailored co-design and co-creation mechanisms

More than a third of stakeholders touch upon the idea of opening up the agenda-setting, design and evaluation of European research and innovation to society and citizens. Stakeholders are supportive of the idea that the Framework Programme should address citizens' concerns better and involve them in a more substantial role with sufficient attention paid to "Societal Readiness Levels" (SRLs) aimed at increasing societal impact. In several cases, stakeholders highlighted also crowdfunding as a possible additional part in the COFUND scheme.

Stakeholders underline also the need to enhance science communication, as well as promote R&I projects to develop more ambitious communication strategies, including all types of media. They place particular attention on making sure that the impacts of designated R&I missions are clearly communicated and disseminated to society at large.

- Reinforce Social Sciences and Humanities (SSH) to make mission-orientation a success

Many stakeholders reflected upon SSH underlining its value in particularly with relation to societal challenges and the suggested mission-orientated approach. Generally, stakeholders call for more adequately reflecting the SSH dimension in the design of call and consortium requirements, proposal evaluations and impact measurement.

- EIC should simplify the current support to innovation and act as an European Accelerator

Around 80% of stakeholders who reflected upon the future European Innovation Council (EIC) favour the overall idea and provide detailed suggestions on the possible role, objectives and arrangements for its operation. A recurring view is that the EIC should not add an extra layer of governance, but rather seek to identify gaps, coordinate and simplify the existing support instruments serving as an umbrella initiative with a concretely defined value added. The idea of bringing together existing instruments (SME instrument, Fast Track to Innovation, FET Open and inducement prizes) for a comprehensive support to all forms of innovation and technologies, including market-creating innovation is well echoed across the stakeholder input.

Stakeholders consider that support to innovative SMEs and start-ups is essential to maximise Europe’s potential for growth and socioeconomic transformation. Thus the role of EIC in support to SMEs is frequently emphasised. Some stakeholders and Member States are of the opinion that the introduction of the EIC should make the support landscape for SMEs much clearer and easier to navigate.

There is a split opinion from stakeholders on the success of the current SME Instrument scheme. While some consider the programme a great achievement of Horizon 2020, others are much more critical pointing out the high rates of oversubscription and casting doubt on the EU added value of funding single companies.

The main concerns expressed in relation to the EIC idea are that support to incremental innovation should not diminish due to an increased emphasis on breakthrough innovation that the EIC will aim

to promote. There are also voices against the creation of a separate organisation suggesting evaluating more carefully the possible merging of the EIC mandate with the EIT, FET or ERC to capture the whole research-innovation spectrum.

The European Parliament stresses the importance of innovation support in general, and of disruptive innovation and scaling up in particular. The Council emphasises the importance of supporting the whole innovation value chain, including high-risk disruptive technologies, while the possible future EIC should support breakthrough innovations and the scaling up of innovative companies.

- Boost international cooperation to tackle global challenges

Many stakeholders reflected on the international cooperation including around 70% of all Member States who submitted position papers. A predominant view among stakeholders is that cooperation with third countries should be strengthened to counter the drop in internationalisation activities and participation rates from third countries that was experienced moving from FP7 to Horizon 2020. Some stakeholders advocate that science is a strong force in international diplomacy; hence, the EU should seek to strengthen collaboration in science and technology further beyond Europe. Several contributions also highlighted that the Commission should consider making it easier for participants from third countries to join ongoing projects on an ad-hoc basis, especially if they do not qualify to receive EU funding. One suggestion is to allow secondary recipients of funds, who are not part of the EU, to negotiate the terms of their cooperation directly with their European partners in order to establish a mutually beneficial arrangement. As a principle, reciprocity between third country programmes should be sought, where relevant.

A few stakeholders touched upon the issue of exploitation of research and innovation results in Europe first. There were suggestions that the EU could adopt legislation to encourage stakeholders conducting research mainly financed by European public funds, to exploit the results of this research primarily on European soil.

The European Parliament calls for strengthening international R&I cooperation, including with associate partners and emerging countries, as soon as possible through concrete actions. The Parliament, in addition, highlights the value of science diplomacy. The Council reaffirms the importance of reciprocity.

- Open science entails a complex cultural change that should be supported

Among stakeholders who reflected on these issues, Member States, universities and research organisations appear to be more vocal. It is widely acknowledged that data and knowledge produced from EU funded projects should be openly shared. Stakeholders frequently cite the need to adhere to FAIR data principles. Business representatives underline more that the opt-out option for Open Data Pilot should be maintained to secure some confidentiality of market-oriented innovation outputs. Stakeholder contributions highlight that open science, open data and open access paradigm calls for establishing new principles in citation and academic reward system, as well as require more attention to development of skills in research data management. Some stakeholders also mention European Open Science Cloud (EOSC) agenda, in most cases expressing support to this EU level initiative. Incentives for Open Science were also mentioned.

The European Parliament opinion is in favour of the general principle of Open Access, while ERAC regards the 100% Open Access policy of Horizon 2020 as a clear measure in favour of knowledge circulation. Importantly, the Council Conclusions on the transition towards an Open Science System give valuable guidance for the future, while the Council Conclusions on the Interim Evaluation of Horizon 2020 highlight the role of Open Science in boosting impact and transparency.

- Make the R&I support landscape simpler

Concerns that the EU R&I funding instrument landscape is too complex are widely echoed in the majority of position papers across all stakeholder groups. Stakeholders advocate for aligning

intervention logics of the proposed instruments with already well-embedded schemes to detect gaps, overlaps and work towards better synergies. Some stakeholders explicitly emphasise that existing support schemes should be carefully evaluated and discontinuation of funding should be an option for measures that do not hold self-sustainability test (sunset clause).

The EIT receives positive remarks as an attempt to integrate all sides of the knowledge triangle and create cross-border innovation networks as 'true pan-European actors'. Yet stakeholders recognise that EIT KICs are part of the proliferation of R&I instruments and call for formulating their clear added value and complementarity with other instruments. A frequent plea for better synergies and coordination between EIT and EIC is expressed. There is also a call for improving the EIT and the KICs' openness to the inclusion of new relevant actors. Stakeholders also note the unnecessary detailed rules and control requirements applied by the EIT for existing KICs, and call for better adapting them to the nature of Horizon Europe.

ERAC considers it particularly urgent to rationalise the funding schemes, while considering public-to-public partnerships essential for more coordinated implementation of national and EU R&I. The Council similarly stresses that the current R&I ecosystem has become too complex and that all partnership initiatives should have an exit strategy from EU funding. The European Parliament advocates 'decomplexifying' the EU funding landscape.

- Synergies with other EU programmes are difficult to achieve, but are essential

An overwhelming majority of stakeholders specifically mention synergies with the ESI funds as an area deserving most of attention. Also, cluster survey responses confirm synergies with the ESI funds as the most frequently-discussed area for future complementarities. There is widespread recognition, however, that achieving real complementarities between the Framework Programme and the ESI funds is difficult in practice due to different nature and implementation modalities of both funding instruments. In the views of some stakeholders, the Seal of Excellence has not lived up to expectations as an attempt to bridge both programmes. Several stakeholders draw attention to the need for ensuring that research infrastructures are able to effectively utilise the ESI funds to support their construction and operation. Alignment and modifications in State Aid rules to ensure more innovation-friendly regulatory environment is an equally prevailing concern of stakeholders.

The need to strengthen synergies and links with other EU programmes and instruments is much less pronounced, though universities as well as some Member States refer specifically to synergies with higher education area. Stakeholders acknowledge the necessity to strengthen the connections of all three sides of the knowledge triangle and design complementarities between programme intervention logics. Research organisations and industry stakeholders also recognise the untapped potential of closer knowledge triangle integration. An idea of creation excellence-based university network is proposed Critique of the idea of 'European Universities' label is expressed by both university and industry networks.

- Enhance the strategic programming process

Many stakeholders, and the majority of Member States, reflected on the strategic programming process. Several stakeholders flag that the transparency in the process of formulating work programmes and traceability of stakeholder inputs should be improved and the comitology process enhanced. Programme Committees should be fully involved in strategic discussions before orientation papers are presented by the Commission. There should be enough time for negotiations before decisions are taken. The process for drafting work programmes must be predictable, uniform and transparent, allowing time for development of views and the identification of synergies between the Programme Committees. An overall need to better align the interfaces between the EU, Member States and societal stakeholders (joint standing committees) is flagged by another range of contributors. The introduction of more flexible biennial work programmes is explicitly welcomed

by some respondents. There is also a more radical call to implement open calls with several cut-off dates per year instead of having calls for proposals with deadlines.

Some stakeholders were also in favour of enhancing the management capacity of Commission Directorates-General. Here, the need for better coordination among it was suggested to better coordinate the work of the various Commission Directorates-General and the executive agencies to ensure more strategic management approach and streamlined interpretation of rules. Other stakeholders underline the need to resource and enhance the management capacities of the Commission, in alignment with the level of ambition for the future programme.

- Continue the drive for simplification

Simplification efforts already implemented by the Commission have been well recognised. The large share of stakeholders, however, call for further simplification actions. This was also a main finding of the simplification workshop organised with European stakeholder umbrella organisations.

The two-stage submission procedure is regarded as beneficial. It is a widely-held view that a more selective first stage evaluating excellence and impact must be completed first, while the implementation and consortium competence can be judged at the second stage. Some stakeholders suggest also concrete targets for this procedure such as reaching a 1 in 3 success rate at the second stage. At the same time, stakeholders consider that a more detailed feedback to all the unsuccessful applicants also should be ensured. There is also a call for further optimisation of the Participant Portal.

It is generally acknowledged that the current cost reimbursement formula (100% for direct costs + 25% for indirect costs) works well and has helped to simplify the current programme, even though it is suggested to consider an increase of indirect costs in case of non-profit organisations.

Views on the introduction of lump sum-based funding are split. Around one third of stakeholders that reflected on this topic welcome this initiative, stating that it has considerable simplification potential, especially for SMEs and small projects with small-size participants. More than a half of stakeholders, however, are more cautious and call for a careful assessment of the lump-sum pilots beforehand. Stakeholders call for a thorough attention to the lump-sum calculation methodology to ensure that it does not shift workload from administration and financial support teams to researchers and does not create a competition on pricing and distort the 'level playing field'.

Another area of concern relates to the need for a better model for reporting personnel costs, as expressed by some Member States and organisations highlighting the need for an appropriate system of personnel remuneration so that the rules are not disadvantageous for participants coming from some countries. Other topics cited included the introduction of the Single Rulebook, simplification of the Annotated Model Grant Agreement and further improvements to the Participant Portal.

Generally, there is a consensus that the evaluation system of the Framework Programme should be robust, fair, clear, transparent, and as fast as possible. Among the key improvements of the evaluation process, stakeholders mention the need to increase the quality of the feedback information provided to the applicants; the composition of and complementarities between skills, experiences and perspectives (e.g. sector, including industry; discipline, especially SSH; gender; nationality; end-users in case of close to market calls, etc.) of evaluation panel members; and re-introduction of consensus meetings.

- Adapt the definition of innovation and improve evaluation to capture impacts of FP funding

A large majority of stakeholders highlighted aspects related to the need for better defining and measuring impact, especially with regards to the mission-oriented approach. The significance of tracing impact is widely recognised, especially by Member States and universities. Stakeholders

acknowledge the need to adopt a broader view on impact covering not only economic, but also social, scientific and cultural impacts. The impact definition should describe the desired outcomes of research and innovation while TRLs stipulate the route to get there. It is also underlined that impact should be viewed in a much longer term than the current impact assessment practices generally capture. This implies that Framework Programme project coordinators should be obliged to provide interviews also long after the project has ended. A call to develop better methodological frameworks to allow for tracking economic and social impact has been raised. But some stakeholders, especially business and industry, warn that impact measurement should not become too complex and overly bureaucratic.

Some stakeholders commented on the reporting and monitoring obligations, stating that imposed reporting obligations should be feasible for beneficiaries and relevant to measure the progress of projects towards the defined overarching goals. They flag the need to establish comprehensive monitoring systems to measure the extent to which supported actions contribute to societal challenges and other programme objectives. Other stakeholders emphasise that monitoring is essential to ensure reflection, improve learning curves and revisit the structure of Horizon Europe instruments to adapt to emerging trends.

6 Inclusion of the stakeholder consultation results in the legal proposal

Stakeholder views have been analysed and taken into account, to the extent possible, regarding the structure and key principles, implementation and governance of Horizon Europe.

Following the overall endorsement by stakeholders, the three-pillar structure is maintained and refined to enhance linkages between pillars for a greater impact. Key Enabling Technologies, due to their effectiveness in tackling societal challenges, will continue under Global Challenges pillar. The design of all new elements, but in particular missions and the European Innovation Council, fully reflect stakeholder views. Citizens will be involved in selecting the most relevant missions, while the EIC aims at simplifying existing support instruments. Although the EIC will focus on breakthrough innovation, Horizon Europe will continue to support incremental innovation through the Global Challenges and the EIT.

Synergies between different funding programmes will be facilitated by, for example, making the Seal of Excellence more operational and addressing issues of State Aid. The complexity of the research and innovation system is fully addressed by the new approach to Partnerships, which will lead to a smaller number of more coherent initiatives having higher impact and leverage. Moreover, the current Horizon 2020 support to lower-performing EU countries will be continued and strengthen.

As regards implementation issues, the current funding rates will be maintained and lump sums will be scaled up, though taking into account lessons learnt from the ongoing pilot phase. Provisions on association to the Horizon Europe, and eligibility criteria for funding are both designed to increase international cooperation. Finally, the strategic programming for calls will become more transparent and open, to ensure a more active involvement of EU institutions, citizens and end-users.

Annex 3: Evaluation results

1 Lessons from the evaluations of previous Framework Programmes

While European research and innovation programmes have been successful, there are important lessons to be learned from the past, from stakeholder feedback, and from analytical studies. Research, innovation and education should be addressed in a more coordinated manner and coherent with other policies and research results better disseminated and valorised into new products, processes and services. The intervention logic of EU support programmes should be developed in a more focused, concrete, detailed, inclusive and transparent manner. Programme access should be improved and start-up, SME, industrial, EU13 and extra-EU participation increased. Monitoring and evaluation need to be strengthened.

1.1 Improved horizontal and vertical policy coordination

A number of ex-post evaluations of the Framework Programme have noted that the coordination between, on the one hand, the Framework Programme and other EU policies, and on the other hand, the Framework Programme and Member State research activities could be improved. With regard to horizontal policy coordination in the narrow sense, the FP7 interim evaluation[19] noted that a strategic shift is needed to establish stronger and better connections between research, innovation and education (the so-called 'knowledge triangle'). As for broader horizontal policy coordination, the FP6 ex-post evaluation[20] called for a clearer division of labour between the FP and the cohesion policy funds. It also stated that other EU policies such as transportation and energy would benefit from a more coordinated interface between research activities under the Framework Programme and regulatory and demand-side policies.

The need for horizontal policy coordination is confirmed by the conclusions of the OECD's work on the most appropriate system of innovation governance. OECD[21], for instance, mentions the need to develop "a strategic, horizontal approach", which "should include and develop the innovation policy potential in other ministerial domains and ensure a co-ordinated division of labour between them". And OECD[22] concludes that "given the increasingly central role of innovation in delivering a wide range of economic and social objectives, a whole-of-government approach to policies for innovation is needed". With regard to vertical policy coordination, the FP6 ex-post evaluation noted that, given its small size compared to Member State expenditure, the Framework Programme should not try to substitute for Member State R&D policies but should use its added value in a more strategic way and set an attractive and accepted European agenda. In the same vein, an evaluation[23] concluded that the division of labour between the EU and national levels should be further refined, in particular in view of the introduction of the likes of the European Research Council and the Joint Technology Initiatives. The need for vertical policy coordination is confirmed by the results of OECD work on the optimal system of innovation governance. OECD[24], for instance, calls for "coherence and complementarities between the local, regional, national and international levels".

[19] Annerberg et al. (2010), Interim Evaluation of the Seventh Framework Programme, Report of the Expert Group.
[20] Rietschel et al. (2009), Evaluation of the Sixth Framework Programme for Research and Technological Development, p. 58-59.
[21] OECD (2005), Governance of Innovation Systems, vol.1: synthesis report.
[22] OECD (2010), The OECD Innovation Strategy – Getting a head start on tomorrow.
[23] Arnold E. (2009), Framework Programme 6 – Meta-evaluation, Technopolis Group.
[24] OECD (2010), The OECD Innovation Strategy – Getting a head start on tomorrow.

1.2 Focus and a more robust intervention logic

A number of ex-post evaluations[25]of the Framework Programme have noted that the programme's design could be improved. Some pointed that the Framework Programme lacks a clear and robust intervention logic: the programme has too many objectives, and higher-level objectives are insufficiently translated into lower-level objectives.

With regard to the Framework Programme's objectives, the FP6 ex-post evaluation[26] as well as expert evidence[27] noted that there were too many – addressing almost all S&T and socioeconomic challenges - and that they were too abstract and vague and therefore untestable, complicating ex-post evaluation. A European Parliament ITRE Committee report[28] noted in the same vein that "an ever-growing number of objectives and themes covered and diversification of instruments has widened the scope of FP7 and reduced its capacity to serve a specific European objective". In addition, no explicit links are made between higher-level objectives and lower-level concrete technical goals[29]. Meanwhile, instruments are not designed explicitly to achieve particular objectives: challenges are defined so as to match existing instruments, not the other way around[30]. The result is 'catch all' instruments trying to tackle all problems and to satisfy all types of stakeholders. That is why the European Court of Auditors has called for addressing a single objective through each instrument[31].

The importance of focus and a proper hierarchy of objectives (combined with appropriate monitoring) are confirmed by OECD work. OECD[32] for instance, argues in favour of "a more strategic focus on the role of policies for innovation in delivering stronger, cleaner and fairer growth". The OECD[33] notes that "third-generation innovation policy cannot be properly implemented without precise targets and intelligent follow-up. Governments should increase their capacity to develop actions plans based on horizontal, strategic approaches and translate these into concrete measures to be taken by each ministry or agency.

1.3 Lower barriers to participation and increase dissemination and valorisation of outputs

All ex-post evaluations of the Framework Programme - see, for instance, the chapters on participation in the FP6 ex-post [34]and FP7 interim evaluations[35] - are unanimous in their view that application, contract negotiation and project management procedures are too complex and burdensome and that this results in high barriers to application and participation to the Framework Programme, in general but in particular for first time, start-up, SMEs and applicants from new Member States.

---

[25] Rietschel et al. (2009), Evaluation of the Sixth Framework Programme for Research and Technological Development; European Court of Auditors (2007), Evaluating the EU RTD FP – Could the Commission's approach be improved, Special Report No 9/2007, paragraph IV.
[26] Rietschel et al. (2009), Evaluation of the Sixth Framework Programme for Research and Technological Development.
[27] Arnold E. (2005), What the Evaluation record tells us about Framework Programme performance, Technopolis Group.
[28] European Parliament, ITRE Committee Report, (2011), Report on FP7 Interim Evaluation, 2011/2043(INI).
[29]European Commission, (2005), Five-year assessment if the European Union Research Framework Programmes 1999-2003.
Arnold E. (2009), Framework Programme 6 – Meta-evaluation, Technopolis Group.
[30] Stampfer M. (2008), European Added Value of Community Research Activities - Expert analysis in support of the ex-post evaluation of FP6, WWTF, Vienna Science and Technology Fund.
[31] European Court of Auditors (2009), Networks of excellence and integrated projects in community research policy: did they achieve their objectives? Special report n. 8/2009.
[32] OECD (2010), The OECD Innovation Strategy – Getting a head start on tomorrow.
[33] OECD (2005), Governance of Innovation Systems, vol.1: synthesis report.
[34] Rietschel et al. (2009), Evaluation of the Sixth Framework Programme for Research and Technological Development.
[35] Annerberg et al. (2010), Interim Evaluation of the Seventh Framework Programme, Report of the Expert Group.

Participants' main reasons for getting involved in the Framework Programme relate to networking and the creation of new knowledge[36]. Research under the Framework Programme is also more of a long-term, exploratory, technologically complex nature[37]. The Framework Programme should therefore not be expected to produce new, immediately marketable products and processes.

Nevertheless, Framework Programme's evaluations conclude that more attention should be paid to the production of project outputs and to their dissemination and economic valorisation, in particular since the Framework Programme is supposed to support Europe's competitiveness. What is highlighted is the absence in the Framework Programme of valorisation channels that enable the exploitation of research results and the linkage of knowledge created through the Framework Programme with socially beneficial uses[38]. In the same vein, the FP7 interim evaluation observes a lack of clarity on how the Framework Programme incorporates innovation (as opposed to 'pure' research).

In this respect, OECD[39] argues that "the creation, diffusion and application of knowledge are essential to the ability of firms and countries to innovate and thrive in an increasingly competitive global economy".

1.4 Strengthen monitoring and evaluation

The main problem affecting the monitoring and evaluation system of the Framework Programme relates to the aforementioned lack of focused objectives and a robust intervention logic. The evaluation process aims to link evidence emerging from project implementation with the strategic and specific objectives set for the programme. As the European Court of Auditors[40] observed, if this connection is difficult to make, an assessment exercise becomes extremely complicated. The evaluation and monitoring system suffers from other problems as well, however.

The importance of a proper monitoring and evaluation system is emphasized by the OECD[41], for instance, recommends "improving evaluation and learning": "In general, governments should create a solid basis for evaluation and learning and make them part of the policy-making process. This includes evaluation of broader reforms, as knowledge about their impact on innovation is useful for feedback and policy formulation. A more holistic approach to evaluation and learning can enhance feedback in the governance system and lead to more effective policy". The OECD[42] also argues that "evaluation is essential to enhance the effectiveness and efficiency of policies to foster innovation and deliver social welfare. Improved means of evaluation are needed to capture the broadening of innovation, along with better feedback of evaluation into the policy-making process. This also calls for improved measurement of innovation, including its outcomes and impacts".

[36] Arnold E. (2009), Framework Programme 6 – Meta-evaluation, Technopolis Group.
[37] Polt W. et al.(2008), Innovation impact study – Final report.
[38] Rietschel et al. (2009), Evaluation of the Sixth Framework Programme for Research and Technological Development; Annerberg et al. (2010), Interim Evaluation of the Seventh Framework Programme, Report of the Expert Group.
[39] OECD (2010), The OECD Innovation Strategy – Getting a head start on tomorrow.
[40] European Court of Auditors (2007), Evaluating the EU RTD FP – Could the Commission's approach be improved, Special Report No 9/2007.
[41] OECD (2005), Governance of Innovation Systems, vol.1: synthesis report.
[42] OECD (2010), The OECD Innovation Strategy – Getting a head start on tomorrow.

2 Lessons learnt from the Interim Evaluation of Horizon 2020

The Horizon 2020 Interim Evaluation Staff Working Document identified the following strengths and challenges that need to be addressed in the last three years of Horizon 2020, as well as in the next Framework Programme:

2.1 Strengths

1. The evidence presented in the Horizon 2020 interim evaluation has demonstrated that, overall, Horizon 2020 is an attractive and well performing programme. It has so far attracted more than 100,000 applications, representing a huge increase in the annual number of applications compared to FP7. It involves top level participants from the higher education, research and private sectors; from a wide range of disciplines and thematic fields; and from over 130 countries. 52% of participants are newcomers. Industrial participation has increased compared to FP7. 23.9% of the budget for industrial and enabling technologies and societal challenges goes to SMEs, far exceeding the target. Stakeholders are generally very satisfied with the programme.
2. Horizon 2020's objectives and rationale for intervention remain highly relevant and have been validated by, and are fully consistent with, recent EU and global priorities, such as the Sustainable Development Goals. The programme has also proven that it is flexible and can respond to emergencies (e.g. Ebola, Zika) and emerging needs.
3. Horizon 2020 is on track to be cost-efficient, achieving a very low administrative overhead, thanks to the extensive externalisation of programme implementation, the creation of a Common Support Centre, and the large-scale simplification of the rules for participation, in particular the funding model, which has reduced time to grant and lowered costs for participants, to the satisfaction of stakeholders and without reducing the level of co-funding by beneficiaries.
4. In terms of effectiveness, through its focus on scientific, economic and societal impacts, Horizon 2020 is on track to contribute to the creation of jobs and growth and the achievement of the priorities of the Juncker Commission. It strengthens the science base by involving the EU's and world's best research institutions and researchers; by training large numbers of EU-based researchers; by producing large numbers of world class open access scientific publications and data; by producing scientific breakthroughs; and by building cross-sectoral, inter-disciplinary, intra- and extra-European research and innovation networks.
5. It fosters industrial leadership by successfully involving the private sector and SMEs; by creating networks between the business sector, universities and research institutions; by providing businesses and SMEs with risk finance to carry out their research and innovation projects; by investing in demand-driven innovation; by producing high quality, commercially valuable patents and other intellectual property rights; by generating proofs of concept and demonstrators and supporting the deployment of innovation solutions; by producing new knowledge, strengthening capabilities, and generating a wide range of innovation outputs including new technologies, products and services; and by increasing the competitiveness of beneficiaries. It addresses major societal challenges by producing publications, patents, prototypes, products, process and methods. It is successful in spreading excellence and widening participation through dedicated instruments and as a cross-cutting issue throughout the programme. It achieves encouraging results in terms of gender equality and the integration of the social sciences and humanities.

6. Compared to FP7, Horizon 2020 is an internally more coherent programme. Synergies with other programmes and instruments are being strengthened.
7. Horizon 2020 has clear European added value in terms of speed, scale and scope and a strong additionality: 83% of funded projects would not have gone ahead without EU funding.

2.2 Challenges

1. Horizon 2020 suffers from underfunding, resulting in large-scale oversubscription, much larger than in FP7, which constitutes an enormous waste of resources for applicants and of good proposals for Europe.
2. While Horizon 2020 demonstrates potential in terms of supporting breakthrough, market-creating innovation, such support needs to be strengthened substantially.
3. There is a need for greater outreach to civil society to better explain results and impacts and the contribution that research and innovation can make to tackling societal challenges, and to involve them better in the programme co-design (agenda-setting) and its implementation (co-creation).
4. While great efforts have already been made to increase the synergies between Horizon 2020 and other EU programmes (notably European Structural and Investment Funds), these can be strengthened further, particularly in view of R&I capacity building for lower performing regions.
5. While Horizon 2020 has achieved a broad international outreach, international cooperation needs to be intensified and more efforts are needed to ensure that the programme fully delivers on its target for sustainable development.
6. While compared to FP7, great progress has been made in terms of simplification, simplification is a continuing endeavour, which requires constantly identifying new candidate areas for improvements; at the same time, there is scope for rationalising the Horizon 2020 funding landscape.
7. While Horizon 2020 has made great progress in terms of making openly accessible to the wider scientific community and public the scientific publications and data it generates, more can be done in this respect.

Annex 4: Added Value of EU-funded R&I

Without replacing national Research and Innovation (R&I) activities, EU funded R&I activities through the Framework Programmes produce demonstrable benefits compared to national and regional-level support to research and innovation in terms of scale, speed and scope. The added value comes through – *inter alia* –strengthening the EU's scientific excellence through competitive funding; the creation of cross-border, multidisciplinary networks; the pooling of resources to achieve critical mass for tackling global challenges, and developing the evidence-base to underpin policymaking. Overall, this increases EU's global attractiveness as a place to carry out research and innovation, strengthens the EU's competitiveness, contributes to growth and jobs [43] and makes the EU a world leader in tackling global challenges. Therefore, EU research and innovation should be "one of the essential policy priorities in the future".[44]

Added value:

- **Strengthening the EU's scientific excellence through competitive funding** – Excellence-based EU-wide competition increases the quality and visibility of the research and innovation output beyond what is possible with national or regional level competition. This is shown by the fact that EU-funded peer-reviewed research publications are cited more than twice the world average. Publications from EU funded R&I activities are almost four times more represented in the world's top 1% of cited research compared with the overall publication output of the 28 EU Member States.[45] Compared to 1.7% of national publications, 7% of ERC publications (973, since its creation in 2007) are among the top 1% highly cited in the world by field, year of publication and type of publication.[46]
- **Creating critical mass to address global challenges**- Collaborative projects funded at EU level will help to achieve the "critical mass" required for breakthroughs when research activities are of such a scale and complexity that no single Member State can provide the necessary financial or personnel resources". This occurs where a large research capacity is needed and resources must be pooled to be effective, or where there is a strong requirement for complementary knowledge and skills (e.g. in highly inter-disciplinary fields). Investing in research and innovation at EU level will address global challenges (eg migration, security, climate change, health) which facilitates finding solutions much faster and efficient compared to what can be done at national level.
- **Reinforcing the EU's human capital –** EU funded R&I activities support human capital reinforcement through mobility and training which provide access to complementary knowledge.[47] 300,000-340,000 researchers in the EU Framework Programmes teams are

[43] Macro-economic modelling suggests that by 2030, the extra impacts of investing EUR 70 billion in R&I at EU level is expected to generate between 0.27% and 0.35% more GDP, to increase EU net exports by between EUR 18 and 23 billion and to increase employment by between 110 000 and 179 000 units compared to the reference scenario. Source: PPMI study, "Assessment of the Union Added Value and the Economic Impact of the EU Framework Programmes (FP7, Horizon 2020)" (2017).

[44] High Level Group Own Resources report, http://ec.europa.eu/budget/mff/hlgor/library/reports-communication/hlgor-report_20170104.pdf

[45] Elsevier, based on Field Weighted Citation Index.

[46] The European Research Council is recognised as a global brand synonymous with research excellence, with substantial structuring effects in the Member States. Four ERC grantees have been awarded the Fields Medal after being funded by the ERC. The ERC, MSCA and FET, together with collaborative research themes, have supported at least 17 Nobel Prize winners prior or after the award of their prize and Horizon 2020 beneficiaries have also contributed to major scientific discoveries including the Higgs Boson at CERN, the detection of gravitational waves and the discovery of a planetary system composed of seven Earth-like worlds (exo-planets) located relatively close to Earth in 2017.

[47] Study on assessing the contribution of the Framework Programmes to the development of human research capacity: http://ec.europa.eu/research/evaluations/pdf/archive/other_reports_studies_and_documents/fp_hrc_study_final_report.pdf

fully or at least partly involved in EU-funded research activities[48]. In the case of MSCA, evidence shows that the research impact of internationally mobile researchers is up to 20% higher than the impact of those who opt to stay in their home country[49].

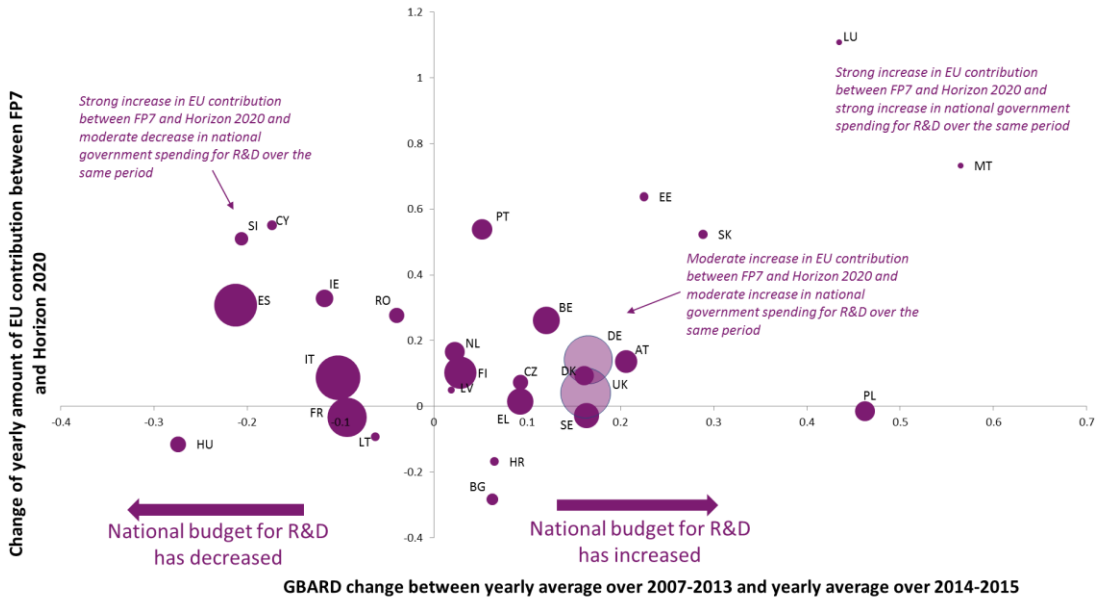
- **Building multidisciplinary transnational networks for more impact** – EU R&I activities build cross-sectoral, inter-disciplinary, intra- and extra-European research and innovation networks which is key for bringing knowledge quickly to market and gaining industrial leadership. Based on a counterfactual analysis, EU funded R&I teams had, on average, 13.3 collaborations versus six collaborations in the control group. The beneficiary teams also built almost two times more collaborations with partners from outside the EU (on average, 3.6 partners from third countries versus 2.1 partners in the control group).[50] This leads to more impact: for example, Horizon 2020 publications including authors from associated and third countries score up to more than three times as much as the world average.[51]
- **Increasing the EU's competitive advantage** – EU R&I activities increase the competitive advantage of participants, for example through international multi-disciplinary networks, the sharing of knowledge and technology transfer and access to new markets. According to a counterfactual analysis, EU funded R&I teams grow faster (11.8% more)[52]. EU-funded R&I teams are around 40% more likely to be granted patents or produce patent applications compared with non-funded teams.[53] Furthermore, patents produced in the context of EU Framework Programmes are of higher quality and likely commercial value than similar patents produced elsewhere.
- **Creating new market opportunities through collaborative multi-disciplinary teams and dissemination of results** - Compare to the national level, EU R&I activities involve key industrial players, SMEs and end-users, which reduces commercial risks, for example through the development of common standards and interoperable solutions and by defragmenting existing markets. EU funded collaborative R&I activities with open access policies enable a more rapid and wide dissemination of results to users, industries, firms (SMEs in particular), citizens, etc. – leading to a better exploitation and larger impact than would be possible only at Member State level.
- **Strengthening the evidence-base for policy-making** – EU funded R&I activities have an important role of supporting policy-making, which is for example illustrated by the results of EU funded projects related to antimicrobial resistance[54] and EU funded projects in the field of climate change which played a key role in developing and aggregation climate change models, with a strong impact at the International Panel on Climate Change (IPCC).
- **Leveraging private investment:** EU funded R&I activities induce the private sector to invest more of their own funds than they would under national funding schemes. A counterfactual analysis shows a 24.6% difference in the budget leverage.[55] Involving key EU industry players helps ensure that research results and solutions are applicable across

[48] PPMI study (2017), Assessment of the Union Added Value and the Economic Impact of the EU Framework Programmes (FP7, Horizon 2020).
[49] http://www.oecd.org/sti/Science-brief-scoreboard.pdf, "Outflows tend to be associated with higher rated publications than their staying or returning counterparts. Assuming one could raise the performance of "stayers" to the level of their internationally mobile researchers […] this would help countries catch up with leading research nations."
[50] PPMI study (2017), Assessment of the Union Added Value and the Economic Impact of the EU Framework Programmes (FP7, Horizon 2020). Based on survey data.
[51] Elsevier based on Field Weighted Citation Index.
[52] Average growth rate of 24.4% in EU funded teams compared with 12.6% in the control group.
[53] PPMI study (2017), Assessment of the Union Added Value and the Economic Impact of the EU Framework Programmes (FP7, Horizon 2020). Based on survey data.
[54] Several of these projects have allowed collaboration with policy makers, such as the European Medicines Agency and their results have had an effect on antibiotic stewardship policies and infection control policies
[55] Beneficiary teams increased their R&D budgets by 22.4%. The corresponding value for the non-FP teams was -2.2%. PPMI study (2017), Assessment of the Union Added Value and the Economic Impact of the EU Framework Programmes (FP7, Horizon 2020). Based on survey data.

Europe and beyond, enables the development of EU- and world-wide standards and interoperable solutions, and offers the potential for exploitation in a market of 450 million people: based on preliminary data, public-private partnerships (PPPs) are expected to attract between EUR 0.90 and 2.17 from private actors per each EUR of EU funding invested.[56] Existing public-private partnerships in advanced manufacturing and processing (Factories of the Future, SPIRE and Energy-efficient Buildings) can already show private investments between 1.5 and 5.4 times the public funding, taking current investments into account and discounting intentions regarding future investments.[57] Thanks to its leverage effect, it is estimated through macro-econometric modelling that each EUR of EU investment in R&I would bring a GDP increase of between EUR 6 and 8.5 during 2014-2030.

- **High additionality** – The EU invests in distinctive research and innovation projects, which are unlike those funded at national or regional level: the programme's additionality (i.e. not displacing or replacing national funding, see Figure 3) is very strong with, on average, 83% of projects that would not have gone ahead without Horizon 2020 funding.[58]

Figure 3 Change in Government budget allocations for R&D and change in EU contribution between FP7 and Horizon 2020 (size of circles: number of applications in Horizon 2020)



Source: LAB-FAB-APP, Investing in the European future we want, Lamy High Level Group Report (2017)

[56] Data provided by the Thematic Units responsible for the seven Joint Undertakings.
[57] Annual monitoring reports of Factories of the Future, SPIRE and Energy-efficient Buildings.
[58] PPMI study (2017), Assessment of the Union Added Value and the Economic Impact of the EU Framework Programmes (FP7, Horizon 2020). Based on survey data.

What stakeholders say about the EU Added Value of EU programmes and funds

In their open responses to cluster based public consultation 2,541 stakeholders elaborated on the EU added value of EU programmes and funds. Four types of EU added value were most frequently mentioned:

Collaboration: 36% of respondents referenced collaboration and cooperation as an added value of the EU programmes and funds. Respondents noted the EU programmes and funds allow addressing macro-level challenges with a cross-border character (e.g. environmental sustainability, energy, health). The programmes also helps to access external expertise, competencies, resources and innovations that may not be available in one country, while allowing to scale-up and enhance innovative projects beyond national contexts. Multi-annual strategic plans and long-term strategies are also more helpful in aligning priorities between international partners than national programmes. Business and industry stakeholders frequently noted that the EU programmes and funds by default promote access to the EU single market that boosts their global competitiveness and help achieve greater long-term impacts. Here the creation of new cross-border value chains, standards and interdisciplinary partnerships between diverse stakeholders and markets that were not connected before is particularly pertinent. Civil society organisations note that improved collaboration contributes to the harmonisation of the EU market and policies, improves social cohesion among Member States and advances European integration. This allows achieving strategic development objectives, particularly in cases where critical mass and pooling of resources is present. In addition research organisations view international cooperation beyond the European Union as a considerable added value of the programmes, as it contributes to greater impact of research projects, expands possible partnership options and introduces a European dimension beyond the EU. A positive externality of this cooperation, according to research organisations, is the breakdown of research silos and the minimisation of research effort duplications.

Maximising competition: 22% of stakeholders underlined that the EU programmes and funds provide considerable improvements in competitiveness of participants by incentivising cross-border and cross-sectoral partnerships and thus contributing to pooling of resources, knowledge transfer along with other positive spill-over effects. Stakeholders also note that the EU programmes and funds improve the overall competitive edge of Europe by sustained investments in innovation that address pan-European and global societal challenges; and in the maintenance of effective innovation ecosystems throughout Europe. National public authorities note that while oversubscription is one of the main obstacles that prevent the programmes from achieving its objectives, high competition for funds also strengthens the European knowledge base and boosts the competitiveness of successful applicants. This is particularly pertinent, in-part due to increased visibility and exposure. Furthermore, performance benchmarking of participants by all applicants improves the overall performance, leading to more ambitious and higher quality projects, breakthroughs and increased impact. Regional public authorities note that EU R&I investments also strengthen the integration of SMEs into European value chains that improves efficiency.

Mobility: 10% of stakeholders noted that since quality research is not localised to a specific country, one of the most pronounced added value of EU programmes and funds is the support for the mobility of researchers, particularly through mechanisms such as Marie Skłodowska-Curie Actions (MSCA) and Erasmus. These are considered as vital in flagship programs that support scientific exchange, foster methodological innovation, multi-centred research collaborations, and a culture of joint research. Universities further note that support for mobility has several amplifying effects on the added value of EU programmes and funds, particularly in the form of skills and career development, as well as improvements in social cohesion and cooperation between European researchers, thus increasing the productivity of this community. Furthermore, it also provides greater freedom in choosing research topics and scope, partners, and impact areas than national efforts of EU Member states. International organisations meanwhile note that mobility contributes to successful cross-border collaboration, while also providing hardly measurable benefits to research and commercial activities.

Access to new markets: 9% of stakeholders noted that the programme, along with other EU funds and programmes stimulates access to the EU single market and new markets that may not exist or are too small on a national level. The support for the entire innovation chain (TRL 1 to 8) from the idea, to research and go-to market actions and partnerships, stemming from longer-term funding modalities helps achieving these objectives. Furthermore, the programmes are considered somewhat more successful in accelerating time-to-market of innovative solutions. Business and industry stakeholders further note that EU funds help reducing risks associated with R&D investments that on national and local levels are frequently funded through loans,

allowing to divert additional resources to new market entry. Explicit incentives for research-industry cooperation also allow developing innovative products, thereby generating new markets and unlocking private sector investment in innovation provided ex-post market uptake.

Annex 5: Macroeconomic modelling

Macroeconomic modelling is used to quantify the economic impact of the future EU R&I Programme in terms of GDP gain and job creation in the EU. While there is a general consensus[59] that R&I are decisive in fostering productivity growth, quantifying the impact of R&I policies at a macroeconomic level requires modelling tools that appropriately capture how R&I translate into economic gains.

There are several models available for assessing the impact of R&I, with each model presenting specific features. This impact assessment uses results produced by three macroeconomic models: NEMESIS, QUEST and RHOMOLO. NEMESIS results were produced by a team of external experts[60], while RHOMOLO and QUEST results were produced by the European Commission services (DG JRC for RHOMOLO and DG ECFIN for QUEST).

The strengths of these models rely on their specificities. Di Comite and Kancs (2015)[61] consider that NEMESIS is the richest model in terms of innovation types and policy elasticities when compared to other standard macroeconomic models for R&D and innovation policies (QUEST, RHOMOLO, GEM-E3). The forward-looking dynamic approach of QUEST makes the model the most appropriate for assessing the impact of R&I innovation policies over time. By modelling regional economies and their spatial interactions, RHOMOLO is the most suitable model to address questions related to geographic concentration of innovative activities and spatial knowledge spillovers.

The three models are used to assess the impact of the baseline scenario in order to triangulate the signs, patterns and sizes of the impact of continuing the current Framework Programme. The specificities of the models are then used to produce additional sets of results: the rich set of elasticities and innovation channels in NEMESIS is used to assess the impact of modifying precise R&I parameters of the model that capture the changes foreseen in the future Programme, while the spatial dimension of RHOMOLO is used to assess regional impacts.

1 NEMESIS

Presentation of the model

The NEMESIS model was developed by a European consortium[62] in 2000 in order to analyse the macro-sectoral impacts of European structural policies. Its endogenous growth mechanisms were first based on R&D investments and the related knowledge spillovers. The model became a reference tool for the assessment of European or national research and innovation policies. Since 2004, the model has been used by the European Commission for several analyses, including the assessment of the 3% R&D effort in the Lisbon Strategy[63], the assessment of the RTD National

[59] Di Comite F. and Kancs D., Macro-Economic Models for R&D and Innovation Policies (2015), IPTS Working Papers on Corporate R&D and Innovation – No 03/2015.
[60] Seureco (2018), Support for assessment of socio-economic and environmental impacts (SEEI) of European R&I programme.
[61] Ibidem.
[62] Lab. ERASME / Ecole Centrale Paris (now SEURECO), Federal Planning Bureau of Belgium, E3M3 lab. / ICCS /NTUA and Chambre d'Industrie et de Commerce de Paris.
[63] Brécard, D., Fougeyrollas, A., Le Mouël, P., Lemiale, L. and P. Zagamé (2006), "Macro-economic consequences of European Research Policy: Prospects of the NEMESIS model in the year 2030", Research Policy n°35(7), pp. 910-924. Doi: 10.1016/j.respol.2006.03.001.

Action Plan related to the Barcelona Objective[64] and the assessment of the impact of European research and innovation Programmes (ex-ante assessment of the 7th Framework Programme[65] and of Horizon 2020[66]). In 2017, NEMESIS has been used for the ex-post assessment of the 7th Framework Programme and the interim evaluation of Horizon 2020[67].

Structure

NEMESIS is a macroeconometric model composed of a system of sectoral detailed models for every EU countries. The endogeneisation of technical progress in NEMESIS is derived from the new growth theories where innovations result from the investment in R&D by private firms and from the R&D achieved by the public sector. In the new version of NEMESIS used for this impact assessment, innovations still arise from firms' and public investments in R&D, but also from investments in two other complementary innovation inputs: ICT and Other Intangibles (including training and software). These improvements have allowed enhanced accuracy in assessing research and innovation policies by considering the most up-to-date theoretical as well as empirical findings of the economic literature (Le Mouël, et al., 2016).

How NEMESIS models R&I

1 Firms determine their investments in the three innovative assets (private R&D, ICT and OI).

2 The investment effort feeds their own knowledge (stock variable) as well as the knowledge in others sectors and countries through knowledge matrices (knowledge transfers). For each innovative asset, these knowledge stocks are modelled as a weighted sum of the stock of assets, R&D, ICT or OI, belonging to all sectors and countries. The spread parameters used to build these stocks are calibrated using matrices based on patent citations between sectors and countries. These matrices combine the citations between patents allocated by technology classes and country with the OECD concordance table, in order to allocate these citations between sectors (Johnson, 2002).

3 The growth of the knowledge stock of each innovation asset coupling with the knowledge absorption capacity (measured with the investment intensity in each innovative asset) generates innovations.

4 These innovations take two forms: product and process. Product innovation increases the intrinsic quality of the product sold by the firms whereas process innovation improves the production process without changing the quality of the product sold (pure TFP effect). This distinction between process and product innovations is crucial as econometric studies show that process innovations alone have a negative, or only a slight positive impact on employment, whereas the impact of product innovations is always positive (Hall, 2011).

5 New product innovations raise internal as well as external demands for the enhanced product. New process innovation reduce the production cost of the sector that, in a context of competitive market, will reduce the end-user prices of the product and then increase its demand on the internal and external markets.

6 All these dynamics at sectoral level are brought together by the input-output tables of the model. Then, the combination of these sectoral interdependencies ("bottom-up") with the "top-down" macro-economic forces impulses the medium and long term dynamics of the model. These macroeconomic forces depend mainly on the labour market and the wage setting that are the drivers for the final consumption of vaughan, and also for the domestic production prices and so of the competitiveness of the economy

The macroeconomic dynamic in NEMESIS can be summarised in three main phases:

[64] Chevallier, C., Fougeyrollas, A., Le Mouël, P., and P. Zagamé (2006), "A time to sow, a time to reap for the European Countries: A macro-econometric glance at the RTD National Action Plans", Revue de l'OFCE, 2006/5 (n°97 bis), pp. 235-257. Doi: 10.3917/reof.073.0235

[65] Delanghe, H. and U. Muldur (2007), "Ex-ante impact assessment of research programmes: The experience of the European Union's 7th Framework Programme", Science and Public Policy, n°34(3), pp. 169-183, doi: 10.3152/030234207X218125.

[66] European Commission (2012), "The Grand Challenge – The design and societal impact of Horizon 2020", Directorate-General for Research and Innovation. Doi: 10.2777/85874.

[67] PPMI (2017), "Assessment of the Union Added Value and the Economic Impact of the EU Framework Programmes (FP7, Horizon 2020)", 2017. https://frama.link/o6oBPRZU.

1. An investment phase that is a "demand phase" in which all the dynamics are induced by the change in the R&D expenditures without or with moderated impacts of the innovation (as the innovations take time to appear). This phase can be viewed as a Keynesian multiplier.

2. The innovation phase: the arrival of innovation (process and product) reduces the production cost of the new products or raises their quality that induces an increase of external and internal demands.

3. The obsolescence phase: progressively the new achieved knowledge declines because of the knowledge obsolescence[68] and in the long-term, the macro-economic track goes back to the reference scenario.

Key assumptions for the impact assessment

Key assumptions in NEMESIS for assessing the impact of the Framework Programme are related to budget size, budget allocation and the value of key parameters such as leverage[69] and performance.

	Key assumptions (continuation of Horizon 2020)
Budget size	Continuation of Horizon 2020 budget in constant prices – 15%
Budget allocation across years, countries and sectors	Horizon 2020 allocation
Knowledge spillovers	Inter-sectoral and international spillovers modelled using patent citation techniques with no additional specificity for the Framework Programme.
Direct leverage effect	Direct leverage: - Basic research: 0 - National funding of applied R&I: 0.1 - EU funding of applied R&I: 0.15 Indirect leverage: firms keep their investment effort constant in the long term.
Economic performance	Higher performance of EU funding (+15%) compared to national funding
Financing	Reduction in public investment

Budget size and allocation are assumed to be the same as in Horizon 2020 in constant prices, minus the contribution from the UK (assumed to be 15% of the budget). The Programme is assumed to be financed by lowering national public investment. Regarding the direct leverage effect, the assumptions used are supported by a survey[70] on research units involved in the 7th Framework Programme and by the empirical literature[71]. A sensitivity analysis[72] shows that this parameter does not significantly drive the results produced for this impact assessment. Economic performance in NEMESIS is calibrated by country and sector on the basis of the available empirical literature. A higher leverage and performance parameter for EU funding compared to national funding reflects the benefits related to the EU added value of the Programme, with values that are supported by existing quantified evidence on publications, patents and revenues from innovations[73].

In order to assess the impact of the various changes regarding the structure and priorities of Horizon Europe, each of the changes for more impact and more openness (section 3) was translated into variations of the parameters in NEMESIS. While the sign of these variations is straightforward, their size is uncertain. Therefore, different scenarios were considered, from low to high, by using ranges in the variation of the parameters. These ranges rely on plausible values found in the

[68] The obsolescence of the innovation comes from the depreciation rate used in the knowledge stock formulation. These depreciation rates are of 15% for R&D, 35% for ICT and 36% for the Other Intangibles.
[69] Amount of additional R&I expenditures leveraged by the initial R&I investment.
[70] PPMI (2017), Assessment of the Union Added Value and the Economic Impact of the EU Framework Programmes (FP7, Horizon 2020), Final report, European Commission report.
[71] Seureco (2018), Support for assessment of socio-economic and environmental impacts (SEEI) of European R&I programme.
[72] Ibidem.
[73] Ibidem.

literature[74], with extreme values showing how impactful Horizon Europe can be in the most ambitious and optimistic conditions.

Table 2 Assumptions in NEMESIS

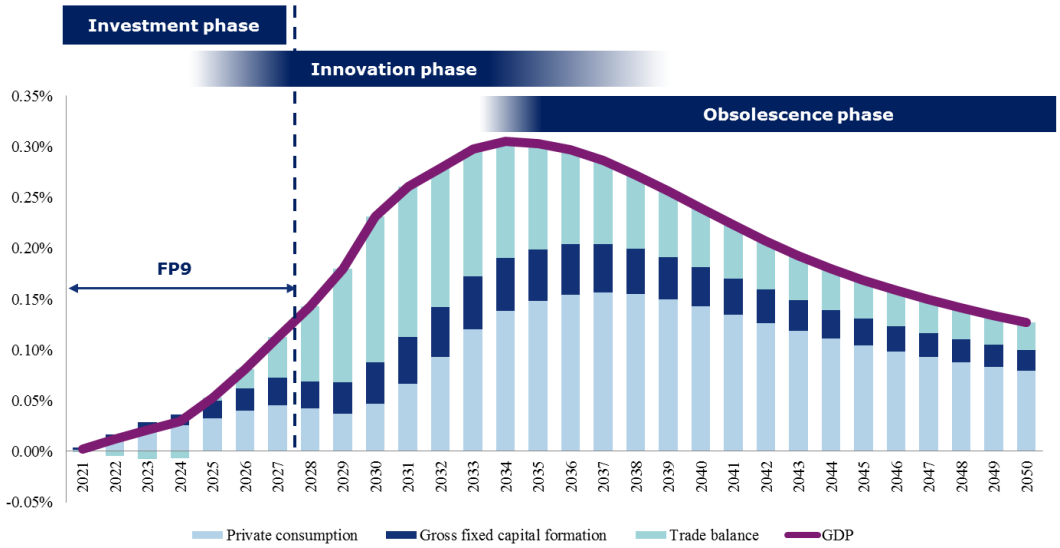
Changes for more impact	This assumes …	Range
Higher economic performance	Focus on R&I with higher economic impacts and on breakthrough innovations.	Higher performance of EU funding compared to national funding: +0 (baseline) to +5 percentage points.
Lower knowledge obsolescence	More focus on breakthrough knowledge.	14% to 13% obsolescence rate compared to 15% in the baseline.
Stronger complementarities with other innovative assets	More cross-technological and cross-sectoral R&I.	5% to 10% stronger than in the baseline.
Higher direct leverage of private R&D	Better access to finance of innovative firms, especially for SMEs.	0.1 (baseline) to 0.15.
Changes for more openness	**This assumes …**	**Range**
Higher complementarities with national support to R&D	Increased complementarities through partnerships.	Increased leverage for basic research: 0.05 to 0.1 compared to 0 in the baseline.
Stronger knowledge diffusion	Facilitated knowledge diffusion nationally, between the different categories of research organisations and/or internationally.	5% to 10% stronger than in the baseline.

Results

Results from the NEMESIS model indicate that the Framework Programme is expected to generate large GDP gains. The continuation of the Framework Programme is expected to produce 0.08% of additional GDP on average over 25 years, which means that each euro invested can potentially generate a return ranging from 10 to 11 euros of GDP gains over the same period[75]. The highest gains (+0.31% of GDP) are expected to occur around 2034.

Figure 4 GDP impact of the continuation of Horizon 2020 (NEMESIS, deviation in % from a situation without Framework Programme)

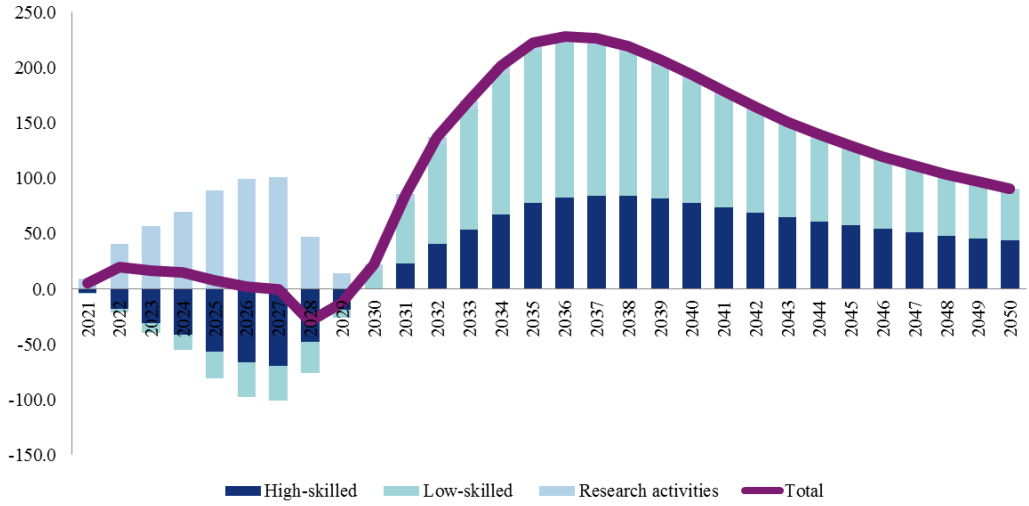
[74] Ibidem.
[75] Figures in constant prices. This corresponds to about EUR 720bn over 25 years, and EUR 550bn over 20 years.



Source: Seureco (2018), Support for assessment of socio-economic and environmental impacts (SEEI) of European R&I programme.

The impact on jobs is also substantial. Over the period of the Programme, up to 100 thousand jobs are expected to be directly created in R&I activities. During this period, while the Programme has a positive effect on jobs in R&I, the decrease in national public investment that is assumed by the model is mechanically accompanied by a comparable decrease in non R&I-related jobs. The net indirect impact of the Programme on jobs materialises as from 2030, with the creation of more than 200 thousand jobs after 2035, including more than 80 thousand high-skilled jobs.

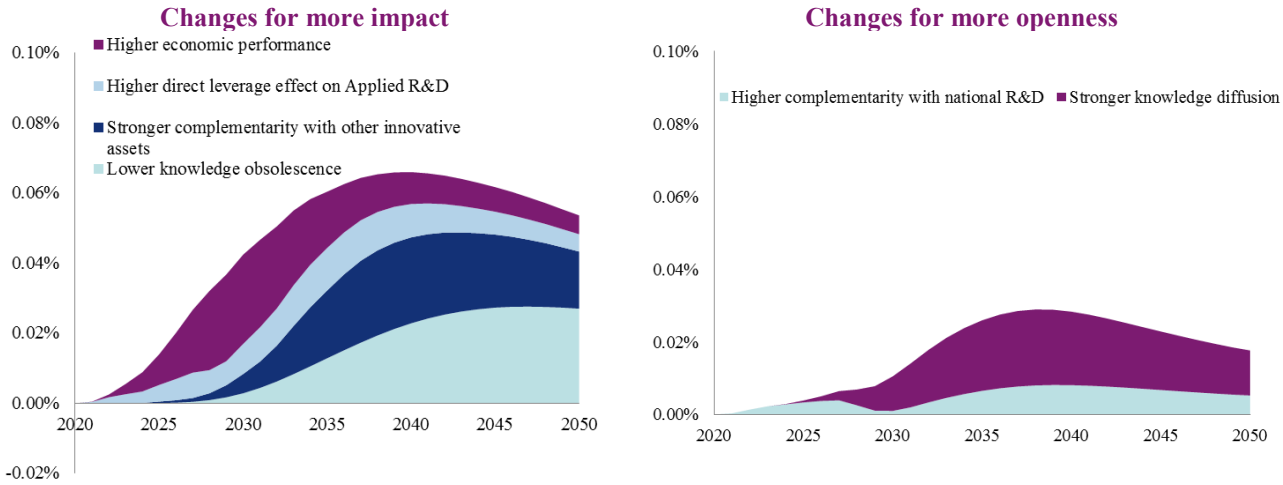
Figure 5 Employment impact of the continuation of Horizon 2020 (NEMESIS, deviation in thousand jobs from a situation without Framework Programme)



Source: Seureco (2018), Support for assessment of socio-economic and environmental impacts (SEEI) of European R&I programme

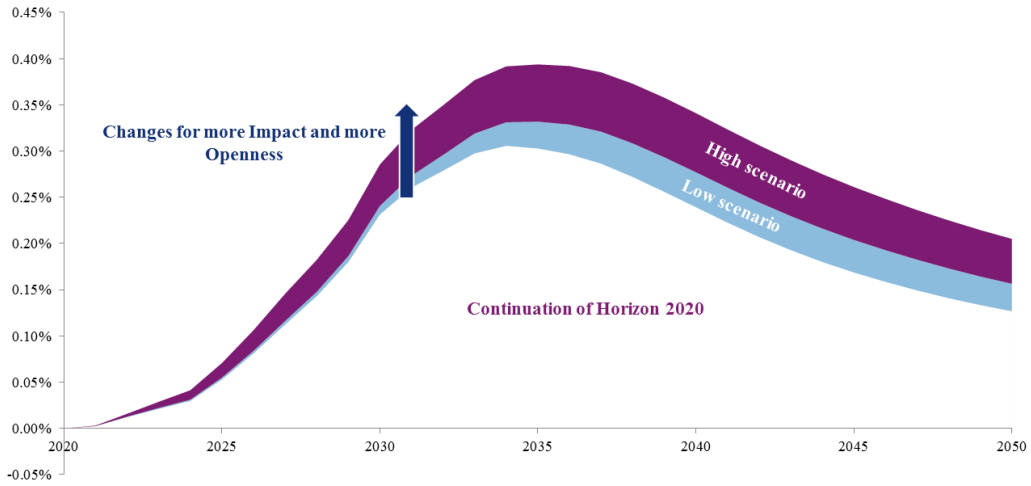
Compared to the continuation of Horizon 2020, the changes in the design of the Programme can potentially generate an additional GDP gain up to 0.04% in a low scenario, and up to 0.1% in a high scenario. The impact of the changes is expected to be the most significant after 2030. The total impact of the Programme on EU GDP would be between EUR 800 billion and EUR 975 billion over 25 years.

Figure 6 Decomposition of GDP impact of changes for more impact and more openness (deviation in % from the continuation of Horizon 2020, scenarios based on highest values of the ranges)



Source: Seureco (2018), Support for assessment of socio-economic and environmental impacts (SEEI) of European R&I programme

Figure 7 GDP impact of changes for more impact and more openness (deviation in % from a situation without Framework Programme)



Source: Seureco (2018), Support for assessment of socio-economic and environmental impacts (SEEI) of European R&I programme

Limitations of the model

While NEMESIS' strengths justify its relevance for measuring the impact of R&I policies, the model's specificities and approach also imply a number of limitations to be taken into account when interpreting the results. First, it relies on the empirical observation of relationships and allows for flexibility in behavioural functions, which may generate inconsistencies among the most recent developments in macroeconomic theory. Furthermore, it does not use forward-looking expectations but adaptive ones. Regarding the use of human capital in the model, NEMESIS does not link that with investments in the educational system.

2 QUEST

Presentation of the model

The QUEST model is a global dynamic general equilibrium model developed by the Directorate General for Economic and Financial Affairs of the European Commission[76]. The different model variants have been extensively used for macroeconomic policy analysis and research, e.g. analysing the impact of fiscal and structural reforms and assessing the impact of Cohesion Policy[77]. QUEST is a fully dynamic structural macro-model with rigorous microeconomic foundations derived from intertemporal utility and profit optimisation. The model also accounts for frictions in goods, labour and financial markets.

Structure of the model

QUEST belongs to the class of micro-founded dynamic general equilibrium (DGE) models that are now widely used in economic policy institutions as the latest step in the development of macroeconomic modelling. The focus in these models is on the economy as a whole, as an integrated system of economic agents that base their economic decisions over a range of variables by continuously re-optimising, subject to budgetary, technological and institutional constraints. These models are forward-looking and intertemporal, i.e. current decisions account for expectations about the future.

This impact assessment uses the semi-endogenous growth version of the European Commission's QUEST model with an R&D production sector (QUEST3RD). The model economy is populated by households, final and intermediate goods producing firms, a research industry, a monetary and a fiscal authority. In the final goods sector, firms produce differentiated goods which are imperfect substitutes for goods produced abroad. Final good producers use a composite of intermediate goods and three types of labour: low-, medium-, and high-skilled. The model has two types of households, liquidity and non-liquidity constrained, a feature which has become standard in dynamic stochastic general equilibrium modelling. Liquidity constrained households have no access to financial markets. They simply consume their current income at each period. Non-liquidity constrained households buy the patents of designs produced by the R&D sector and license them to the intermediate goods producing firms. The intermediate sector is composed of monopolistically competitive firms, which produce intermediate products from rented capital input using the designs licensed from the household and by making an initial payment to overcome administrative entry barriers. The production of new designs takes place in research labs, employing high skilled labour and making use of the commonly available domestic and foreign stock of knowledge. Importantly, the model is a global multi-country model of the EU Member States and the rest of the world in which individual country blocks are interlinked with international trade and knowledge spillovers.

Assumptions used for the impact assessment

	Key assumptions (continuation of Horizon 2020)
Budget size	Continuation of Horizon 2020 budget in constant prices – 15%
Budget allocation across years, regions and sectors	Horizon 2020 allocation
Spillovers	International trade and knowledge spillovers, based on trade statistics and elasticities in the relevant literature.
Direct leverage effect	Identical leverage of EU funding and national funding
Economic performance	Identical performance of EU funding and national funding

[76] See Ratto, M., Roeger, W., & in't Veld, J. (2009). QUEST III: An estimated open-economy DSGE model of the euro area with fiscal and monetary policy. *Economic Modelling*, 26(1), 222-233.

[77] See Varga, J., Roeger W. and in 't Veld, J. (2014), "Growth effects of structural reforms in Southern Europe: the case of Greece, Italy, Spain and Portugal" *Empirica*, vol. 41, issue 2, 323-363., Varga, J. and in 't Veld, J. (2011). "A model-based analysis of the impact of Cohesion Policy expenditure 2000-06: Simulations with the QUEST III endogenous R&D model." *Economic Modelling*, 28 (1-2), 647-663. and https://ec.europa.eu/info/business-economy-euro/economic-and-fiscal-policy-coordination/economic-research/macroeconomic-models_en for other publications using the QUEST model.

For this impact assessment, results were produced based on two scenarios regarding the financing of the Framework Programme. In a first scenario, financing relies on raising additional VAT revenues in the Member States. The second scenario assumes that future Programme is financed at the expense of lowering national public investment.

Results

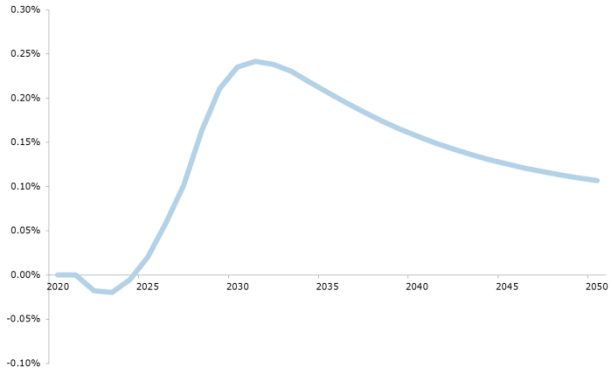
The results highlight the importance of the underlying financing assumptions. As value added taxes are some of the least distortive taxes, financing productivity-enhancing R&D investments from these resources is unambiguously beneficial at the EU level in the medium and long run (see left side graph in

Figure 8a).

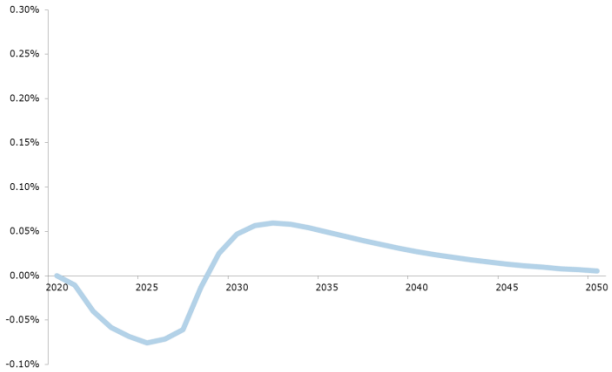
By changing from VAT financing to public investment cuts (e.g. roads, buildings), Members States loose the potential productivity effects of these public investments and the GDP results are lower both in the short- and long-run (second panel in

Figure 8b).

Figure 8 GDP impact of the continuation of Horizon 2020 (QUEST, deviation in % from a situation without Framework Programme)



a. VAT financed



b. Financed through public investment cuts

Source: European Commission, DG ECFIN

There is a small short-run output loss due to crowding out effects in the beginning of the intervention period. This is because R&D subsidies stimulate innovation by helping R&D intensive companies to attract more high-skilled labour from traditional production into research with higher wages. In the second scenario, the expected GDP effects are less beneficial at the EU level. Similar to R&D investments, public investment is also productivity-enhancing, therefore, this type of financing is more costly for the Member States. It also takes longer to compensate the short-run output loss.

In both scenarios, the GDP gains peak around the 2030-2032 period, up to 0.14%, and gradually decrease after the Programming period due to the depreciation of tangible and intangible capital. The average impact over 25 years can reach up to 0.14% over 25 years. Note, that in the QUEST simulations EU and nationally funded R&I have the same leverage and performance effects.

Limitations of the model

Although the model is well-suited to simulate the effect of public financed subsidies to private R&D, it does not distinguish between research undertaken in private or public R&I entities. All R&D activities are carried out by a (virtual) R&D sector. Being an aggregate macroeconomic model, QUEST also misses the extensive regional details present in RHOMOLO.

3 RHOMOLO

Presentation of the model

RHOMOLO is the spatial computable general equilibrium model of the European Commission focusing on EU regions. It has been developed and maintained by the regional economic modelling team at the Directorate-General Joint Research Centre (DG JRC) in cooperation with Directorate-General for Regional and Urban Policy (DG REGIO). It is used for policy impact assessment and provides sector-, region- and time-specific simulations to support to EU policy making on investments and reforms covering a wide array of policies. RHOMOLO is built following a micro-

founded general equilibrium approach[78] and is used to provide a breakdown of results by region and sector.

[78] The micro-founded general equilibrium approach is also the basis for other macroeconomic models developed by the Commission such as the QUEST model developed by the Directorate-General for Economic and Financial Affairs (DG ECFIN).

Structure of the model

RHOMOLO is a spatial dynamic general equilibrium model that covers 267 regions at the NUTS2 level. Each region contains 10 economic sectors. A subset of these operates under monopolistic competition. The rest of the sectors operate under perfect competition. Regional goods are produced by combining labour and capital with domestic and imported intermediates, creating vertical linkages between firms.

Final goods are consumed by households, government and investors. Each region is inhabited by a representative household which supply labour of three skills type, consume and save. The government levy taxes, purchases public consumption goods, conduct public investments and allocate transfers to the various agents in the economy. Goods and services can be sold in the domestic economy or exported to other regions. Trade between regions is associated with a set of bilateral regional transportations costs. The RHOMOLO model incorporates imperfect competition in the labour market. The model allows one to switch from a wage curve to a Phillips curve. RHOMOLO contains two types of capital, sector specific private capital and public capital available to firms in all sectors within the region.

How RHOMOLO models R&I

- R&D expenditure is modelled as private investments. Hence, R&D spending generates demand for capital goods. In addition, R&D spending leads to the accumulation of an intangible knowledge capital stock which in turn spills into an increase in total factor productivity (TFP).
- Expenditure for R&D support is introduced into the model as a reduction in user cost of capital which in turn generates an increase in R&D investments.
- The impact of R&D expenditure on total factor productivity through the accumulated knowledge capital stock is captured by a set of regional spillover elasticities which are conditional on R&D intensity within the region. Higher regional R&D intensity is associated with higher spillover from knowledge capital to TFP. The R&D spillover elasticities are based on estimates by Kancs and Siliverstovs (2016)[79].

Assumptions used for the impact assessment[80]

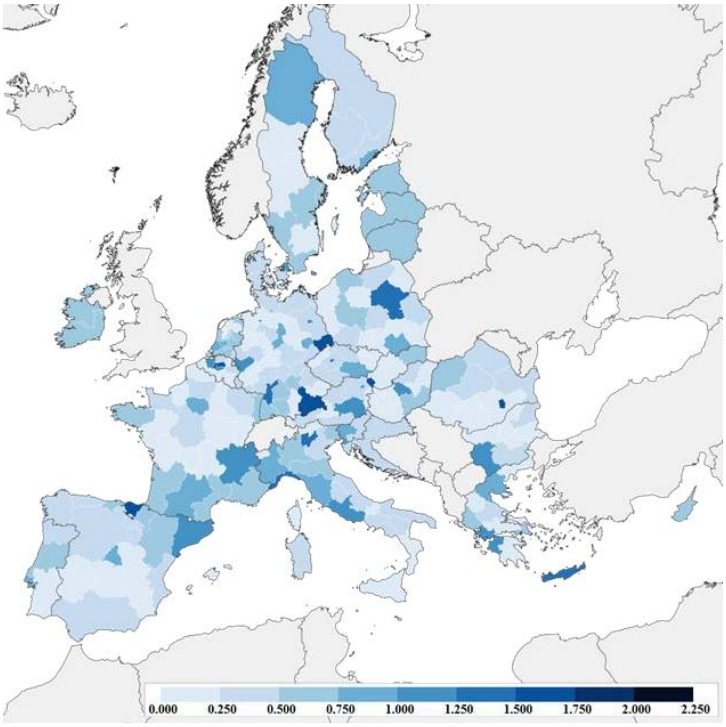
	Key assumptions (continuation of Horizon 2020)
Budget size	Continuation of Horizon 2020 budget in constant prices – 15%
Budget allocation across years, regions and sectors	Horizon 2020 allocation
Regional spillovers	Regional spillovers are conditional on R&D intensity within the regions.
Direct leverage effect	Direct leverage: Calculated as a weighted average from NEMESIS Indirect leverage: Determined endogenously by the models investment demand specification
Economic performance	Identical performance of EU funding and national funding
Financing	Reduction in public investment

The regionalisation of funding is based on the regional distribution of existing Programme spending. Hence, it is assumed that future R&I support would follow the same regional distribution

[79] Kancs, D. and Siliverstovs, B. (2016), R&D and non-linear productivity growth, Research Policy, 45, 634-646.
[80] Christensen, M., Assessing the regional socio-economic impact of the European R&I programme, forthcoming.

as previous spending programmes. Figure 9 shows the assumed regional accumulated spending for R&D support for the period 2021-2027 in percent of GDP. Large regional variations in spending can be observed.

Figure 9 Accumulated regional spending in support of R&D in the reference scenario (percent of GDP)



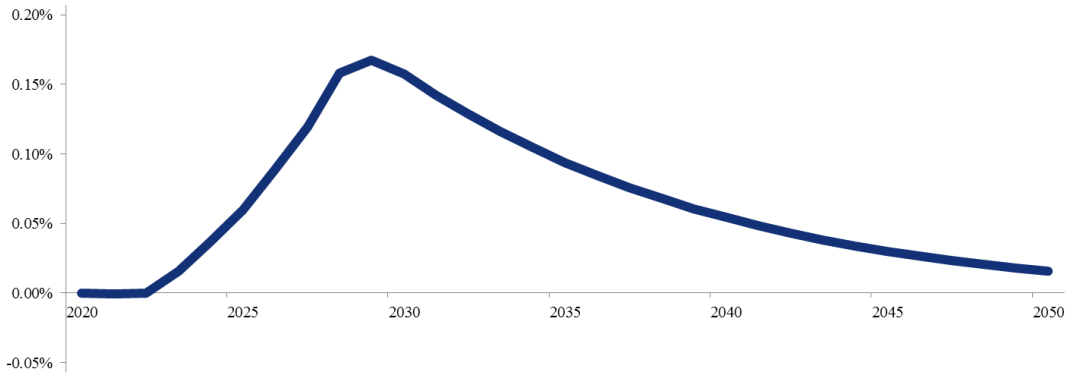
Source: European Commission, DG JRC

The impact of the Spreading Excellence and Widening Participation (SEWP) programme is also measured using RHOMOLO by using the regional allocation of funds for the years 2014-2015 under SEWP. The largest receivers of funding were regions in Cyprus, Hungary, Slovenia, Portugal and Estonia. The funding is mainly concentrated in regions in the widening countries. However, some regions in other member states also receive funding through participation in project with counterparts in the widening countries.

Results

Results from RHOMOLO show significant benefits of continuing the EU R&I Programme compared to a situation in which funding is reallocated to national public investments. The Programme is expected to generate up to 0.17% (in 2020) of additional GDP compared to a situation without Framework Programme, with an average impact of 0.08% of GDP over 25 years.

Figure 10 GDP impact of the continuation of Horizon 2020 (RHOMOLO, deviation in % from a situation without Framework Programme)



Source: European Commission, DG JRC

Key regional results from the model are the following:

- Regions from all Member States are directly or indirectly impacted by SEWP measures, not targeted countries only.
- Regional impact of the SEWP can reach up to 0.18% of regional value added in some regions.
- Each Euro invested in the SEWP part of the Framework Programme is expected to bring similar return in terms of GDP gain compared to the rest of the Programme.

Limitations of the model

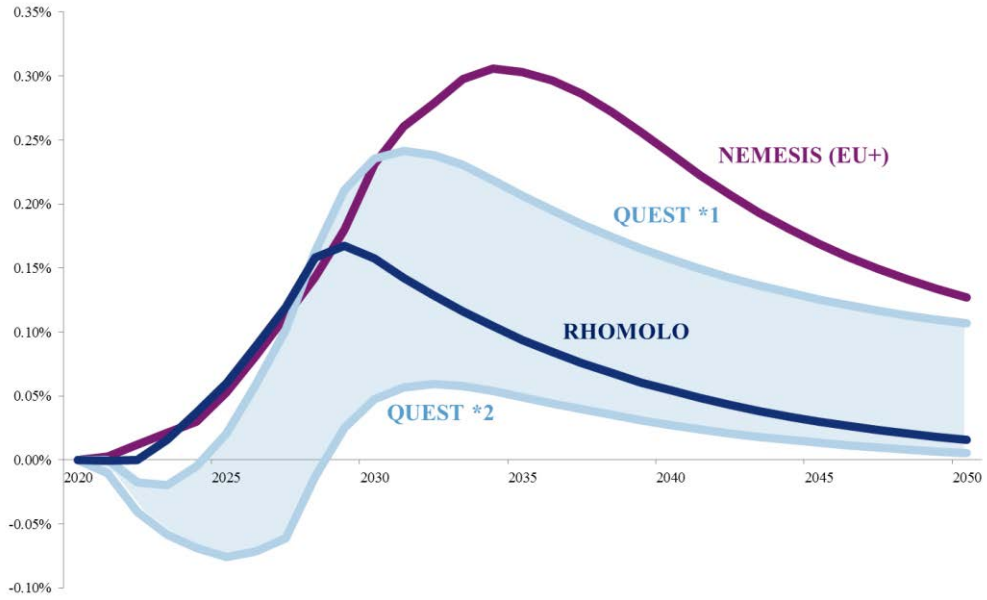
While the spatial dimension of RHOMOLO is clearly a key strength of the model, the extensive regional disaggregation of the model requires that the dynamics are kept relatively simple[81], implying that the optimisation problems in RHOMOLO are inherently static and do not acknowledge the inter-temporal consequences of innovation decisions that can change not only the level but also the rate of growth of regional economies. The model is solved by recursive dynamics. Furthermore, RHOMOLO does not explicitly distinguish between private and public R&D investments or between types of endogenous innovation.

4 Comparison of results

RHOMOLO, QUEST and NEMESIS are three different models corresponding to different approaches and with very different specifications and settings of parameter values. One should therefore not expect the three models to produce identical estimates of the economic impact of a given policy change. However, comparing the findings from the three models for the baseline scenario (i.e. the continuation of Horizon 2020) allows assessing the consistency of the impacts identified in each model and contributes to address to some extent the issue of model uncertainty.

[81] Di Comite F. and Kancs D. (2015), Macro-Economic Models for R&D and Innovation Policies, IPTS Working Papers on Corporate R&D and Innovation – No 03/2015.

Figure 11 GDP impact of Horizon 2020 continuation (deviation in % from a situation without Horizon 2020)



Source: European Commission, DG Research and Innovation. Note: EU+ indicates that Nemesis uses higher performance and leverage for EU funding compared to national funding as a reflection of the EU added value of the Programme. QUEST *1 assumes that financing of the Programme relies on VAT increase. QUEST *2 assumes that financing relies on lowering public investment.

Overall, NEMESIS, QUEST and RHOMOLO present consistent results in terms of sign and temporal pattern of the GDP gain from the Framework Programme (compared to the discontinuation of the Programme) over 2021-2050. The three models show a strong increase in the GDP impact during or after the period covered by the Programme, with highest impacts expected between 2029 and 2034. The size of the GDP gain is the highest based on the NEMESIS results. This can be explained by the fact that the three models use different sets of innovation channels and elasticities. Furthermore, the parameters and mechanisms in QUEST and RHOMOLO do not directly take into account the higher leverage and performance expected from EU funding of R&I compared to national funding, which are acknowledged in NEMESIS as an illustration of the EU added value of the Framework Programme.

Annex 6: Indicators

1 Key Impact Pathways Indicators

1.1 Scientific impact pathway indicators

The Programme is expected to have scientific impact by delivering creating high-quality new knowledge, strengthening human capital in R&I, and fostering the diffusion of knowledge and Open Science. Progress towards this impact will be monitored through the proxy indicators in Figure 12, set along three key impact pathways.

Figure 12 Key scientific impact pathways indicators

Short-term	Medium-term	Longer-term	Scientific impact
1 Message: Horizon Europe generates world-class science, as shown by the high-quality publications that become influential in their field and worldwide[82].			
Publications - Number of FP peer reviewed scientific publications[83]	Citations - Field-Weighted Citation Index of FP peer reviewed publications	World-class science - Number and share of peer reviewed publications from FP projects that are core contribution to scientific fields	**Creating of high-quality new knowledge**
Data needs: identification of publications co-funded by the FP through the insertion of a specific DOI for the FP (funding source code) when publishing, allowing follow-up tracking of the perceived quality and influence through publication databases and topic mapping.			
2 Message: Horizon Europe strengthens human capital, as shown by the improvement in skills, reputation and working conditions of participants[84].			
Skills - Number of researchers having benefitted from upskilling activities in FP projects (through training, mobility and access to infrastructures)[85]	Careers - Number and share of upskilled FP researchers with more influence in their R&I field	Working conditions - Number and share of upskilled FP researchers with improved working conditions	**Strengthening human capital in R&I**
Data needs: collection of unique identifiers of individual applicants to the FP at proposal stage, allowing follow-up tracking of their influence in their field through publication and patent databases, awards and prizes, as well as evolution of working conditions through salary levels and benefits.			
3 Message: Horizon Europe opens up science, as shown by research outputs shared openly, re-used and at the origin of new transdisciplinary/trans-sectoral collaborations[86].			
Shared knowledge - Share of FP research outputs (open data/ publication/ software etc.) shared through open knowledge infrastructures	Knowledge diffusion - Share of open access FP research outputs actively used/cited after FP	New collaborations - Share of FP beneficiaries having developed new transdisciplinary/ trans-sectoral collaborations with users of their open FP R&I outputs	**Fostering diffusion of knowledge and Open Science**
Data needs: Identification of research outputs (in particular publications and research data) co-funded by the FP through the insertion of a specific DOI for the FP when publishing or sharing openly (e.g. OA journals/platforms (publications) and open			

[82] Indicators on publications are collected under Horizon 2020, for instance the number of peer reviewed publications and top 1% or 10% citations but with different coverage across programme parts.

[83] The indicators will be tracked also for co-authored publications across types of organisations, disciplines, sectors, countries (including associated and third countries).

[84] Data on individual researchers and innovators is collected only under some programme parts under Horizon 2020 (ERC, MSCA). It is proposed to extend the coverage to the whole Programme and to look at the overall effects of the FP on individuals based on the collection of unique identifiers for each beneficiary at project's start. This shall allow for a more solid and automated analysis of the contribution of the Programme to the strengthening of human capital without further data requests to beneficiaries.

[85] By type of activities: training, mentoring/coaching, mobility, access to infrastructures

[86] Two indicators were specified as a cross-cutting issue under Horizon 2020 for open access publications and open access to data.

FAIR repositories (data)), allowing follow-up tracking of open access performance in terms of active use/citations and collaborations.

1.2 Societal impact pathway indicators

The Programme is expected to have societal impact by addressing EU policy priorities through R&I, delivering benefits and impact through R&I missions, and strengthening the uptake of research and innovation in society. Progress towards this impact will be monitored through the proxy indicators in Figure 13, set along three key impact pathways.

Figure 13 Key societal impact pathways & progress indicators

Short-term	Medium-term	Longer-term	Societal impact
4 Message: Horizon Europe helps addressing EU policy priorities (including meeting the SDGs) through research and innovation, as shown by the portfolios of projects generating outputs contributing to tackling global challenges.			
Outputs - Number and share of outputs aimed at addressing specific EU policy priorities (including meeting the Sustainable Development Goals (SDGs))	Solutions - Number and share of innovations and scientific results addressing specific EU policy priorities (including meeting the SDGs)	Benefits - Aggregated estimated effects from use of FP-funded results, on tackling specific EU policy priorities, including contribution to the policy and law-making cycle	**Addressing EU policy priorities through R&I**
Data needs: Projects classified according to the specific EU policy priorities (including the SDGs) pursued and follow-up tracking of their outputs, results and impacts. Portfolio analysis on effects from scientific results & innovations in specific EU policy priority/SDGs areas, text mining.			
5 Message: Horizon Europe produces knowledge and innovation that contribute to achieving missions of EU interest [87].			
R&I mission outputs - Outputs in specific R&I missions	R&I mission results - Results in specific R&I missions	R&I mission targets met - Targets achieved in specific R&I missions	**Delivering benefits and impact through R&I missions**
Data needs: Projects classified according to the missions pursued and follow-up tracking of their outputs, results and impacts according to the target set. Portfolio analysis on effects from scientific results & innovations in mission areas.			
6 Message: Horizon Europe creates value for European citizen, as shown by the engagement of citizen in the projects and beyond the projects by improved uptake of scientific results and innovative solutions[88].			
Co-creation - Number and share of FP projects where EU citizens and end-users contribute to the co-creation of R&I content	Engagement - Number and share of FP beneficiary entities with citizen and end-users engagement mechanisms after FP project	Societal R&I uptake - Uptake and outreach of FP co-created scientific results and innovative solutions	**Strengthening the uptake of innovation in society**
Data needs: Collection of data at proposal stage on the roles of partners (incl. citizen) in the projects, structured survey of beneficiary entities and tracking of uptake and outreach through patents and trademarks and media analysis.			

1.3 Economic impact pathway indicators

The Programme is expected to have an economic/innovation[89] impact by influencing the creation and growth of companies, creating direct and indirect jobs, and by leveraging investments for

[87] Missions are a new element under the Framework Programme, which did not exist under Horizon 2020 and will be not be specified at the stage of the legal proposal. The interim evaluation of Horizon 2020 pinpointed to the lack of data to track the societal impact of the Programme beyond publications and patents in fields related to societal challenges. It is proposed to assess the progress towards the achievement of the targets set in each mission.

[88] Data on responsible research and innovation was collected under Horizon 2020 at the level of the activities within projects. It is proposed to go beyond this indicator to assess the effects of the co-creation on the development of citizen engagement mechanisms in beneficiary entities (such as citizen fora, participatory research, co-creation facilities, etc.) to then assess the extent this affects the uptake and outreach of the scientific results (e.g. changing behaviours) and innovative solutions from the programme.

research and innovation. Progress towards this impact will be monitored through the proxy indicators in Figure 14, set along three key impact pathways.

Figure 14 Key economic impact pathways indicators

Short-term	Medium-term	Longer-term	Economic impact
7 Message: Horizon Europe is a source of economic growth, as shown by the patents and innovations that are launched on the market and generate added value for businesses[90].			
Innovative outputs - Number of innovative products, processes or methods from FP (by type of innovation[91]) & Intellectual Property Rights (IPR) applications[92]	Innovations - Number of innovations from FP projects (by type of innovation) including from awarded IPRs	Economic growth - Creation, growth & market shares of companies having developed FP innovations	**Innovation-based growth**
Data needs: Reporting of beneficiaries on innovative products, processes or methods from FP and their practical use, and insertion of a specific DOI for the FP (funding source code) when filling IPR applications, allowing follow-up tracking of the patents through patent databases and trademarks ("follow the investor approach").			
8 Message: Horizon Europe generates more and better jobs, initially in the projects, and then through the exploitation of the results and their diffusion in the economy[93].			
Supported employment - Number of FTE jobs created, and jobs maintained in beneficiary entities for the FP project (by type of job[94])	Sustained employment - Increase of FTE jobs in beneficiary entities following FP project (by type of job)	Total employment - Number of direct & indirect[95] jobs created or maintained due to diffusion of FP results (by type of job)	**Creating more and better jobs**
Data needs: Collection of information on individuals involved in FP projects at proposal stage, including their workload (Full Time Equivalent) and job profile allowing follow-up tracking of employment in beneficiary organisations. Longer-term indicator will be an estimate based on a dedicated study.			
9 Message: Horizon Europe is leveraging investments for research and innovation in Europe, initially in the projects, and then to exploit or scale-up their results[96].			
Amount of public & private investment[97] mobilised with the initial FP investment	Amount of public & private investment mobilised to exploit or scale-up FP results	EU progress towards 3% GDP target due to FP	**Leveraging investment**
Data needs: Data on co-funding in FP projects by source of funds including other EU funds (e.g. ESIF), collection of unique identifiers of applicants to the FP at proposal stage (e.g. VAT), allowing follow-up tracking of their capital. Longer-term indicator will be an estimate based on a dedicated study.			

[89] An innovation is a new or improved product or practice (policy, process or procedure) of an institutional unit, or a combination thereof, that differs significantly from the unit's previous products and practices and has been brought into practical use by the unit or made available to others.

[90] Horizon 2020 includes an indicator on the growth and job creation in participating SMEs but no data is collected. It is proposed to extent this indicator to the whole programme and to collect information on the types of jobs created or maintained based on the collection of unique identifiers of companies. This shall allow for a more solid and automated analysis of the contribution of the Programme to the creation of more and better jobs without further data requests to beneficiaries.

[91] Types of innovation: by level of novelty of the innovation (e.g. based on the Oslo Manual definition), by objective of the innovation (incl. social innovation) and by source of innovation (i.e. technological (Key Enabling Technologies, other) /non-technological)

[92] Patents, trademarks, standards. The indicators will be tracked also for co-authored IPR across types of organisations, disciplines, sectors, countries (including associated and third countries).

[93] Data on innovative products, process or methods developed in FP projects is collected under Horizon 2020 but the effects on company creation, growth and market shares are not monitored.

[94] Types of jobs: by level of qualification (low, medium, high (based on ISCED 1997 levels) and contract duration (short, long term).

[95] Direct jobs: jobs within beneficiaries entities. Indirect jobs: Jobs in non-FP beneficiary entities (e.g. suppliers).

[96] Public and private funding leveraged under Horizon 2020 is computed on different ways depending on the types of action. It is proposed to use an overall indicator of the direct and indirect public and private investment leveraged including venture investment, loans and other co-financing, to be able to assess the overall contribution of the Programme to the achievement of the 3% target for R&D investments.

[97] Including venture investment, loans and other co-financing.

2 Key Management and Implementation Data

This section specifies a number of key management data for assessing the state of implementation of the Programme. The data covers the inputs and activities of the Programme, including the European Partnerships.

- *Number of proposals and applications submitted, EC contribution requested and total costs of submitted proposals (by source of funds)*
- *Number of proposals reaching the quality threshold (funded/not funded)*
- *Number of retained proposals*
- *Success rates of proposals*
- *EC contribution and total costs of retained proposals (by source of funds)*
- *Number of participations and single participants*

This information shall be collected according to:

- *Types of action*
- *Types of organisations, including Civil Society Organisations (with specific data for SMEs)*
- *Countries and regions of applicants and participants (including from associated and third countries)*
- *Sectors*
- *Disciplines*

Data shall also be monitored on the profiles of beneficiaries and evaluators:

- *Gender balance (in projects, in EC advisory groups and evaluators)*
- *Role(s) in project*[98]
- *Share of newcomers to the Programme*

Data shall also be monitored on the implementation processes:

- *Time-to-grant*
- *Time-to-pay*
- *Error rate*
- *Satisfaction rate*
- *Rate of risk taking*

Data shall also be monitored on:

- *The financial contribution that is climate-related*

Data shall also be collected on:

- *Communication of R&I results*
- *Dissemination of R&I results*
- *Exploitation and deployment of R&I results, including through monitoring the funding allocated for uptake of research and innovation results through the instruments listed in Annex 7 on synergies with other EU programmes.*

[98] e.g. Research performer; Technology development; Testing / validation; Demonstration (proof of viability); Scale-up; Private buyer of solutions to be developed; Public procurer of innovative solutions; Finance provider; Provision of the technology basis; Provision of the technology infrastructure; Representative of civil society interests/needs; Co-definition of a research / market need; Training, dissemination activities).

Annex 7: Synergies with other proposals under the future Multiannual Financial Framework

1 Why do we need synergies between EU programmes?

The set of EU funding programmes under the next multiannual budget must be closely linked to each other, and they must work in synergy. This can be described as:

- **Compatibility:** harmonisation of funding rules for projects; making co-funding schemes more flexible; pooling resources at EU level;
- **Complementarity** between EU programmes: no overlap in funding;
- **Coherence:** alignment of strategic priorities in support of a common vision.

An important lesson learned from the Horizon 2020 interim evaluation is that, in cases where those programmes were not designed with a clear strategic overview on their complementarities from their inception, it proved difficult to ensure full complementarity and coherence at the implementation stage.

More effective synergies between EU programmes under the next EU Multinational Financial Framework (MFF) will make the EU's overall investments more effective, readable and able to provide better value for citizens. It will amplify the impact of EU-level investments in R&I for creating jobs, growth and competitiveness on the ground by bringing European, national and regional R&I funding schemes better into play. Ultimately, they should contribute in a complementary way to a common vision and shared objectives on tackling the major challenges facing Europe and ultimately make the EU as a whole better equipped to face ever-increasing competitive pressure from global markets.

What have we learned from the Horizon 2020 Interim Evaluation?

"It is difficult to assess to what extent the political willingness to increase Horizon 2020's external coherence has translated into practical implementation. Given different rules and implementation structures, and varying scale and scope of programmes, promoting synergies at project level (in terms of combining different financing sources for the same project) still appears difficult"[99].

Differences in applicable rules lead to legal uncertainty for potential applicants; while communication, coordination and support for synergies between all institutional actors involved is not optimal.

"Despite initiatives being taken to reinforce synergies with other EU funds, notably the ESIF, further coherence is hampered by the different intervention logics and complexity of the different funding and other rules "[100].

"The main areas to be addressed to improve the generation of synergies and to boost their impacts on regional development, on growth, job creation and tackling societal challenges are: strategic framework and programming; generation of concrete guidance and implementation of best practice; monitoring. These issues should support a more specific, widespread, efficient and effective implementation of synergies between Horizon 2020 and ESIF"[101].

[99] In-Depth Staff Working Document on Horizon 2020 Interim Evaluation, SWD(2017) 221 final, p.171.
[100] 'LAB-FAB-APP: Investing in the European future we want' - Report of the High Level Group on Maximising the Impact of EU R&I Programmes, July 2017, p26.
[101] Synergies between Framework Programmes for Research and Innovation and European Structural and Investment Funds – Contributing to the Interim Evaluation of Horizon 2020, September 2017, p6.

Exploring synergies between the Framework Programme and other MFF proposals related to the support of the research and innovation systems at the programme design stage aims to:

(i) ensure complementarity in designs and objectives of the different Programmes to ensure the most efficient use of limited public resources and enhanced readability for beneficiaries;
(ii) capture the scope of the activities supported through the different Programmes to ensure full synergies and coherent approaches on the ground for instance through aligned strategic programming processes (e.g. on priority areas, partnerships), and common missions to guide funding priorities of different Programmes;
(iii) ensure the development of complementary and combined funding across programmes and facilitate the implementation of the Seal of Excellence

What do stakeholders say?

The large majority of stakeholders state the broad view that increased synergies, coordination and strategic alignment with other EU programmes would help to maximise the impact of the future EU R&I programme.

In general, this is a consistently high priority for other EU institutions:

- [The European Parliament]"Notes that synergies between funds are crucial to make investments more effective….regrets the presence of substantial barriers to making synergies fully operational and seek, therefore, an alignment of rules and procedures for R&D&I projects under ESIF and FP…..encourages the Commission to enhance synergies between the Framework Programme and other dedicated European funds for research and innovation, and to establish harmonised instruments and aligned rules for those funds"[102].
- [The Council] "Highlights the importance of improved synergies and complementarities between the FP and other EU funding instruments. Considers therefore that regulations for the next FP and the European Structural and Investment Funds, as well as state aid rules and any other relevant EU programmes must be designed from the very beginning with synergies, coherence, compatibility and complementarity in mind in order to provide a level playing field for similar projects under different management modes and to consider harmonization of funding rules for R&I towards those of the FP"[103].

Specific suggestions from stakeholder organisations include:

- To include education activities in relevant parts of the EU R&I programme and secure synergies with the next EU framework programme for education.
- To increase the impact of national and regional funding coming from ESIF allocated to R&I activities, to allocate a minimum specific percentage of the budget devoted to synergies with the R&I programme for each Member State.
- To step up efforts for the 'Seals of Excellence' enabling excellent-but-unfunded projects submitted to the R&I programme to be funded under other schemes (including private, national, other EU funds).
- To co-construct the future R&I and ESIF programmes by ensuring efficient support from the ESIF funds to excellent R&I projects in capacity-building (upstream) and uptake of results (downstream).
- Request for broader acceptance of usual cost-accounting practices and for the introduction of the

[102] European Parliament Report on the assessment of Horizon 2020 implementation in view of its interim evaluation and the Framework Programme 9 proposal June 2017, p.15.
[103] Council Conclusions "From the Interim Evaluation of Horizon 2020 towards the Ninth Framework Programme", December 2017, p.11.

single audit principle/cross-reliance on audits.

2 The role of the Framework Programme in the EU R&I support system

The Framework Programme remains the sole EU programme supporting mainly trans-national research and innovation activities and networks, including through partnerships with Member States, businesses and foundations, based on the key criteria of excellence. This includes the trans-national access to and integration of national research infrastructures across Europe and the development of ESFRI[104] pan-European research infrastructures.

The Framework Programme will cover activities that support the development, demonstration and market uptake of innovative solutions (through co-creation, EIC's Accelerator, public procurement) that usually have a trans-national dimension or require more support than may be provided for at national/regional level, and are first-of-a-kind innovative solutions for Europe. Across its activities the programme will support the development of the skills of researchers and innovators involved. While the Framework Programme is open to participation from all Member-States and beyond, it will continue to support the building of capacity in low-performing countries in R&I through dedicated collaboration-based schemes - including for policy reforms, in the context of strengthening the European Research Area, including outermost regions.

Other programmes under the next MFF will provide support for research and innovation activities, including demonstration of solutions tailored to specific national/regional contexts/needs, as well as bilateral and interregional initiatives. In particular, the European Regional Development Funds support the building of research and innovation eco-systems in the Member States in terms of infrastructures, human resources, modernisation of the public and private sectors, and (inter)regional cooperation networks, such as clusters structures. MFF programmes such as the Connecting Europe Facility (CEF), the Digital Europe Programme (DEP), the European Social Fund (ESF) or LIFE make notably use of public procurement as one instrument to deploy physical infrastructures and innovative technologies and solutions in specific areas - that can originate from the Framework Programme activities, but not only.

The Framework Programme will also provide support for R&I activities underpinned by these infrastructures and facilities, including testing, experimentation and demonstration across all sectors and disciplines. Actions implemented through other MFF programmes will provide the backbone for system transitions (e.g. infrastructures for energy transition) and ensure supportive framework conditions such as interoperability, standards, innovation-friendly regulations, but also enhanced skills and awareness of the wider population, the spreading of best practice in research and innovation policy implementation, but also for the wider diffusion and uptake of (European) innovations in the international arena, e.g. through external action.

Overall the wider dissemination of R&I results attained through the Framework Programmes towards a broader audience within the European institutions but also Member States and other stakeholders will be encouraged. Through the Seal of Excellence, high-quality but unfunded proposals under the Framework Programme will continue to be promoted for support through alternative funding sources, including ERDF or ESF where relevant.

[104] European Strategic Forum on Research Infrastructures.

Moreover, the development of the corporate eGrants/eProcurement suite of business processes and IT tools for all centrally managed programmes will provide for harmonised implementation and improved possibilities for exploiting synergies at project level. Cross-reliance on audits of other EU programmes could also be considered, although its effectiveness will depend on the homogeneity of the rules between programmes.

Table 3 Support to R&I projects/activities, incl. closer-to-market activities, replication & diffusion of technologies & innovative solutions – Complementarities Framework Programme/ Other EU programmes

Horizon Europe	What will the other EU programmes typically cover?
R&I activities/projects: - Programme focussed on **excellent R&I from TRL 1-9** with continued strong focus on collaborative R&I - Support to **individual entities** and **transnational collaborations** (top down and bottom-up) - Mainly **grants** for TRL 1-8; **repayable or convertible advances**, **equity and/or guarantee for loans** (no grants) for TRL 5/6-9 - Support **technological & non-technological** innovations ((citizen science, user-led innovation, social innovation, business model innovation, public sector innovation etc.), including innovative delivery mechanisms - Continuation of **Coordination and Support Actions** - Incentives for **institutional changes towards Responsible Research and Innovation** (RRI) and gender equality. - Continued streamlined support to **European Partnerships**: co-programming, co-funding (incl. through procurement), institutional funding open to all types of public, private stakeholders (incl. foundations) **Market uptake:** - Market uptake considered as of FP projects' proposal development, fostering applicants to **co-create/ experiment** their research and solutions with users from the outset, including within the KICs co-location centres. - Supporting innovation actions and the demonstration of solutions of a **first-of-a-kind nature in Europe** with potential for replication - Establishing **pipelines of innovative solutions** from R&I projects (incl. from ERC Proof of concept) targeted to public and private investors, including EIC's Accelerator and other EU programmes - Support to roll out and replication of innovative solutions with **cross-border & transnational dimension** - **Support to pre-commercial procurement and public procurement of innovation** as a stand-alone tool maintained - Support to **scale-up** of companies with **breakthrough potential to create new markets** with financial instruments **under the EIC**, in particular where the market does not provide viable financing - Improved **monitoring and dissemination** of R&I results including through initiatives such as the **dissemination and exploitation Boosters and the Innovation Radar** - also directed to other DGs and programmes for further implementation.	**R&I activities/projects** - Continue support R&I activities tailored to specific **national/regional** contexts/needs, as well as **bilateral and interregional** initiatives (e.g. ERDF, LIFE) - Build **R&I capacity** in countries and regions (including regional and national research infrastructures): ERDF, InvestEU (infrastructure, human capital and SME windows), External Instrument, Erasmus-supported European Universities initiative, Strategic Partnerships, Knowledge Alliances and Mobility - High-quality but unfunded proposals under the Framework Programme (SME and MSCA Seals of Excellence) should be supported through **alternative funding sources**, including ERDF or ESF where relevant. In the case of the SME SoE, they should benefit from **similar funding conditions** elsewhere, including under national/regional funding schemes. - **Pool resources** for coordinated parallel actions that complement with the Framework Programme (including ERDF or ESF for the support of European Partnerships) and for R&I in specific areas (i.e. with ETS Innovation Fund) - **Align funding provisions/financial regulations** between programmes. - Provide **advice** on finding alternative funding sources through COSME+. **Market uptake:** - Support user-driven activities tailored to specific **national/regional** contexts (e.g. living labs, testbeds under the ESI funds, DEP) - Support demonstration and innovation activities tailored to specific **national/regional** contexts including **trans-regional activities** (incl. LIFE, ESI funds) - **Take up** FP results and support further development, dissemination and deployment for the benefit of economy and society (project pipelines) (all EU programmes when relevant) - Replicate and deploy tested technologies and innovative solutions to improve the environment, energy consumption or the health of citizen or in digital technologies at **local and regional level** incl. **trans-regional** through CAP, LIFE, ERDF or ESF (e.g. for acquiring technologies, skills development) while preserving competition within the internal market - Support the take-up of innovative solutions by **individuals and final users, industry and public administration** (e.g. for energy consumption, health, environment) through ESIF, LIFE, CAP, etc. - Build **enabling framework conditions for the transition processes** (e.g. energy transition) such as interoperability, standards, innovation-friendly regulations, but also enhanced skills and awareness of the wider population, the spreading of best practice in research and innovation policy implementation, but also for the wider diffusion and uptake - Support wider **diffusion and uptake** of (European) innovations (including through External Instrument) - Deploy **physical infrastructures** allowing technological system transitions (e.g. for a transition to clean energy under CEF; financial instruments under Invest EU, ERDF) - Reinforce **cooperation between DGs** for developing further the public procurement for innovative solutions in key areas of European interest, in particular for energy, transport, environment, health & ICT

Table 4 Support to entrepreneurship, start-ups, SME growth/scale up, clusters & innovation hubs

Horizon Europe	What will the other EU programmes typically cover?
Support to entrepreneurship & SME growth: - Support the launch and **scale-up** of start-ups, innovative SMEs and mid-capital firms with breakthrough potential to create new markets with financial instruments through the **European Innovation Council** (pathfinder, accelerator), preserving competition within the internal market and not crowding out private investments - Dedicated **R&I thematic window** and **SME Window** (i.e. including innovative SMEs) under InvestEU that are closely linked to the objectives of the Framework Programme - **Blended finance** for innovators that is distinct from indirect financial instruments under InvestEU, but in synergy with funds and intermediaries supported by InvestEU - Support to companies (incl. mentoring and coaching) provided within the **EIT KICs, ,** including investments via **EIC's Accelerator** **Support to clusters, hubs and broader innovation ecosystem:** - Joint programmes and other actions son to enhance **innovation ecosystems** - Reinforcement of **EIT KICs co-location centres** (innovation hubs) for experimentation and testing with end-users - Support to development of **standards for innovative products/services** in FP projects	**Support to entrepreneurship & SME growth:** - Ensure full complementarity with **financial instruments** implemented through InvestEU windows to support scale-up of companies - Support the **growth and internationalisation** of mainstream individual companies (e.g. through COSME; ERDF and External Instrument) in a competitive environment - Support to business **skills development** (ESF) **Support to clusters, hubs and broader innovation ecosystem:** - Support the construction and equipment of **structures for SME support** (clusters, incubators, etc., notably under ERDF) - Support to **regional/national** innovation ecosystem development incl. provision of advice and support services to companies (incl. through COSME+ and the Enterprise Europe Network and through the ESI funds). - Shape **R&I supportive standards** in the international standardisation arena (incl through COSME)

Table 5 Support to research infrastructures, human capital development, networking & policy-making

Horizon Europe	What will the other EU programmes typically cover?
Research infrastructure: - **Consolidate** the landscape of European research infrastructures e.g. ESFRI: support early-phase development of pan European research infrastructures, the European Open Science Cloud and European Data Infrastructures and enable delivery of High Performance Computing/data services - **Open, integrate and interconnect** national research infrastructures - Support **partnerships** with industry for the supply of high-tech components while ensuring a level playing field between competitors. - Reinforce European research infrastructure **policy** and international **cooperation** **Human capital development:** - Supporting **individual researchers** (incl. ERC, MSCA) and **R&I networks** for the exchange of knowledge, incl. mobility & career development - Continue supporting **mobility & career development** of researchers in ERA (e.g. Human Resources Strategy for researchers, EURAXESS, RESAVER Pension Fund, etc.) - Continue supporting **access to research infrastructures** for researchers, innovators & SMEs on a transparent and non-discriminatory basis - Continue supporting **responsible research and innovation** and **gender equality** & gender dimension in research and innovation - Continue supporting the development of entrepreneurial **skills** in universities (EIT-KICs) and reinforce the role of the EIT KICs for **future skills identification** in areas related to global challenges - Increase FP role in **modernisation of universities in ERA**, i.e. through embedding Open Science practices as well as	**Research infrastructure:** - Support the national/regional contributions to the **construction** of pan European research infrastructures i.e. with ERDF and InvestEU Fund - Exploit the potential of the CEF and Digital Europe Programme instruments for the large-scale coordinated **procurement/ deployment** of digital infrastructures and infrastructures for digital technologies - Use External instruments for developing capacity in third countries to participate in **global research infrastructures** of EU interest - Provide **appropriate and continued financial support** for long-lasting initiatives beyond FP funding life-time **Human capital development:** - Support to **skills development** (technical, digital and transversal) to support the use of innovative solutions, while increasing employability and career prospects, but also entrepreneurial skills through the future COSME (Erasmus for Young Entrepreneurs) and ESF - Build/reinforce **human R&I capacity** in countries & regions (including through regional & national research infrastructures & fellowships): European Social Fund (incl. basic digital skills), InvestEU (research infrastructure, human capital & SME windows); Erasmus (targeting particular sectors to provide a pipeline of talented pre-graduates that can embark on a research career, European Universities initiative, Strategic Partnerships individual mobility for studies and for traineeships); External Instrument - Develop skills and capacities towards **gender equality** and **Responsible Research and Innovation** - Foster **links and synergies** between relevant policy actions

Horizon Europe	What will the other EU programmes typically cover?
entrepreneurship focus (e.g. skills, recognition and rewarding mechanisms, etc.) - Continue **mentoring & coaching** companies to enhance innovation & entrepreneurial skills (EIC, EIT/KICs) - Launch new Recognition prizes (Women Innovators, Capital of Innovation, EIT awards) and EIC **Prizes** - Continue reinforcing **human capacity in low R&I performing countries** (ERA Chairs) **Networking and policy-making :** - Continuation of **coordination and support actions** incl. **Sharing Excellence** actions (Teaming, Twinning, ERA-Chairs), **Policy Support Facility** to help EU Member States reform their research and innovation policies and **Innovation Deals** to identify barriers to innovation at sectoral level - Rationalised support to **European Partnerships**: co-programming, co-funding, institutional funding open to all types of stakeholders - Improved **monitoring and dissemination of R&I results** towards policy - **EIC Forum** of national agencies implementing national innovation policies	linking education/research/innovation **Networking and policy-making :** - Ensure strong **coordination** between programmes, especially in the area of research infrastructures, innovation hubs, large demonstrators etc. - Continue support R&I networking activities tailored to specific **national/regional** contexts and **inter-regional** cooperation - Build **R&I policy capacity** in countries and regions e.g. by developing networks across the quadruple helix to input policy evidence - Support through CAP and ERDF to upgrade **national and regional ecosystems** and make them more innovation-conducive (incl. through **Smart Specialisation Strategies**) - External Instrument actions to help improve **framework conditions** for innovation and for cooperation in R&I

3 Synergies with the European Regional Development Fund (ERDF)

Table 6 European Regional Development Fund- Research and innovation related support

Sectors/Domains: - Under development **Target beneficiaries:** - All of the Framework Programme's beneficiaries may also get ERDF support either for different types of projects or within a common project **Geographical coverage:** Member States and regions	**R&I activities/projects** - Supports R&I projects of individual enterprises, and public institutions, cooperation university-business and university researchers **Market uptake:** - Focusses funding for R&I on the take-up of technology and knowledge - Social innovation and co-creation, use of design-thinking and other newer forms of innovation - Supports all types of market take-up, prototyping, IPR management advice, etc. (within State-Aid limits!) - Funds replication and diffusion of innovative solutions and technology deployment, including the actual public and private procurement of innovative solutions - Open to PCP and PPI funding (both preparation of Terms of Reference and actual procurement), offers technical assistance and training for national and regional authorities; networking among different countries - Supports interregional partnerships along value chains for joint investment pipelines, with the aim for industrial transition
Support to entrepreneurship & SME growth: - Financial instruments under ERDF - Funds the provision of advice and support services **Support to clusters, hubs and broader innovation ecosystem:** - Funds the construction and equipment of infrastructures for SME support (clusters, incubators, etc.) - Funds the innovation ecosystem development	**R&I Infrastructure:** If in line with the relevant smart specialisation strategy, ERDF may pay for: - The construction and upgrade of research infrastructures (this may include some training "on the job" to correctly use new infrastructures and equipment) - The construction and upgrade of innovation infrastructures (pilot lines, living labs, demonstrators, tech transfer offices) **Human capital development:** - Funds the purchase of equipment and infrastructures needed for human capital development, if relevant for the implementation of the smart specialisation priorities. **Networking and policy-making:** - Supports the development and improvement of national & regional innovation eco-systems including business-industry-citizens-public support bodies' cooperation, innovation governance, capacity-building and the cooperation with other regions & Member-States for mutual learning & joint investment pipelines - Invests in networking with other countries & regions bringing together the policy-makers & funding agencies/authorities/stakeholders on the ground - Invests in better innovation policy-making for industrial modernization (Smart Specialisation) - Invests in better innovation governance (entrepreneurial discovery process)

The Regional Development Funds aim at strengthening the EU's economic, social and territorial cohesion. They have a prominent role in developing, improving and connecting national and regional innovation ecosystems, and are expected to continue to dedicate important amounts in the post-2020 period to research and innovation ecosystem investments, i.e. in research or innovation infrastructures, SME innovation capacities, networking, innovation support services and human capital. Support to innovation is provided through smart specialisation strategies which prioritise public research and innovation investments through a bottom-up approach for the economic transformation of regions, developing innovation ecosystems, building on regional competitive advantages and facilitating market opportunities in new inter-regional and European value chains. Smart specialisation provides a strategic framework to support 'upstream actions' to prepare stakeholders to participate in the Framework Programme, and 'downstream actions' to exploit and diffuse research and innovation results, developed under the Framework Programme.

Horizon Europe will continue to support and build capacity of low-performing countries in research and innovation, in the context of strengthening the European Research Area and reforms to the research and innovation systems. The complementarity between the Framework Programme's support and ERDF support to the national and regional innovation systems will be ensured. For instance, the Teaming mechanism will still require compliance with the relevant Smart Specialisation strategy.

The scaling-up and transferability of projects and the communication and sharing of practices constitute two key areas of improvement for the future. Establishing a more structured cooperation across the Commission would pool efforts and streamline various initiatives. In this regard, transnational cooperation activities and innovative national actions will be further supported with a view to promote social innovation in the implementation of the European Pillar of Social Rights.

Arrangements for synergies between Horizon Europe and ERDF or ESF or national contributions for similar type of projects will be further enhanced benefiting from more conductive rules. Legal provisions allowing cumulative funding of grants from the Framework Programme and ERDF/ESF for the same action (provided that there is no double funding) will be kept allowing a pro rata basis approach. Programme co-fund actions will be designed to facilitate such funding synergies and simplified rules. Similarly, funding of Seal of Excellence awards from national ERDF or ESF allocations will be simplified and facilitated. Moreover, the take-up in Horizon Europe of simplified cost options for reimbursing expenditure (lump sums, flat rates, unit costs) will further facilitate the combination of funds. To accomplish the enhanced synergies and simplification mentioned above, all relevant rules and regulations will be revised accordingly in time for Horizon Europe, provided certain conditions are fulfilled.

High-quality-but-unfunded proposals under the Framework Programme (Seals of Excellence awarded under SME actions or the Marie Skłodowska-Curie Actions, MSCA) will be able to benefit from the same co-funding rates elsewhere, including under regional funding schemes. For example, this means that ERDF or ESF allocations can be used to support Seal of Excellence projects, where relevant to the local context and smart specialisation strategy.

Portfolios of R&I results and innovations attained by projects funded under the Framework Programme that correspond to existing national or regional needs will be made available to national or regional ERDF and ESF managing authorities in a consistent and organised manner. The role of advisory services and their access to available innovations, knowledge and results stemming from the Framework Programme will be given particular attention. More specifically, the ERDF may feature increased funds dedicated to the take-up of results and the rolling out of novel technologies and innovative solutions from past Framework Programmes and Horizon Europe.

Box 1 Concrete examples of how synergies with ERDF and ESF could look like in practice

- Horizon Europe projects can be implemented using the equipment and research infrastructures previously funded from the ERDF.
- SME who have received a Seal of Excellence (SoE) can apply for alternative funding under conditions to be further defined under relevant rules and regulations, including GBER with regard to State-aid compatibility. That allows for reducing administrative burden and costs on the SME and funding body side.
- Researchers who received the MSCA SoE under the Framework Programme can be supported through alternative sources of funding at regional or national level, including through use of ESF. This allows countries/institutions to identify and employ excellent researchers, while removing/reducing the need to carry out a new evaluation of the proposals.

4 Synergies with the European Social Fund (ESF+)

Table 6 European Social Fund + - Research and innovation related support

Sectors/Domains: - Not sector-specific **Target beneficiaries:** - No groups are excluded **Geographic coverage:** - EU	**R&I activities/projects** - Future ESF to continue promoting social innovation (i.e. policy testing and experimentation in the social & employment policy fields)
Support to entrepreneurship & SME growth: - ESF programme: - access to finance (microcredit and microloans)for vulnerable groups and micro-enterprises; continued support for youth, social entrepreneurship	**R&I Infrastructure:** - Complements other EU instruments for investments in R&I infrastructure **Human capital development:** - Aims to improve the quality, efficiency and openness of (tertiary) education e.g. developing new teaching methods, delivering high quality educational content, which is relevant to labour market needs - Stimulates partnerships between higher education, business and research organisations - Aims to strengthen human capital in R&I, e.g. through training and capacity building for researchers (e.g. complementarities and synergies with MSCA Seal of Excellence and MSCA co-funded doctoral and postdoctoral research training programmes) and for teachers; opening tertiary education access to disadvantaged groups - Can mainstream curricula oriented towards equipping students with the skills needed in the future labour market developed under the Framework Programme. **Networking and policy making:** - ESF support for reforms of education systems, curricula

The European Social Fund (ESF) is instrumental in supporting continuous investments in skills which are key for harnessing technological development. Skills are a crucial element for developing environments conducive to innovation, including in the European Research Area. The ESF+ will mainstream and scale up Framework Programme-funded innovative curricula that will equip people with the skills and competencies needed for the jobs of the future (based on forecasting of future professions).

Across the EU funds, the ESF represents the major bulk of funding for social transformation mainstreaming social innovation in the economy and reinforcing human capital, including for research and innovation.

The deployment and support of ESF to Framework Programme-funded skills and competencies curricula can take several approaches (i.e. integration of Framework Programme-funded curricula in national or regional programmes; transnational cooperation networks on skills). This will translate for example through synergies and complementarities between ESF and the Framework Programme-MSCA co-funded doctoral and postdoctoral research training programmes. MSCA proposals with the Seal of Excellence may be funded by the ESF+ to support activities promoting

human capital development in research and innovation and to attract talents, in aiming to strengthen the European Research Area.

Box 2 Concrete examples of how synergies with ESF could look like in practice

- Framework Programme-MSCA researchers can use previously ERDF funded equipment and infrastructures for the trainings and ESF can financially support innovative training activities as well as other capacity-building measures (e.g. networking activities, mobility allowance).

5 Synergies with the EU programmes for agricultural and maritime policy

Table 7 European Agricultural Guarantee Fund; European Agricultural Fund for Rural Development; European Maritime & Fisheries Fund - Research and innovation related support

Sectors/Domains: - Agriculture **Target beneficiaries:** - Farmers - Policy makers - Bio-industries - SMEs **Geographical coverage:** - EU	**R&I activities/projects:** - Support to R&I in Member States' CAP Strategic Plans - Knowledge exchange and innovation actrivities within Agricultural Knowledge and Innovation System (AKIS) - Innovation projects (operational groups) with EIP-AGRI (European Innovation Partnership) - Bottom-up innovation projects (operational groups) **Market uptake:** - Investments projects - EIP-AGRI
Human capital development: - AKIS (European Agricultural Knowledge and Information Systems) /EIP-AGRI - Conditionality in coming CAP plans **Networking and policy making:** - CAP network - European Innovation Partnership network	

Research and innovation are set to play a stronger role in the future agricultural and maritime policy as part of a key priority to foster innovation, in particular through the wider diffusion of innovation and better access to new technologies and investment support.

Through the Framework Programme's strategic planning processes, coherent approaches with these policies will be ensured. In particular they will work in tandem to promote Food and Nutrition Security and the Sustainable Management of Natural Resources as a strong component under the Framework Programme and the modernised CAP. This commitment is reflected in developing an ambitious, integrated Strategic Research and Innovation Agenda (building on the Strategic Approach to EU Agricultural R&I, Food 2030, and the Bioeconomy Strategy) as an important input into the shaping of Horizon Europe and for serving the evolving innovation needs of the CAP.

The development of the Strategic Research and Innovation Agenda Plan will inform priorities of the Framework Programme in the area of food and natural resources whereas the uptake of research and innovation results into a modernised CAP will be promoted. This will build on the work undertaken to date through the European Innovation Partnership on Agricultural Productivity and Sustainability (EIP-AGRI)[105] in mobilising the agricultural sector for innovation, funding multi-actor pilot projects and making new knowledge available. The ambition is to bring about systemic knowledge generation and CAP support that is generated upstream, thus leading to the downstream uptake and deployment of innovations by end users within projects. This will enable the CAP to make best use

[105] For example through a dedicated budget under CAP, programmed to be implemented under the Framework Programme

of research and innovation results and to promote the use, implementation and deployment of innovative solutions, including those stemming from projects funded by the Framework Programmes and from the European Innovation Partnership.

Box 3 Concrete example of how synergies could look like in practice

The implementation phase will ensure greater uptake of Framework Programme results in CAP programmes, e.g. by:

- Reinforcing the role of Agricultural Knowledge and Innovation systems (AKIS) in Member States and improve the connections between national AKIS at various levels (regional, national, EU levels). The role of advisory services and their access to research outcomes will be given particular attention.
- Increasing the impact of CAP instruments to foster demonstration, investments or new business models in farming and rural areas. Examples provided under CAP instruments could address innovations in digitisation, precision farming and the bioeconomy.

6 Synergies with the Single Market Programme

Table 7 Single Market Programme - Research and innovation related support

Sectors/Domains: - SMEs across sectors - Focus on SME in strategic value chains **Target beneficiaries:** - SME intermediaries - Cluster organisations - Technology clusters - Specialised SME support actors **Geographical coverage:** - EU	**Market uptake:** - Support SME's uptake of innovation through Joint Cluster Initiatives & Scaling-up Instrument - Facilitates SME's access to markets, including through public procurement
Support to entrepreneurship & SME growth: - Upgraded Enterprise Europe Network: specialised business advisory services, e.g. scale-up advice for entrepreneurs with a proven business model - Erasmus for Young Entrepreneurs: mentoring; initial business matchmaking - New Scaling-up Instrument: For SMEs & strategic value chains channelled by Joint Cluster Initiatives; supports SME scale-up across regional, sectoral & technological boundaries to access global industrial value chains - Delimitation New Scaling-up Instrument/ EIC accelerator: focus on growth drivers beyond innovation (e.g. internationalisation, skills); specialised mainstream SMEs (#only breakthrough innovators in EIC) **Support to clusters, hubs and broader innovation ecosystem:** - Joint Cluster Initiatives: foster strategic interregional collaboration among specialised clusters and eco-systems to strengthen EU value chains (10-20 major EU value chains)	**Human capital development:** - Integrated business support, incl. skills development and mentoring in "Erasmus for young entrepreneurs" **Networking and policy-making:** - Strategic Cluster Initiatives: strategically connect ecosystems and clusters - Enterprise Europe Network (innovation ecosystem integrator & corporate tool) - SME Panels and SME Feedback tools for policy making through the EEN

The Single Market Programme - which integrates the COSME programme - addresses the market failures, which affect mainstream SMEs, and will promote entrepreneurship and the creation and growth of companies. Thus it will focus on generating growth opportunities for mainstream enterprises. Under Horizon Europe, the European Innovation Council will support, in a complementary way, the scale-up of innovative start-ups, SMEs and mid-cap firms with market-creating innovation potential; in particular where the market does not provide viable financing.

Horizon Europe will remain the one-stop-shop for EU innovation policy support, as well as measures stimulating innovation uptake that are already embedded in dissemination and exploitation strategies of actions supported under Horizon 2020. Full complementarity will be ensured between the COSME scaling-up instrument for mainstream companies deployed through InvestEU and the actions of the future European Innovation Council for innovative companies, as well as in the area of support services for SMEs, in particular where the market does not provide viable financing.

For the dissemination of both future programmes (Horizon Europe and the Single Market Programme) the Enterprise Europe Network (EEN) may play, as other existing SME support structures, a complementary role to dedicated support structures put in place for the Horizon Europe, such as National Contact Points (NCPs). The future mandate of Enterprise Europe Network and the Horizon Europe support structures (e.g. NCPs, Innovation Agencies) will be defined to avoid duplication, with the aim of maximising benefits to SMEs.

The skills and knowledge available in existing networks including EEN may be used for enhanced existing services, like for example coaching activities under the EIC beneficiaries. These include investment readiness development, linking with private investors, business partners and customers through brokerage activities and events including trade fairs. The networks may also be used for the testing of new initiatives with regards to support delivery to SMEs via specific actions.

7 Synergies with the InvestEU Fund

Table 8 InvestEU Fund - Research and innovation related support

The InvestEU Fund will integrate current EU-level financial instruments and budgetary guarantees under a single mechanism and in particular deploy indirect financial instruments provided for under Horizon Europe and other EU programmes. **Sectors/Domains:** - R&I Window - SME Window including innovative companies - Sustainable infrastructure window - Social, skills and human capital window **Target beneficiaries**: - Financially viable projects or commercial entities facing market gaps or sub-optimal investment situations **Geographical coverage:** - EU	**R&I activities/projects** - The R&I window and products for innovative companies developed under the SME Window, will provide a range of debt and equity financing products in line with the variety of potential final beneficiaries at different development stages and in different EU policy areas. **Market uptake:** - The R&I window will support high-risk investments in R&I and new technologies, including in large-scale first-of-a-kind demonstrations for which market investor interest may be low. - The R&I window will de-risk investments in innovative technologies and, together with the SME window, transfer established solutions to new markets. - Products for innovative companies developed under the SME Window will boost SME investment capacity.
Support to entrepreneurship & SME growth: - The SME window will improve access to finance by supporting SME financing, including and in particular for innovative companies. It will further support start-ups and companies commercialising R&I results. - The R&I window and SME Window will provide a range of financing products to support growth of companies, including and in particular innovative ones. - The Social, skills and human capital window will promote inclusive entrepreneurship, improve access to employment (including self-employment), job creation, labour market integration, social inclusion by increasing the availability of and access to micro-finance[106], and access to finance for social enterprises.	**R&I Infrastructure:** - The R&I Window will facilitate access to finance through debt and equity instruments to research infrastructures. It would support in particular those that are financially viable and investment ready. **Human capital development:** - Social and human capital window: support to investment in all levels of education and (necessary for building a knowledge-based society), support to increase vocational training and lifelong learning, including non-formal learning investment in human capital. **Networking and policy making:** - The InvestEU Fund will provide project development assistance to support the development of a robust pipeline of investment projects. It could also be used to facilitate blending opportunities with grants schemes.

Financial instruments for research and innovation and innovative companies, including SMEs, supported under Horizon Europe or other EU programmes will be deployed through InvestEU. InvestEU will feature a dedicated R&I window as well as a dedicated SME window that will also

[106] With specific regard to vulnerable groups including refugees micro-enterprises and young adults.

target innovative companies, possibly through a sub-window. Investment efforts under InvestEU will complement investment and support efforts under Horizon Europe (including by supporting high-risk investments in research and innovation and new technologies) in a manner that does not crowd out private investments.

Additionally, Horizon Europe will provide blended finance for innovators in a way that is distinct from indirect financial instruments under InvestEU, in case of a very high level of risk where no intervention from InvestEU would be possible (yet). Blended finance shall be implemented in tandem with financial intermediaries supported by InvestEU, in order to ensure investment continuity where appropriate and necessary.

Box 4 Concrete example of how synergies could look like in practice

A radically innovative SME with scale-up potential that is supported under the **Accelerator scheme** of **Horizon Europe's European Innovation Council** and hence is benefiting from a mix of finance and other types of support in order to deliver on a particular innovation – which implies that the latter becomes fully market-mature and investment-ready – can be introduced to the different schemes under the **SME window of InvestEU**, in order to allow it to find additional finance – where appropriate and necessary – in view of supporting further company development and scale-up. The idea is that the Accelerator will de-risk the innovation project driven by the SME to a point that it becomes an attractive investment target for financial intermediaries implementing SME products under InvestEU.

8 Synergies with the Connecting Europe Facility

Table 9 Connecting Europe Facility – Research and innovation related support

Sectors/Domains: - Energy - Transport - Digital **Target beneficiaries:** - Public authorities - Industry: infrastructure building/ manufacturing, Infrastructure managers, transport operators - Consultants for studies **Geographical coverage:** CEF-transport divided into 2 'envelopes': - General envelope: for all Member States - Cohesion Fund envelope: for Cohesion Member States	**R&I related activities/projects:** - Transport, energy, telecom: Support to deployment of new technologies & innovation, as per TEN-T guidelines Art.33 - Real-life pilots (studies/works) - Deployment of existing innovations **Market uptake:** - CEF supports pilots, prototypes for certain technologies developed under the Framework Programme or relevant for transport infrastructure - CEF funds transnational infrastructures to strengthen Energy Union and accelerate energy transition: research and innovation state-of-the-art should be considered in CEF (particularly regarding digital applications, electric charging and alternative fuels). - CEF transport supports the development of the SESAR Joint Undertaking solutions through the SESAR deployment managers: technology deployment;
Support to entrepreneurship & SME growth: - Grants and public procurement	**R&I Infrastructure:** - Not R&I infrastructures but efficient and interconnected networks + main infrastructure components - Smart infrastructure for sustainable mobility (digital, alternative fuels, multimodality, innovation) - Safer, secure, resilient and accessible infrastructure (i.e. climate resilience) **Networking and policy making:** - Support to policy making: alternative fuels, ITS, Urban, etc. policies

The future CEF will prioritise the large-scale roll-out and deployment of existing and proven/demonstrated innovative new technologies and solutions which result from Framework Programmes in transport, energy and mobility, in particular through the Climate, Energy and Mobility cluster as well as digital technologies. Research and innovation needs in the areas of transport, energy and the digital sector within the EU will be identified and established during the Horizon Europe strategic planning process.

Strategic synergies will be pursued through making the two programmes' contributions to EU policy more explicit and clearer, while deployment of state-of-the-art technology will be pushed within targeted areas – for example electro-mobility[107]. The exchange of information and data between the Framework Programme and CEF projects will be facilitated in particular by highlighting technologies arising from Framework Programme projects with a high market readiness that could be deployed through CEF.

The blending of funds and instruments for common objectives, for example public procurement, will be explored. In view of the investment challenges in the three CEF focus areas, and the transformational character of most of the CEF projects, public procurement for innovation could be used to facilitate and de-risk the take-up of such technologies in the networks sector. This could also enable system operators to invest substantially higher volumes than they (both through their balance sheets and their regulated asset bases) are used to.

Box 5 Concrete example of how synergies could look like in practice

Research and development on low-emission vehicles will be supported by the Framework Programme, while re-charging infrastructure / alternative re-fuelling stations will be deployed under CEF.

9 Synergies with the Digital Europe Programme

Table 10 Digital Europe Programme - Research and innovation related support

Sectors/Domains: Digital technologies for : - High Performance Computing (HPC) - Cybersecurity - Artificial Intelligence - Advanced digital skills - Areas of public interest and industry **Target beneficiaries:** - Public authorities and administrations - Industry including SMEs **Geographical coverage:** - EU wide	**Market uptake:** - Support to transformation of areas of public interest and industry - Wide deployment of digital technologies - Large-scale deployment projects making best use of digital capacities and latest technologies such as High Performance Computing and Artificial Intelligence in areas of public interest
Support to entrepreneurship & SME growth: - Through Digital innovation hubs and networking of competence centres **Support to clusters, hubs and broader innovation ecosystem:** - Support to Digital Innovation Hubs and networking of digital facilities	**R&I Infrastructure:** - Co-investment in digital capacities (through joint procurement) - Promotion of interoperability and standardisation **Human capital development:** - Support to advanced digital skills in HPC and Big Data, Cybersecurity and Artificial Intelligence

The Digital Europe initiative is a new initiative dedicated to enlarging and maximising the benefits of digital transformation to all European citizens and businesses. Both Horizon Europe and the Digital Europe Programme (DEP) will provide public support in the field of digital technologies. Under Horizon Europe, a dedicated budget will be allocated to a cluster "Digital and industry". In

[107] See p.43-44 of the Connecting Europe Facility Mid-Term Evaluation Staff Working Document (SWD 2018 44 final) for details on the coherence and complementarity with Horizon 2020. For example: "With its deep research and development shape, Horizon 2020 can be seen as an instrument for providing financial support to studies, assessments and preliminary tests and pilot projects, which can be then tested and deployed in the framework of CEF".

addition, digital technologies will, because of their cross-cutting nature, also be developed in a wide range of other (thematic) parts of the programme.

While several thematic areas addressed by Horizon Europe and Digital Europe coincide (e.g. both will cover High Performance Computing, Artificial Intelligence, Cybersecurity), the type of actions to be supported, their expected outputs and their intervention logic are different and complementary. Digital Europe will focus on large-scale digital capacity and infrastructure building. These capacities and infrastructures will support the wide uptake and deployment across Europe of critical existing or tested innovative digital solutions. This will mainly be implemented through coordinated and strategic investments with Member States, notably through joint public procurement, in digital capacities to be shared across Europe and in EU-wide actions that support interoperability and standardisation as part of developing a Digital Single Market.

Research and innovation needs related to digital aspects will be identified and established as part of the strategic planning process of Horizon Europe; this includes research and innovation for High Performance Computing, Artificial Intelligence, Cybersecurity, combining digital with other enabling technologies and non-technological innovations; support for the scale-up of companies introducing breakthrough innovations, including based on digital technologies; the integration of digital across all the Global Challenges pillar; and the support to e-Infrastructures.

Digital Europe capacities and infrastructures will be made available to the research and innovation community, including for activities supported through Horizon Europe including testing, experimentation and demonstration across all sectors and disciplines. As the development of novel digital technologies matures through Horizon Europe, these will progressively be taken up and deployed by Digital Europe. Horizon Europe initiatives for the development of skills and competencies curricula, including those delivered at the co-location centres of the European Institute of Innovation and Technology's Digital KIC (EIT Digital), are complemented by Digital Europe-supported capacity-building in advanced digital skills.

To ensure strong coordination mechanisms for programming and implementation the strategic programming and operating procedures for both programmes are aligned, inter alia using the services provided by the Horizon Europe Common Support Centre. Their governance structures involve the respective Commission services as well as others concerned by the different parts of the respective programmes.

Figure 15 Complementarities between Horizon Europe and Digital Europe at the strategic level

Horizon Europe	Digital Europe
Development of technological and non-technological solutions, including digital content	Large scale deployment of digital capacity and existing digital technologies in areas of public interest or market failure
Research, technological development, demonstration, piloting, proof-of-concept, testing and innovation including precommercial deployment	Capacity and infrastructure building on HPC, AI, Cybersecurity and advanced digital skills
Research and innovation on digital technologies	Making the best use of digital capacities in areas such as health, public administration, justice and education
Selection through EU level competition and support for cross-border collaboration	Large-scale deployment of digital capacities, infrastructures and solutions within Member States as part of an overall EU strategy or policy

Horizon Europe	Digital Europe
EU-level calls for proposals: grants, public procurement, financial instruments and budgetary guarantees (*).	An important part will be strategic co-investment with Member States through public procurement. Funding also to be provided through procurement grants, financial instruments and budgetary guarantees(*).
Networking at EU level of research & innovation actors	Promotion of interoperability of digitised public services
Support to cross-border access to and integration of research infrastructures	Construction, maintenance, upgrade and use of digital capacities and infrastructures in computing, AI and cybersecurity.
Development of skills and competencies curricula	Support for capacity building on advanced digital skills
Supporting EU-wide research databases	Building of shared digital capacities including "common data spaces" of public sector data and other publicly available data

(*) To be implemented under the InvestEU Fund.

Complementarities in specific thematic priorities Digital Europe / Horizon Europe

High Performance Computing (HPC)

=> **Digital Europe** will focus on co-investment (through joint procurement with Member States) in the latest supercomputers, the networking of supercomputing facilities and the use of these in areas of public interest, e.g. health, public administration, climate, etc. Supercomputing capacity will be also available to the scientific community and industry, notably SMEs. The budget will be used: (i) to procure together with Member States two top-range exascale super computers by 2022-23; (ii) to provide an EU coordinated framework for MS wishing to upgrade and share their mid-range supercomputing facilities across Europe; (iii) to facilitate the networking and use of the supercomputing facilities.

=> **Horizon Europe** will support research and innovation underpinned by HPC infrastructures and facilities, including testing, experimentation and demonstration across all sectors and disciplines. On HPC specifically, Horizon Europe funding will cover research and innovation for next generation computing paradigms, architectures and programming environments, like cognitive computing, neuromorphic systems, multi-purpose quantum computing and codes for post-exascale performance. It will explore features like extreme low-power and large-scale distributed data processing.

Cybersecurity

=> The DEP will focus on:

- Investments in **advanced cybersecurity equipment** and infrastructures that are essential to protect critical infrastructures and the DSM at large. This could include investments in quantum facilities for cybersecurity (e.g. Quantum key distribution and facilities for post quantum cryptography) and other tools to be made available to public and private sector across Europe.
- **Scaling up existing technological capacities in the Competence Centres** in Member States and **ensuring wide deployment of the latest cybersecurity solutions** across the economy;
- **Networking of Cybersecurity Competence Centres in the Member States** with leading technology capacity able to support the digital economy. This should also include aligning and enhancing cybersecurity skills;

=> **Horizon Europe** will provide support for research and innovation underpinned by cybersecurity infrastructures and facilities, including testing, experimentation and demonstration across all sectors and disciplines impacted by cybersecurity. In addition Horizon Europe will support research and innovation on cyber-secure components and software relevant for areas such as protection of infrastructure or privacy and data protection. These novel approaches include, e.g. new paradigms for safety- and security-by-design, for cryptography, for self-healing systems and for cyberattack monitoring and rebuttal.

Artificial Intelligence (AI)

=> **Digital Europe** will focus on common capacity building to ensure the wide deployment of AI in Europe including, e.g. (i) the provision of an "AI on demand" based on open source software, algorithms, tools and equipment, and on a "common data space" containing public sector data and other publicly available data. The platform will be made available widely across Europe (notably through the Digital Innovation Hubs, see below) to actors in all sectors; (ii) the set up and reinforcement of the network of Digital Innovation Hubs to cover all regions in Europe with AI expertise and facilities. Support will go both, to the reinforcement of existing competence centres (at the core of the Digital Innovation Hubs) and to building up of new ones where needed.

=> **Horizon Europe** will support for research and innovation underpinned by AI infrastructures and facilities, including testing, experimentation and demonstration across all sectors and disciplines that are influenced by Artificial Intelligence. Horizon Europe will also support research and innovation in advanced AI technologies including explainable AI, unsupervised machine learning and data efficiency. Horizon Europe will support the networking and EU-wide access to specialised innovation hubs and innovation infrastructures for research and innovation performing activities.

Digitisation of areas of public interest and of industry

=> **Digital Europe** will support the Europe-wide transformation of areas of public interest and of industry. This will be done through co-investment with Member States and, where relevant, the private sector in leadership deployment projects making the best use of digital capacities and latest digital technologies in areas of public interest or market failure. The added value of Digital Europe will be in ensuring interoperability of solutions, suitable regulatory frameworks and standards across the EU, as well as higher impact through EU-wide actions avoiding digital divide and fragmentation, and with significant economies of scale. An important component of Digital Europe will be the access to and availability of advanced digital skills. This action will complement the training activities performed in the KIC-Digital of the EIT under Horizon Europe.

=> Under **Horizon Europe** a dedicated budget will be allocated to support research and innovation dedicated to “digital and industry” and digital aspects will be behind almost every research, including health, transport, environment, energy, etc.

10 Synergies with the Programme for Environment & Climate Action (LIFE)

Table 11 LIFE - Research and innovation related support

Sectors/Domains:	**Market uptake:**
- Better integration of environmental legislation: Natura 2000 areas	- ”Standard action projects” best-practice or demonstration projects (public, private, university) for new measures or approaches at Member

- Waste, water, air pollution plans - Projects with direct environmental impact - Climate mitigation measures - Climate adaptation measures **Target beneficiaries:** - Cities, NGO, administrations, entreprises **Geographical coverage:** - EU	State/regional level with significant environmental or climate impact - "Strategic integrated projects' mobilising and ensuring the effective contribution of other EU, national/regional/private funds to the implementation of key measures as per the environmental and climate plans (e.g. river basin management plans, clean air plans, adaptation strategies or climate and energy plans) - Not directly supporting PCP/PPI but regions could use the Strategic Integrated projects to that end - Capacity building, policy implementation and support for large-scale deployment of innovative solutions for clean energy transition (energy efficiency, renewable energy)
Support to entrepreneurship & SME growth: - Financial instruments as part of Invest EU	**Networking and policy making:** - Not addressing R&I actors but enterprises, cities, NGO, administrations

The future LIFE programme will continue to act as a catalyst for implementing EU environment, climate and energy policy and legislation, including by taking up and applying research and innovation results from the Framework Programme. The future LIFE programme will, firstly, strengthen its role as a catalyst for the implementation of EU legislation and policies, for instance through strategic integrated projects. Secondly, its complementarity with other EU programmes will be reinforced where the market does not provide viable financing.

LIFE synergies with Horizon Europe will ensure that research and innovation needs to tackle environmental, climate and energy challenges within the EU are identified and established during Horizon Europe's strategic research and innovation planning process. LIFE will continue to act as a catalyst for implementing EU environment, climate and energy policy and legislation, including by taking up and applying research and innovation results from Horizon Europe and help deploying them at national and (inter-)regional scale where it can help address environmental, climate or clean energy transition issues. They can subsequently be deployed at large scale, funded by other sources, including Horizon Europe. In particular LIFE will continue to incentivise synergies with Horizon Europe through the award of a bonus during the evaluation for proposals which feature the uptake of results from Horizon Europe. Horizon Europe's European Innovation Council can provide support to scale up and commercialise new breakthrough ideas that may result from the implementation of LIFE projects.

Through strategic programming there is also potential for LIFE to highlight the areas where it sees a research and innovation need. LIFE will continue to incentivise synergies with the Framework Programme through the award of a bonus during the evaluation for proposals that feature the uptake of Framework Programme results.

The integration of Clean Energy Transition sub-programme in LIFE will continue the actions funded under Intelligent Energy Europe III/Horizon 2020-Societal Challenge III. It will focus on capacity building and policy support activities, while the Framework Programme will continue focusing on technology and non-technology related research and innovation for clean energy transition.

LIFE projects will also find further ways to gain support in helping them scale up and commercialise their ideas. This will occur via channelling relevant successful LIFE projects into the European Innovation Council mechanism. This would be relevant for those innovators having benefitted from the LIFE programme for their projects having demonstrated direct environmental impact at the regional or national scale, which also have a high growth potential and ambition to

accelerate the transition to a low-carbon, energy efficient and circular economy through sustainable innovation.

11 Synergies with Erasmus

Table 12 Erasmus - Research and innovation related support

Sectors/Domains: - Education, Training, Youth /Higher Education, Vocational Education and Training, Adult Learning **Target beneficiaries:** - Students (researchers and young entrepreneurs) - Teachers, Researchers and other Higher Education Staff - Higher Education Institutions - Policy Makers & Higher Education stakeholders **Geographical coverage:** EU and international	**R&I activities/projects** - European Universities initiative: o support the development of 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; o foster the emergence of multidisciplinary and multilingual environments where students, lecturers, researchers and other public and private actors co-create and co-share knowledge and innovation, working together to address global societal challenges (for example: they could focus on SDGs or priorities of the Framework Programme). - Further roll out of Higher Education for Smart Specialisation to advice public authorities to involve higher education institutions and to align their educational offer to the needs identified in smart specialisation strategies **Market uptake:** - Strategic Partnerships and Knowledge Alliances for the small-scale testing of research outcomes
Support to entrepreneurship & SME growth: - Support for Innovation Partnerships through Knowledge Alliances - Expanded use of HEInnnovate tool in making innovation and entrepreneurship a core part of overall institutional strategy - Step-up support for University-Business Cooperation and Establishment of regional and national University-Business fora	**R&I Infrastructure:** - Create a Europe-wide platform for digital higher education **Human capital development:** - European Universities initiative – educating students and researchers to be critical and reflective thinkers with solution-oriented analytical skills and ethical and intercultural awareness - Erasmus research internships and Strategic Partnerships will encourage undergraduates and Masters students to be involved in research projects and develop their research and critical thinking skills **Networking and policy making:** - Ensure dissemination of results from Policy Experimentation projects to common stakeholders and explore synergies between Erasmus-supported Peer Learning and Peer Counselling on funding of higher education and Research and Innovation supported Peer Review

Europe's high-level skills needs are addressed by both Horizon Europe and Erasmus through investments in the development of competences, inter-disciplinary, transferable and entrepreneurial skills in forward-looking fields or disciplines that are strategic for smart economic and social development (such as science, technology, engineering and mathematics, climate change, clean energy, artificial intelligence, robotics, data analysis, design, etc.). More specifically, Erasmus will continue to support mobility, cooperation and policy initiatives in the field of higher education, whereas Horizon Europe continues supporting the improvement of skills within funded projects and provides incentives for universities embracing open science.

Both programmes foster the integration of education and research through facilitating higher education institutions to formulate and set up common education, research and innovation strategies, to inform teaching with the latest findings and practices of research to offer active research experience to all students and higher education staff and in particular researchers, and to support other activities that integrate higher education, research and innovation.

Horizon Europe will complement the Erasmus programme's support for the European Universities initiative, in particular its research dimension, 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. This will provide impetus to economic growth.

At the level of postgraduate training, the Marie Skłodowska-Curie Actions (MSCA) under Horizon Europe will further strengthen the provision of transferable skills for researchers, including by transferring research results into teaching. The participation to MSCA projects' activities, in particular network-wide training, where relevant, of Erasmus students or staff and vice versa, will concretise synergies between research and education programmes.

Erasmus European Universities, Strategic Partnerships, Knowledge Alliances or Erasmus Mundus Joint Masters Degrees will support forward-looking skills and new curricula aligned with the objectives of the future EIT KICs and Horizon Europe' Missions to create specific synergies. Encouraging undergraduates and Masters students to be involved in research and innovation projects and develop their research and critical thinking skills will continue to be a higher education priority supported through research internships and Strategic Partnerships under the future Erasmus programme.

The European Universities initiative will be a catalyst for human capital development, education, research and innovation activities and projects. The alliances will seek to address the big societal challenges and skills shortages that Europe faces, underpinned by higher education institutions which can seamlessly cooperate across borders. This will progressively increase the international competitiveness of European higher education institutions by:

- fostering development of 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;
- driving educational and research innovation by making use of the most innovative teaching methods and digital technologies;
- creating new joint curricula based on forward looking skills and multidisciplinary approaches;
- attracting the best students, teachers and researchers across the world and acting as role models and mentors for other higher education institutions throughout Europe;
- fostering opportunities for students, teachers, researchers and other public and private actors to co-create knowledge and innovation together (e.g. working together to address global societal challenges, Sustainable Development Goals or priorities identified by the Framework Programme).

Box 6 Concrete example of how synergies could look like in practice

The Erasmus students could take part in the EIT/KICs courses and vice versa where the Erasmus activities will be easier to access for the beneficiaries of the Framework Programme.

12 Synergies with the Neighbourhood, Development and International Cooperation Instrument

Table 13 EU Neighbourhood, Development and International Cooperation Instrument - Research and innovation related support

Sectors/Domains:	Market uptake:

- Cross-cutting sectorial role covering all pillars of the Framework Programme (sustainable agriculture, food & nutrition security, natural resources & environment, migration, socio-economic development) - 2030 Agenda – Sustainable Development Goals - Commitments under the Paris Agreement (2015) Target beneficiaries: - Public authorities - Civil society - Beneficiaries in procurement contracts Geographic coverage: - Geographic pillar of the External Instrument covering the Neighbourhood, Sub-Saharan Africa, Americas, Asia and Pacific and European non-EU member states, corresponds to global reach of the Framework Programme …	- Infrastructure projects - Investment projects
Support to clusters, hubs and broader innovation ecosystem: - Socio-economic development programmes including access to finance, capacity building and entrepreneurship programmes. - Support to clusters, hubs and broader innovation ecosystem: Development of technology roadmaps	**R&I Infrastructure:** - Laboratory and research facility benchmarking and development **Human capital development:** - Capacity building for researchers as well as - Education - Researcher/expert mobility **Networking and policy making:** - EU representation in international for a and organisations including at regtional level (e.g. the Union for the Mediterranean)

The Neighbourhood, Development and International Cooperation Instrument groups together several existing external instruments[108] under the current MFF in addition to the European Development Fund, which is brought under the EU budget. This new design will address at least in part some of the present fragmentation in external instruments and favour complementarities and synergies, particularly at implementation stage, between detailed external programmes and the Horizon Europe. Synergies will ensure that Horizon Europe activities with the participation of Third Countries and targeted international cooperation actions seek alignment and coherence with parallel market uptake and capacity-building actions under the Instrument.

There are inherent complementarities between Horizon Europe and the Neighbourhood, Development and International Cooperation Instrument, for example in so far as they both contribute towards the EU's international commitments such as the 2030 Agenda for Sustainable Development[109], the Paris Agreement on Climate Change[110], or the renewed EU-Africa Partnership[111] among others.

The overall objectives of the Neighbourhood, Development and International Cooperation Instrument will focus on supporting sustainable economic, social and environmental development, reducing global poverty, maintaining a special relationship with neighbourhood countries and addressing global challenges.

Targeted international cooperation actions will be mainly implemented through the Framework Programme's call topics dedicated to international cooperation. This will pursue the trend of the final years in Horizon 2020 flagship initiatives as a means to lever international cooperation. In addition European Partnerships are also expected to play an important role in structuring cooperation with Third Countries. These comprise both co-programming and co-funding activities. Where relevant, the Framework Programme's partnerships with the participation of Third Countries

[108] Notably including the EDF, DCI; ENI; PI; EIDHR; IcSP; INSC and the CIR. Financial instrument include the European Fund for Sustainable Development (EFSD) and the European Investment Bank's (EIB) external lending mandate (ELM)
[109] See https://sustainabledevelopment.un.org/post2015/transformingourworld
[110] See http://unfccc.int/paris_agreement/items/9485.php
[111] See https://www.africa-eu-partnership.org/en

should seek alignment and coherence with parallel capacity building strands within the Instrument, based on common defined priorities.

Box 7 Concrete example of how synergies could look like in practice

- The Neighbourhood, Development and International Cooperation Instrument develops research capability and supports the role of academia and evidence-based policy making in third countries. Capacity building takes place at individual level, for example through brain circulation and training; at organisational level (laboratories, building research departments) and institutional (by developing good governance, regulatory environments and incentive schemes).
- The EU-African Union partnership will develop a joint research and innovation programme on renewable energy to adapt renewable energy technologies to the African environment, social and economic conditions through joint research efforts. Subsequently market take-up and scaling of technologies and solutions developed could be undertaken by the External Instrument in African markets.
- As part of the external dimension of internal EU policies, opening trade and cooperation in other policy areas including migration and visas are also key contributors for establishing framework conditions for innovation and the penetration of technologies developed in the EU in world markets.

13 Synergies with the European Space Programme

Space technologies, data and services can support numerous EU policies and key political priorities, including the competitiveness of our economy, migration, climate change, the Digital Single Market and sustainable management of natural resources. Space is also of strategic importance for Europe. It reinforces Europe's role as a stronger global player and is an asset for its security and defence. Space policy can help boost jobs, growth and investments in Europe. Investing in space pushes the boundaries of science and research. Europe has a world-class space sector, with a strong satellite manufacturing industry, which captures around 33 % of the open world markets, and a dynamic downstream services sector with a large number of SMEs. The European space economy, including manufacturing and services, employs over 230 000 professionals and its value was estimated at EUR 46-54 billion in 2014, representing around 21% of the value of the global space sector .

The Union has made a strong political commitment with the Space Strategy for Europe, supplemented by an ambitious space agenda welcomed by the Council and European Parliament which provided further political orientations. The Space Strategy focuses on four strategic objectives: (1) Maximising the benefits of space for Europe' society and economy; (2) Fostering a globally competitive and innovative European space sector; (3) Reinforcing Europe's autonomy in accessing and using space in a secure and safe environment; (4) Strengthening Europe's role as a global actor and promoting international cooperation.

Europe needs to maintain and further strengthen its world-class capacity to conceive, develop, launch, operate and exploit space systems. To ensure this, there is need to support the competitiveness of the whole supply chain and actors from industry to research organisations. There is also need to foster the emergence of an entrepreneurial ecosystem, opening up new sources of financing, creating new business opportunities, and making sure this will benefit businesses in all Member States.

Coherence and synergies between the space programme and Horizon Europe will be instrumental for the delivery of solutions to the aforementioned challenges. Space research shall be an integral part of the Global Challenges pillar of Horizon Europe, with research and innovation needs of space sector identified and established as part of the programme's strategic planning process. Space data and services made available by the Union space programmes will be used to develop breakthrough solutions. Horizon Europe will also be instrumental to foster the space entrepreneurial innovation

ecosystem through the Open Innovation pillar and to push the frontiers of space science through the Open Science pillar. Space data and services made available through the European Space Programme can be used to develop breakthrough solutions through research and innovation, including in Horizon Europe, while Copernicus Data and Information Access services will contribute to the European Open Science Cloud and thus facilitate access to this data.

Box 8 Concrete example of how synergies could look like in practice

- Space data and services made available as a public good by the Union Space Programme will be used to develop breakthrough solutions through research and innovation, in particular for sustainable food and natural resources, climate monitoring, smart cities, automated vehicles or disaster management.
- The Copernicus Data and Information Access Services contribute to the European Open Science Cloud and thus facilitate access to Copernicus data for researchers and scientists.
- Horizon Europe will underpin the evolution of the Union Space Programme systems and services as well as the competitiveness of the space sector, notably with regard to sustainability of supply chains, non-dependence and access to space.
- Technology transfer from the space ecosystem can enable multidisciplinary innovation and entrepreneurship.
- The space innovation ecosystem will be fostered by the open innovation pillar of Horizon Europe through a mechanism for pipelines of projects emerging from the implementation of the Space Programme.
- Research infrastructures, in particular in situ observing networks constitute essential elements of the in situ observation infrastructure enabling the Copernicus services. In turn, they benefit from information produced by Copernicus services.

14 Synergies with the Innovation Fund under the EU Emissions Trading System

Table 14 Innovation Fund under the EU Emission Trading System - Research and innovation related support

Sectors/Domains: - Innovative low-carbon technologies in energy intensive industries in Annex I of the ETS Directive, energy storage, CCS and innovative renewable energy technologies **Target beneficiaries:** - Enterprises and their grouping **Geographical coverage:** - EU	**R&I activities/projects:** - Can support projects as of TRL 6-9 **Market uptake:** - Demonstrations & first-of-a-kind commercial scale projects

The Innovation Fund is established by the revised EU Emissions Trading System (ETS) Directive and will support innovation in low-carbon technologies and processes, including environmentally safe carbon capture and utilisation (CCU) that contributes substantially to mitigate climate change, as well as products substituting carbon intensive ones, and to help stimulate the construction and operation of projects that aim at the environmentally safe capture and geological storage of CO_2 (CCS) as well as innovative renewable energy and energy storage technologies.

The EU ETS Directive already sets the frame of the support. For example, projects shall have the potential for widespread application or for significantly lowering the costs of transitioning towards a low-carbon economy for the sectors concerned; technologies receiving support shall not yet be commercially available, but shall represent breakthrough solutions or be sufficiently mature to be ready for demonstration at pre-commercial scale; projects shall be selected in geographically balanced locations within the territory of the Union, etc.

Horizon Europe (and the R&I window of InvestEU Fund) will support research and technology development and innovation in the EU decarbonisation, energy and industrial transformation, especially under pillar 2. However, the need for public financing to overcome the "valley of death"

of low-carbon technologies at high TRLs is significant. The Innovation Fund may, subject to fulfilment of its selection and award criteria, support the demonstration phase of eligible projects that may have received the support from the Horizon Europe or its predecessor programmes. Synergies will be sought in governance cooperation and alignment of funding conditions where possible.

Box 9 Concrete example of how synergies could look like in practice

- Potential Innovation Fund's support provided via financial instruments could be channelled via the EU Invest R&I window, if possible and relevant, subject to meeting the provisions of the ETS Directive.
- Further synergies will be sought in governance cooperation, aiming at coordinated approach vis-à-vis final beneficiaries.

15 Relevant studies

- From Rivalry to Synergy: R&I Policy and Cohesion Policy. European Commission, DG Regional and Urban Policy, February 2018.
- In-Depth Staff Working Document for Horizon 2020 Interim Evaluation, SWD(2017) 221 final, May 2017. See in particular section 9.2: "To what extent is Horizon 2020 coherent with other EU initiatives?"
- Issue Papers for the High Level Group on maximising the impact of EU research and innovation programmes. European Commission, DG Research and Innovation, February 2017[112].
- Synergies between Framework Programmes for Research and Innovation and European Structural and Investment Funds – Contributing to the Interim Evaluation of Horizon 2020 Final Report.
- DG Research and Innovation and Joint Institute for Innovation Policy, 2017.
- EU Funds Working Together for Jobs and Growth: Synergies between the R&I Framework Programmes and the European Structural and Investment Funds. European Commission, DG Research and Innovation, 2016.
- Enabling Synergies between European Structural and Investment Funds, Horizon 2020 and other research, innovation and competitiveness-related Union programmes – Guidance for policymakers and implementing bodies. European Commission, DG Regional and Urban Policy, 2014.
- Maximisation of Synergies between European Structural and Investment Funds and Other EU Instruments to Attain Europe 2020 Goals. European Parliament, REGI Committee, 2016.
- European Parliament Resolution of 6 July 2016 "Synergies for innovation: the European Structural and Investment Funds, Horizon 2020 and other European innovation funds and EU programmes"
- Synergies between EU R&I Funding Programmes: Policy Suggestions from the Launching of the Stairway to Excellence. Joint Research Centre Technical Report, 2014.

[112] The Issue Paper on 'Widening Participation' states: "*An important example of synergies between ESIF and Horizon 2020 is the ELI - Extreme Light Infrastructure (distributed) project, located in Czech Republic, Hungary and Romania, that is supported by these countries under their ESIF resources complementing the European Strategy Forum on Research Infrastructures (ESFRI)*". Many examples of ESIF-R&I Framework synergies are also profiled in the "EU Funds Working Together for Jobs and Growth" publication listed above, while practical ways to improve Horizon 2020-ESIF synergies are outlined in the "Contributing to the Interim Evaluation Final Report" publication listed above.

Annex 8 Detailed information on key improvements in the design of Horizon Europe

1 European Innovation Council (EIC)

1.1 Why do we need an EIC and why should this be done at EU level?

The EU innovation ecosystem generates as many start-ups as the US in number but only a few of them grow-up rapidly[113]. This is even truer for start-ups carrying out breakthrough innovation[114] and for the science-based[115] ones ("deep tech")[116]. The fact that the next wave of breakthrough innovation will be science-based calls for immediate action.

Breakthrough innovation that creates new markets and, therefore, growth and jobs, is too rare in Europe. This is due to a range of factors, including lack of venture capital (VC), deep-rooted aversion to risk that builds also on fragmentation of the internal market and regulatory barriers and lack of transfer of new technologies from the research base to the market. The EIB estimates that the total equity funding gap in Europe is EUR 70 billion, of which 85% is represented by the first valley of death[117].

There is market-based evidence emerging from InnovFin Advisory studies[118] that there is a particularly acute funding gap and need for "patient capital" for so called "deep tech" companies (such as Key Enabling Technologies, Life Science and semiconductor and photonics). These companies are characterised by high capital intensity, high technology risk, and long development periods. The combination of these factors make the investment proposition of "deep tech" companies less appealing from a risk/return prospective than companies such as ICT/digital (which mainly assume product and execution risk).

[113] OECD, Entrepreneurship at a glance 2017, fig. 4.4. The percentage of firms that do not grow at all or by less than 5 % was over 45 % in Europe compared to 37 % in the US (Bravo-Biosca, 2011, A look at business growth and contraction in Europe). The tiny proportion of start-ups that do grow provide a disproportionate share of the new jobs (Marcin Szczepanski, 2017, Helping European SMEs to grow, LAB-FAB-APP, http://ec.europa.eu/research/evaluations/pdf/archive/other_reports_studies_and_documents/hlg_2017_report.pdf July 2017.

[114] "Deep tech" refers to companies founded on a scientific discovery or meaningful engineering innovation. Arthur D. Little, 2016, Systemizing Breakthrough Innovation.

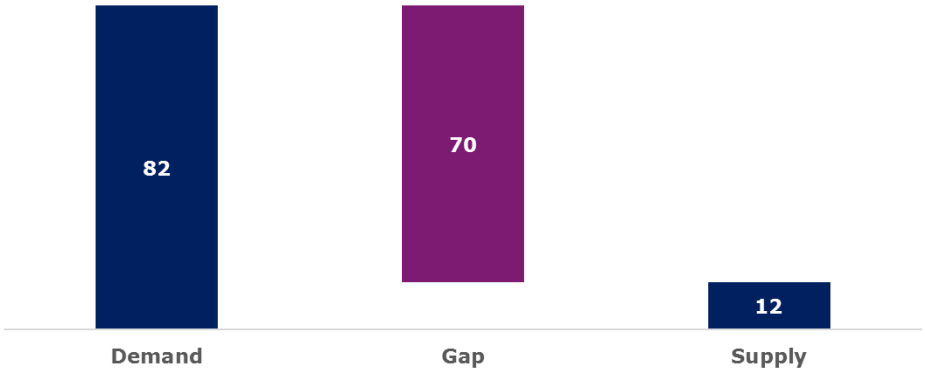
[115] Arthur D. Little (2016), Systemizing Breakthrough Innovation.

[116] The Economist: From clout to rout: June 30, 2016, https://www.economist.com/news/business/21701480-why-european-companies-have-become-fading-force-global-business-clout-rout .

[117] Equity Funding in the EU, Deloitte (July, 2016).

[118] Improving Access to Finance for Beneficiaries of the SME Instrument, InnovFin Advisory (EIB), 2018.

Figure 16 Equity funding in the EU: gap of EUR 70 billion in the SMEs and mid-caps space (up to 3,000 FTEs)



Source: Deloitte, July 2016

High-growth potential firms, which receive public funding in the form of equity, contribute to job creation and growth. The employment growth rate varies from 50% to 145% and turnover from 125 and 800%[119]. Evidence shows that innovative firms not only grow twice as much as their non-innovative counterparts in terms of employment but also "faster growing firms continue to innovate providing impulses to rejuvenate the economy"[120]. This may be due to their absorptive/learning capacity and intensive R&I activities[121].EU support to breakthrough innovators needs to evolve towards an agile, seamless and tailor-made approach**.** Current EU support to breakthrough innovators remains fragmented, complex and does not attract the most innovative companies. It is often described as complex to navigate, too prescriptive, uncoordinated, involving many rules, inflexible projects, forms of funding and management designed for classical R&D projects, not fitting with innovators needs ("one size fits all approach"), etc. Moreover, current EU programmes do not address in a seamless way the required tailor-made support to science/technology leading to breakthrough innovation and scaling up.

Challenges

[119] Improving access to finance for young innovative enterprises with growth potential: evidence of impact on firms' outputs (JRC, 2017).
[120] From Funding Gaps to Thin Markets: UK Government Support for early-stage venture capital. Research report TM/28 (Nesta, 2009).
[121] Acemoglu, D., U. Akcigit, N. Bloom, and W. Kerr (2013). Innovation, Reallocation and Growth, National Bureau of Economic Research, NBER Working Paper 18993.

Europe lacks venture capital for companies to scale-up fast.

The ample supply of venture investment helps US companies to turn market-creating innovations into world-leading companies, while Europe's innovators struggle to access risk finance above the €10 million range.[122] The supply of flexible, agile funding, such as via blended finance (combining grants with loans or equity), or through crowdfunding, is insufficient. This hampers young innovative companies ('*yollies*') to scale up to 'Unicorns'[123]. 'Unicorns' are young companies reaching a market valuation of $ 1 billion. Europe has 26, China has 59, and the US has 109. Per capita, Europe has 7 times fewer unicorns than the US.

Lack of financial resources is the main challenge that EU companies face when commercialising their innovative goods and services[124]. Two-thirds of VC investments in Europe are in the home country of the investor only[125]. Consequently many European start-ups move to the US: US companies enjoy 14 times more later-stage capital than their European counterparts do[126]. The European stock markets provide insufficient help. In 2012-2016, the average European venture capital exit via Initial Public Offering was nearly $70 million versus $220 million for the US[127].

Access to finance for young high growth innovative enterprises needs to be improved

The data on new lending to SMEs shows that of the 25 countries that provided data for 2016, growth in new SME loans was negative in 15 of them, sometimes substantially. In the Czech Republic and Denmark, SME loan growth turned negative in 2016 following positive growth in the previous year. Austria, Luxembourg, Portugal and Slovenia witnessed a bigger decline in 2016 than in 2015. In only a minority of instances, growth rates turned positive or strengthened[128].

In fact, most SMEs, including new, innovative and fast-growing firms, remain heavily reliant on internal resources and traditional bank debt. The lack of appropriate forms of finance, especially of the equity-type, stands in contrast with large businesses, and is limiting entry, long-term investment, expansion and innovation[129].

According to an EIB study, a significant proportion of KETs companies, including innovation leaders with a documented solid growth, find it hard to raise the capital needed to expand. Thus, while there is evidence that high-growth innovative firms can be catalysts for aggregate economic growth, their capacity to grow is highly dependent on the access to financial resources[130]. Almost 30 per cent of the KETs companies fail to obtain adequate debt financing. KETs companies (about 50 per cent) find themselves severely struggling to obtain the finance needed to generate further growth and innovation[131].

Europe has a shortage of risk capital for small, early-stage growing businesses. This is holding back the development of high-growth sectors such as technology, which are essential for economic competitiveness. While sources of capital such as crowdfunding and business angels are becoming more accessible, the EU is still at a significant disadvantage to the US[132].

Europe needs high growth companies to create new jobs

[122] PwC/CB Insights, Money Tree Report Q4 2017, p. 93. Esp. funding rounds of companies above $100 million is 5 times higher in the US and Asia than in Europe (p. 92).
[123] The EIB Investment Report 2017-2018 states that 'Young SMEs with radical innovative projects are the most credit-restrained category of firms' (p. 339, www.eib.org/attachments/efs/economic_investment_report_2017_en.pdf.) Also in http://bruegel.org/2015/05/are-european-yollies-more-hampered-by-financial-barriers-than-their-us-counterparts/ and Cincera, M., J. Ravet, R. Veugelers (2016), The Sensitivity of R&D Investments to Cash Flows: Comparing Young and Old EU and US Leading Innovators, Economics of Innovation and New Technology, 25(3), 304-20.
[124] Flash Eurobarometer 2014 "The role of public support in the commercialisation of innovations".
[125] 33% of around 1,000 investments made by European VCs are into companies based in countries outside of the VC's domestic market. Source: Atomico, The State of European Tech 2017, p. 25.
[126] https://www.project-syndicate.org/commentary/europe-startups-tech-success-by-william-echikson-2017-04 .
[127] https://techcrunch.com/2017/06/07/venture-investing-in-the-us-and-europe-are-totally-different-industries/85 .
[128] Financing SMEs and Entrepreneurs (2018 OECD Scoreboard, p. 23).
[129] Meeting of the OECD Council at Ministerial Level Paris, 7-8 June 2017 (p. 16).
[130] Improving access to finance for young innovative enterprises with growth potential: evidence of impact on firms' outputs, JRC, 2017 (p. 5).
[131] Access-to-finance conditions for Key Enabling Technologies (KETs) companies, EIB, 2016 (p. 4).
[132] Shortage of Risk Capital for Europe's High Growth Businesses AFME, March 17 (p. 4).

Among the 23 million European SMEs, only a fraction are high growth companies quick to grow, invest, create jobs and become leaders in their respective markets. "With more equity investment, more businesses could survive and potentially create new jobs. But start-ups, scale-ups and high growth companies respectively need seed, early-stage and expansion capital to reach their objectives"[133].

Europe is associated with a deep-rooted aversion to risk

Europe is associated with 'a deep-rooted aversion to risk' and a low entrepreneurial spirit compared to the US, China and Korea[134]. In Europe—like most of the world—failure in business can be a stigma, inhibiting an entrepreneur's ability to secure new investors. Relatively few European start-ups (compared to Silicon Valley) set aggressive goals or start with the idea of changing an industry or the world, instead targeting niche growth in their home markets'.

European financial intermediaries (e.g. banks) are also risk averse when confronted to high risk projects. Banks appear to have become more risk averse compared to the pre-crisis period, to the detriment of innovative companies, young firms and start-ups[135]. For instance, under the InnovFin actions in Horizon 2020, the European Commission had to provide 100% guarantee for products such as Energy Demo Projects (EDP) and Infectious Diseases Finance Facility (IDFF) to get the intermediaries on-board to provide loans.

Europe lacks transfer of new technologies from the research base to the market

According to the 2016 Eurobarometer[136], around two thirds of European manufacturing companies have not recently used any advanced technologies and this proportion has increased considerably since the 2015 survey. At the same time, significant resources have been devoted over recent years by the US and Asian economies toward the development and deployment of key enabling technologies such as ICT, nanotech and biotech in such companies. The results can be seen in the ICT industry world-wide. Most of the biggest R&D intensive ICT companies are in US or Asia and many of them are young.[137]

European innovators cannot exploit the scale of the Union and face regulatory complexity

In Europe, innovators and companies with international growth potential have to cope with 28 national markets with their diverse currencies, languages and business cultures.[138] Such fragmentation also applies to the innovation ecosystem. While Europe is home to a growing number of hotspots (London, Berlin, Paris, Stockholm and Amsterdam now figure in the top-20 world-wide start-up ecosystems[139]), these are not well connected[140]. Also, regulations can hinder company growth[141], especially the 'maze of regulatory regimes' in Europe.[142] Consequently, European start-ups tend to move to the more homogeneous US market.[143]

---

[133] The Shortage of Risk Capital for Europe's High Growth Businesses AFME (March 2017, p. 6).

[134] Citizens of EU-OECD countries score lower on their attitude to entrepreneurship and preference for self-employment than those in the US and China, e.g. the index for attitude towards entrepreneurship in 21 EU countries is 46 (males) and 31 (females), compared to 70 resp. 57 in the US, 62 resp. 54 in China and 57 resp. 35 in Korea (figures 2013): http://stats.oecd.org/index.aspx?queryid=70778.

[135] Financing SMEs and Entrepreneurs (2018 OECD Scoreboard, page 39).

[136] Flash Eurobarometer 433, Innobarometer 2016 – EU business innovation trends.

[137] Europe is host to only 19% of these companies, of which 61% are 'youngsters': founded after 1970. In Asia, the share of these youngsters is 68% and in the US even 83%. JRC-IPTS-R&D Scoreboard of the 2500 largest R&D spenders globally (2015); data from 2013. Quoted in Veugelers, 2016, Ecosystems for young digital innovators, paper prepared for the JTT special issue at the occasion of the EIED conference, Paris (2016).

[138] COM/2016/0733 final - Europe's next leaders: the Start-up and Scale-up Initiative.

[139] Global Startup Ecosystem Report, https://startupgenome.com/report2017/.

[140] Europe's next leaders, 2017. Also in Afme, The Shortage of Risk Capital for Europe's High Growth Businesses, March 2017, p. 20, and in EIF: The European venture capital landscape, 2016, par. 3.1.1 .

[141] Better regulations for innovation-driven investment at EU level, Commission Staff Working Document 2016: http://ec.europa.eu/research/innovation-union/pdf/innovrefit_staff_working_document.pdf. The importance of regulation for innovations is also mentioned in Atomico, The State of European Tech, 2017, p. 110 https://2017.stateofeuropeantech.com/.

[142] A.T. Kearny (2014), p. 15: Rebooting Europe's High-tech industry

[143] One US report states that 14 percent of European scale-ups have a "dual model": moved headquarters abroad since the initial phases of its lifecycle. Such companies would raise 30% more capital than scale-ups that follow a domestic funding path. The most popular destination is Silicon Valley: http://mindthebridge.com/european-dual-companies/.

Current EU support is not optimal for breakthrough innovation

Horizon 2020 is the first European programme to support innovation next to research, but few of the young and quickly growing innovative companies take part. The current support is seen as too complex and the multitude of acronyms discourages them to apply. EU support has tended to focus on incremental innovation and prescribed thematic topics that often do not correspond to modern innovation taking place at the intersection between different sectors and dsiciplines.

Tackling these challenges at the EU level allows:

- To pool resources and unleash the potential of European and global markets for EU innovators. Scaling up to exploit the European market is the first step towards international growth. Only the EU as a whole has the capacity to tackle persistent lack of large-scale high-risk venture capital. EU support can be bigger in size and more comprehensive (e.g. common regulation) compared to national or regional support.
- To encourage risk taking and increase the quality of innovations through EU-wide competition between the best. This will provide Europe's best innovators with resources they need to allow them to scale up and compete better at global level. Operating across Europe on a competitive basis will allow to draw on a wider pool of talents and ideas than would be possible through national schemes. Only the most risky and most breakthrough ideas will compete against each other.
- To create synergies across Europe (and beyond) by stimulating cross-border cooperation mainly through networks[144]. European support for innovation creates synergies with related regional and national programmes, agencies and financial intermediaries. For instance, tackling the problem of slow industrial transformation at the EU level provides the critical mass and the networks needed to develop and take up key enabling technologies by manufacturing companies and their supply chains[145].

What do we have now in Horizon 2020?

SME Instrument provides EUR 500 million per year in grants to SMEs for investigation of technical and commercial feasibility of a business idea and development of innovation with demonstration and scale-up purposes (TRL 6).

Fast Track to Innovation provides EUR 100 million in grants to consortia of partners from different countries with innovation projects addressing any technology or societal challenge field. It aims to reduce time from idea to market and to stimulate the participation of first-time applications to EU research and innovation funding.

Future and Enabling Technologies (FET) provides EUR 200 million per year in grants to collaborative research. It aims to stimulate bottom-up small scale explorations (FET-Open), build up a critical mass around promising directions (FET-Proactive) and fund large scale interventions that require a common European effort over a longer period to pursue grand challenges in science and technology (FET Flagships, such as Graphene and the Human Brain Project).

InnovFin actions provide EUR 400 million per year in loans to single beneficiaries for investment in research and innovation, guarantees to financial intermediaries making loans to beneficiaries and

[144] Cooperation within the innovation projects shall not be a requirement as they are close to the market and companies often prefer to walk that 'final mile' alone.

[145] According to companies participating in the business acceleration services of the SME Instrument, the exposure to a European network is crucial for building real business contacts with potential partners, clients and investors. Report: 'Is the SME-Instrument delivering growth and market creation? Analysis of first finalized Phase 2 projects, part 2 in-depth case studies, EASME Dec. 2017.

combinations of loans and guarantees, guarantees or counter- guarantees for national, regional and local debt-financing schemes, venture and/or mezzanine capital to individual enterprises in the early stage (start-up window).

- **EU awards** challenge prizes to innovators who develop a new solution for a highly demanding challenge, such as the battery of the future with advanced specifications. These prizes are open to any bids and can attract both incumbents and newcomers. They are top-down in defining the challenge, but encourage bottom-up new approaches.

- **Public procurement of innovative solutions (PPI)** are grants for establishment of networks of public procurers to prepare for launching PPI as well as direct financing of consortia of public procurers to undertake PPI procurement.

- **Pre-commercial procurement (PCP)** are grants to consortia of public procurers to buy R&D from several competing suppliers in parallel to compare alternative solution approaches and identify the best value for money solutions that the market can deliver to address their needs.

What have we learned from Horizon 2020 Interim Evaluation?

- Horizon 2020's Interim Evaluation identified that the Framework programme has a potential for supporting breakthrough, market-creating innovation, but noted that **such support must be considerably strengthened** in the future.

- In particular, Horizon 2020 Interim Evaluation assessed the programme **lacks connection between grant and loan based financing for companies.** Horizon 2020 invests EUR 400 million per year in risk financing through European Investment Bank (InnovFin) but only a small number of firms receiving Horizon 2020 grants benefit from such financial instruments.

- Similarly, Horizon 2020 invests EUR 500 million per year in the SME Instrument. The Interim Evaluation assessed that the scheme is on track to deliver innovations to the market by providing grant based funding and business acceleration services to SMEs. However, there is also scope for improvement such as the **need to scale up companies** and the need for **more interaction with business angels and Venture Capitalists**.

- The Communication on the Interim Evaluation notes that the future Framework Programme should provide **support faster and more flexibly** and build on the current achievements in innovation support through the SME Instrument, collaborative projects and public-private partnerships.

- Horizon 2020 supports scientific excellence in Europe and has contributed to high-profile scientific breakthroughs. But there is a need to **raise the breakthrough market-creating innovations**, which is vital for future growth and jobs. This is not about switching budget from fundamental research to innovation, but about generating more impact from innovation funding. The increasing impact could build on key ingredients in the success of the **European Research Council**, for example building a prestigious brand focused around excellence, with a strong bottom-up emphasis.

What do stakeholders say?

- The **Lamy High Level Group**[146] called for a 'true EU innovation policy that creates future markets' and proposes that the impact of the EU programme is maximised by fostering ecosystems for research, innovators, industries and governments, and by investing in innovative ideas with rapid scale-up potential. The group notes that an ambitious European Innovation Council should be a central pillar in the next EU research and innovation programme. It also recommends (#4 Design the EU R&I programme for greater impact) that the EIC design new proposal evaluation and selection processes to better capture high-risk, high-return projects, introduces greater flexibility in grant management (stop-go decisions) and tolerates failure.
- **The High Level Group of Innovators**, advising the Commission on innovation , developed a set of recommendations to support single innovators turning disruptive/breakthrough science and technology into market-creating innovations[147] :
  - Funding: empower the innovator, simplify, incentivise private investment,
  - Awareness: champion innovators, communicate success,
  - Scale: build the camp, leverage European ecosystems,
  - Talent: connect people, create prestige for innovators.
- The Commission engaged in a dialogue with a **variety of other stakeholders** to gain more insight on options for EIC. A consultation process was organised with national innovation agencies[148] as well as the wider innovation community through a 'Call for ideas'[149] and cluster consultation. In their feedback through the position papers, stakeholders called for:
  - European Innovation Council that increases synergies and acts as European Accelerator. Some 51% of all stakeholders submitting a position paper for the Framework Programme expressed their views on the idea of the European Innovation Council (EIC). Around two thirds of these stakeholders favour the overall idea of EIC providing detailed suggestions on the possible role and objectives of its organisation and concrete modalities for its functioning.
  - A reoccurring view is that the EIC should not add an extra layer of governance, but rather seek to identify gaps, coordinate and forge synergies with the existing support instruments serving as an umbrella initiative with a concretely defined value added.
  - The idea of bringing together existing instruments (SME instrument, Fast Track to Innovation, FET Open and inducement prizes) for a comprehensive support to all forms of innovation and technologies, including market-creating innovation is well echoed across the stakeholder input.
  - For example, Tekes considers that the role of EIC is to provide the best applicants with a tailor-made growth package including a combination of public and private funding fit for the needs of the company. This must be complemented by top-level expertise services like coaching, mentoring, training, soft landing measures etc. In other words, “EIC should act as an European Accelerator bringing all relevant EU funding and services into a single, fit-for-purpose 'one-stop-shop' for the most promising enterprises”. Some stakeholders (for example, CEASAR) view EIC as a label for excellence and a vehicle to leverage more private investments.
  - The main concerns expressed are that support to incremental innovation should not diminish due to an increased emphasis on radical and ground-breaking innovation that the EIC is envisioned to promote.

[146] The Group's mandate was to provide advice on how to maximise the impact of the EU's investment in research and innovation based on stakeholder feedback and the findings of the interim evaluation. The recommendations are published in the report LAB-FAB-APP, Investing in the European future we want, Lamy Group Report (2017).

[147] https://ec.europa.eu/info/news/high-level-group-innovators-offer-key-recommendations-european-innovation-council-2018-jan-24_en

[148] Commissioner Moedas met twice with representatives of national innovation agencies to discuss their experiences with promoting market-creating innovation, e.g. through providing coaching, loans and venture capital, lessons for the EU and ways in which EU could add additional value to their existing activities. Three workshops with experts from innovation agencies provided additional insights.

[149] In 2016 the Commission ran a call for ideas with a wider innovation community which gathered 1022 replies to the online questionnaire and 183 supporting documents. Overview of responses can be accessed here: https://ec.europa.eu/research/eic/pdf/eic_call_for_ideas-overview.pdf

Four position papers (Denmark, Flanders, Croatia and ALLEA) inexplicitly caution against the creation of a separate organisation. These stakeholders suggest evaluating more carefully the possible merging of the EIC mandate with EIT, FET or ERC to capture the whole research-innovation spectrum.

1.2 What do we want to achieve with the EIC?

With the European Innovation Council (EIC), the objective is to identify, develop and deploy breakthrough innovations, and to support the rapid scale-up of innovative firms carrying out market-creating innovations at EU and international levels.

The EIC will aim at:

1 Fostering breakthrough and market creating innovations in EU and support the rapid scale-up of innovative firms at EU and international levels;
2 Sharing high risks involved in breakthrough innovations, leveraging public and private investment; ensuring the selection of the most promising ideas and impacting innovations, researchers and innovators;
3 Increasing entrepreneurial and risk-taking mind-set in Europe through structural impact of EIC-funded projects and innovators setting a clear and inspirational targets for breakthrough innovation in Europe;
4 Simplifying EU support schemes for breakthrough market creating innovations by combining existing schemes under one EIC umbrella.

The EIC will not create an additional administrative layer; on the contrary, it will provide a one-stop shop for innovation support thereby making the programme more user friendly.

1.3 What changes will the EIC bring and what are the expected implications?

To place the EU in the lead for breakthrough market-creating innovation, the European Innovation Council (EIC) will be set up under the Open Innovation Pillar of the Framework Programme.

The EIC will combine all EU support to breakthrough and market-creating innovation in one place. It will build on the experience gained with Access to Risk Finance and the EIC Pilot launched early 2018 under Horizon 2020, which grouped relevant existing schemes and introduced first reforms (e.g. simplified application form and interviews with potential beneficiaries). However, this pilot phase is constrained by the legal acts of Horizon 2020 and much more is possible in Horizon Europe.

The EIC will provide tailor-made support to innovators through two main funding instruments – the **Pathfinder** and the **Accelerator** - with the following common characteristics: a focus on breakthrough innovation; a largely bottom-up approach (with top-down elements); a high-risk taking behaviour; a focus on innovator needs; and a pro-active management.

- The Pathfinder for Advanced Research will provide grants for early technology stage (proof of concept, technology validation) to early commercial stage (early demonstration, development of business case and development of strategy). Top-down competitive calls

developing key strategic objectives[150] calling for deep-tech and radical thinking will allow to establish critical mass of effort and build up and structure new research communities of a multidisciplinary nature. However, the *Pathfinder* will also allow for the submission of proposals on a bottom-up basis, so as to stimulate the opportunities of serendipity and unexpected ideas, concepts and discoveries. The Pathfinder will be open to all, from academic researchers to start-ups, SMEs and mid-caps.

- The Accelerator will support the further development and market deployment of breakthrough and market creating innovations, to a stage where they can be financed on usual commercial terms by investors (from demonstration, user testing, pre-commercial production and beyond, including scale-up). It will provide tailor-made blended finance (i.e. grant type support with equity financing or financial guarantee) through a single process and according to the needs, stage of development and risk profile of the innovation. The Accelerator will be open to all innovators, start-ups, SMEs and midcaps, but will also accelerate innovations / spin-offs / start-ups generated within the Pathfinder as well as from any other parts of the Framework Programme such as European Research Council (ERC), the European Institute of Innovation and Technology's (EIT) Knowledge and Innovation Communities (KICs) and R&I missions. This instrument will finance projects with high risks concerning innovation that is close to market, or small businesses investments. The open and bottom-up calls will be complemented by focused approaches on emerging breakthrough or disruptive technologies of potential strategic significance.

What is blended finance?

'Blended finance' is a financial instrument that combines grant-type support with equity or access to loans and other types of finance. Finance can be blended both simultaneously — for example, as a grant-plus-loan package offered at once— and sequentially, as when a grant attracts a later investment by a VC fund, business angel or corporate VC arm, or facilitates a loan from a bank or a non-bank lender. The EIC's Accelerator will essentially target high-risk potential market creating innovations. It will hence provide for simultaneous blending, with the aim of de-risking more and from the onset selected operations and attract later stage co- or alternate private investors.

Why blended finance?

Grants may be provided up to demonstration stages, but only covering part of the costs and for limited amounts. Financial instruments such as those to be deployed under InvestEU intervene when a project is "bankable", meaning there is a return on investment, or where the level of risk can be easily mitigated and be acceptable for private investors, including VC funds. This leaves innovators facing "the valley of death" where there are high development costs (which can only be partially covered by grants) but where the level of uncertainty and risks for making returns are too high for private investors. The EIC's Accelerator aims at bridging this valley of death and to de-risk selected operation so as to leverage these investors.

Under both Pathfinder and Accelerator, each EIC awardee would also be offered a series of support services such as coaching, peer to peer mentoring, facilitated access to services provided by others schemes (EIT, national and regional, corporates, etc.), specific support to help with regulatory barriers ("innovation deal" like), access to world-class fairs, etc. The Commission will organise an EIC Forum of Member States' and Associated countries' public authorities and bodies in charge of national innovation policies and programmes, with the aim to promote coordination and dialogue on European innovation ecosystem.

The EIC work programmes will be implemented by a single implementation structure pro-actively managing all EIC funding (i.e. an executive agency and a specific vehicle/networks of finance partners), including the possibility to stop or amend the projects, to support and use technology intelligence in order to strengthen the potential of the projects, etc. This calls for the involvement of

[150] These could include topics such as Artificial Intelligence, Quantum computing, Biocontrol or Second generation digital twins, or any other identified in close cooperation with Member States' networked programmes.

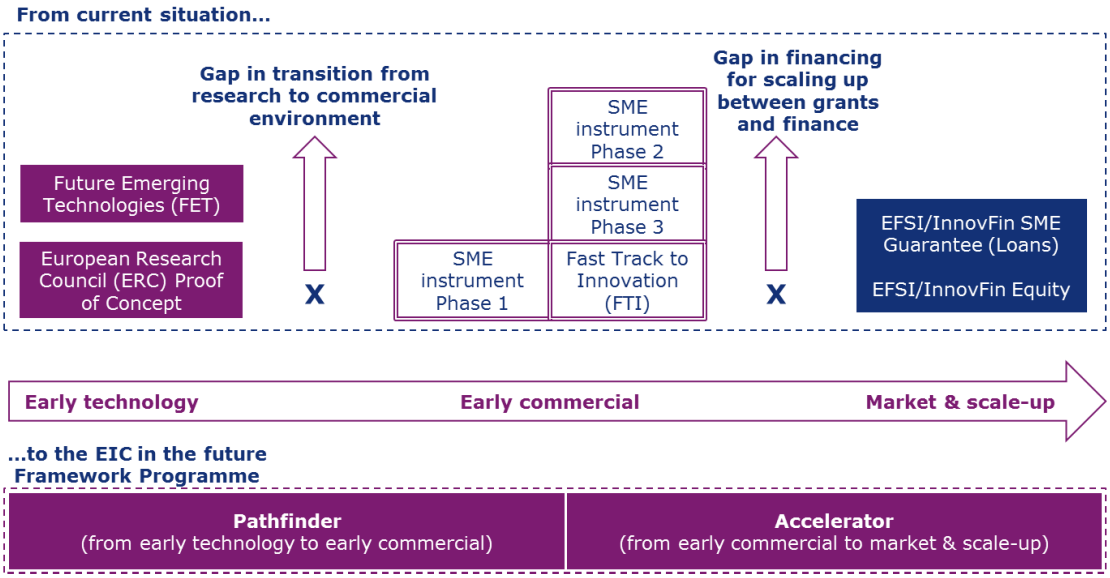
programme managers (ARPA-E approach[151]) who are able and empowered to interact with innovators/market players. In particular, programme managers will propose evaluation ranking based on the constitution of consistent strategic portfolio of projects, expected to make essential contributions to the emergence of potential societal or economic market creating innovations. An EIC Advisory Board (composed of high level investors, entrepreneurs, etc.) will support and guide these programme managers. The EIC Advisory Board will also have the responsibility to advise the Commission services on the implementation (e.g. design of work programme and evaluation processes), to assess emerging technologies and trends (including by bringing in top expertise in areas identified by the programme managers), etc.

The EIC will fund what other investors do not dare to invest into, or at least not alone (risk aversion). In that context, the EIC shall rely on expertise stemming also from the investment world, and also allow for investors to submit projects for which sharing the risks is key (pre-screening).

In order to mitigate risks of distortion of competition, the EIC will operate at market price and will exit from investment as soon as alternate investors are ready to substitute (no crowding out effect).

The EIC would considerably simplify the funding landscape and fill the gaps that currently exist.

Figure 17 Pathfinder and accelerator in the EIC



Evolution not revolution: the EIC from Horizon 2020 to Horizon Europe

Horizon 2020, incl. the EIC pilot	**EIC in Horizon Europe** (experiences from the EIC pilot)
FET Open: bottom-up, early stage, future and emerging technologies FET Proactive, FET Launchpad	Yes, will be taken up in the Pathfinder and further developed through transition activities aiming at nurturing emerging innovations and spin-offs from portfolios of projects.
FTI: consortia, SME-driven	Yes, will be taken up in the Accelerator
SME phase 1 feasibility study	▪ Feasibility studies can be awarded under Pathfinder's transition activities, and where needed as part of the overall support provided under the Accelerator. ▪ Member States and associated countries can set up joint

[151] https://www.darpa.mil/ .

	programmes to support feasibility studies. EIC can co-fund these.
SME phase 2 projects as in the EIC pilot, so bottom-up, with interviews, 4 cut-offs per year, evaluation criteria are Horizon 2020 standard (excellence, impact, organisation). Grants of up to € 2.5 m (in principle, higher is possible).	Yes, will be taken up in the Accelerator, with changes: ▪ even stronger focus on market-creating innovations ▪ 6 cut-offs per year ▪ non-SMEs can also apply: from non-incorporated individuals to mid-caps. Investors may also submit proposals for co-investment by the Union. ▪ larger amounts: more budget per projects ▪ wider range of support: through blended finance: grant-type advances with, equity or loan, guarantees. Will follow the phase of the innovation. ▪ evaluation by experts on excellence, impact and (new) the risk profile ▪ Commission will take yes/no decisions on a first come first served basis ▪ Commission may deviate from the experts' proposal ▪ for projects coming from other parts of the Framework Programme, award decision will rely on review of the on-going project
SME phase 3 business acceleration, e.g. linking SMEs to investors and corporates, open to all beneficiaries	Yes, similar services to be continued in pillar III Open Innovation
SME coaching, role for Enterprise Europe Network and coaches	Yes, similar services to be continued in pillar III Open Innovation
Monitoring of running projects by their self-reporting, private data on VC, experts using the Innovation Radar	Yes, to be continued in pillar III Open Innovation, more intensively. Closer Commission involvement to stop projects not reaching their milestones, or amend projects (high-level programme managers)
Waypoint SMEs to the InnovFin financial instruments by EIB/EIF and their partners	Yes, to be continued in pillar III Open Innovation. InvestEU will have a dedicated R&I window and products for innovative companies under the SME window.
HLG of innovators	Advisory Board will assist in defining the EIC work programmes, objectives, actions, evaluation criteria and selection of proposals.
-	EIC Fellowships
EIC inducement prizes	EIC Inducement prizes

A need for a dedicated implementation structure?

Three scenarios of implementation structure for the EIC are envisaged based on the expected difference in the programme management between Horizon 2020 actions and the EIC namely a move from generic to specialised profiles, passive to active management and from process-driven to portfolio driven management. The three scenarios are as follows:

- Scenario 1: Business as usual - existing EASME as the EIC implementing Executive Agency;
- Scenario 2: EASME revamped as EIC exclusive implementing Executive Agency by transferring non-EIC activities from EASME to other agencies; or
- Scenario 3: EIC implemented by a dedicated newly created Executive Agency possibly starting with the pilot under Horizon 2020 and continuing under Horizon Europe.

Further assessment of different implementation options shall be based on a dedicated cost benefit analysis.

Horizon 2020 implementation by the executive agency EASME	EIC implementation by a dedicated implementation structure
Generic profiles: Project officers (mainly contract agent staff) with generic skills and competences in project management and project finance. No industry/sector specific knowledge required.	**Specialised profiles:** ▪ Programme managers with specialised profiles and considerable knowledge and experience in the industry/sector, in particular with start-ups/scale-ups to respond to the need for high level technical and financial expertise; ▪ Project officers (mainly contract agent staff), with generic skills and competences in project management and finance to help keeping projects on track.
Passive management: Project officers have no power or knowledge to select, steer or terminate the project (apart from financial and legal fraud	**Proactive management:** ▪ Project officers will assist programme managers (responsible authorising officers, i.e. RAOs) in identifying

cases).	research teams and projects (after independent evaluation by external experts). ▪ Programme managers will support actively the management of selected portfolios of projects and propose a vision for their development (e.g. EIC transition activities). Programme managers will steer the beneficiaries by helping project innovators identify and anticipate commercialisation challenges (e.g. market shifts or manufacturing bottlenecks). They may recommend amending or terminating projects, based on pre-established milestones and external reviews.
Process-driven management: Different project officers assigned to the same project at different implementation stages. No connection between different projects overseen by one officer. Projects in the same industry/technology managed by different project officers. Project management and distribution mainly based on the principle of efficiency.	**Portfolio driven management:** RAOs are responsible for the overall management of a portfolio of projects within the same technology domain/industry from the selection process onwards. They are assisted in this role by programme managers. Distribution of projects among RAOs will be based on the principle of effectiveness/impact (i.e. the added value to the portfolio and complementarities, cross-linkages of projects within each portfolio).

1.4 What are the expected implications?

- **More innovations that create the new markets of the future**. Giving more prominence and visibility to science-based breakthrough innovation, the EIC will allow the future Programme to increase its capability to attract Europe's best innovators. The selection process by peer-scientists and innovators and investors will increase probability of supporting the most promising innovators. Those that will be selected will be managed actively (by programme managers empowered as responsible authorising officers) based on a set of challenging targets and possibility to amend and terminate the projects when necessary which will further increase the probability of their breakthrough. The type and volume of financing will be tailor-made to the needs. According to the High Level Group of Innovators[152], a successful EIC should allow the EU to be home to leading companies in major areas for breakthrough deep tech innovation such as Artificial Intelligence, biotech, and augmented/virtual reality (e.g. 1/3 of the leading global companies should come from Europe).

- **Scaled up companies and higher SME growth** The EIC will support late stage innovation activities and market deployment for the most promising ideas, resulting in an increase in the number of growing EU start-ups and SMEs. It will target innovative companies (up to mid-caps) with a great potential for scaling up, offering tailor-made type and volume of financing to the needs of the firm, its size and stage, the nature of the technology and the length of the innovation cycle/market deployment. Co-investment in equity or through guarantees for alternative types of finance (e.g. bank loan) will be awarded for scale-up. These measures are expected to help filling-in the missing gap in risk finance in Europe ("bridging the valley of death"). Such support is expected to have a positive impact on the growth, market valuation, employment and turnover of EU companies (especially SMEs).

[152] Funding - Awareness - Scale - Talent (FAST): Europe is back: Accelerating Breakthrough Innovation, Full set of recommendations from the Independent High-Level Group of Innovators on establishing a European Innovation Council, January 2018.

- **Increased complementarities between grant-type funding financial instruments and leverage from private investment.** Under the EIC Accelerator, blended finance would allow the Union to bear the initial risk of deploying market breakthrough innovations, with the aim of de-risking these operations as they unfold, down to a stage where they can be financed through private capital, hence incentivize private investors. The EIC support through blended finance should lead to a greater propensity to co-invest or to offer lower interest-rates loans and less onerous requirements for collateral, hence to more breakthrough market-creating innovations to be effectively translated and deployed in the market. Financing will be targeted to involve private investors on the basis of de-risking. The alignment of interests with private investors will provide improved access to venture capital and risk finance, hence leveraging the overall volume of finance necessary to develop the innovation to a stage where it can be financed through private capital.

- **More entrepreneurship and risk-taking**. The EIC will provide business acceleration services to innovators and will award EIC Fellowships to the outstanding ones. The EIC will highlight innovators who can inspire others (researchers, youngsters and other potential entrepreneurs) to set up and grow their own enterprises.

- **More accessible and user-friendly support to innovation.** The EIC support and services will be provided through a one-stop shop enabling easy and quick access for innovators to EU support.

1.5 What alternatives were considered?

Four alternative policy options were considered and discarded:

- Full centralisation: Under this option, public support for market-creating innovation at the EU level would be fully centralised. The EU would replace the existing national, regional and local level support to promote market-creating innovation.

- Discontinuation: This option assumes that the EU R&I Framework Programme would stop financing activities related to market-creating innovation. The public support for market-creating innovation would become fully decentralised and solely in the remit of the Member States.

- Horizon 2020: Under this option, the initial Horizon 2020 measures to support innovation would continue. This would include the SME Instrument, Fast Track to Innovation (FTI) and FET Open (and, by implication, other running innovation support actions such as InnovFin, Eurostars, JTIs and KICs).

- Horizon 2020 with the EIC Pilot: This option would combine the three Horizon 2020 measures that offer most opportunities for potential market-creating innovations: the SME Instrument, FTI and FET Open under one umbrella; it would make the SME instrument bottom-up, evaluate the proposals with interviews by financiers and innovators, extend mentoring and coaching to support SMEs; and it would blend grants with financial instruments to assist the growth of companies. InnovFin, Eurostars, JTIs and KICs measures would remain the same as under Horizon 2020 option. This option is being implemented in the second half of the Horizon 2020 programme. However, as this pilot is staying within the

legal and budget boundaries of Horizon 2020, its effectiveness and coherence would remain flawed: the link between direct innovation support (grants) and indirect support (loans, VC) would remain weak; a parallel time-consuming evaluation and decision process would take place through indirect financial instruments, abiding to different criteria and risk perception for private investment; there would be no explicit interface between the EIC and the other parts of the Framework Programme and the three grant schemes would remain 'joint' in the pilot but without optimal coherence.

1.6 How will the EIC be implemented?

	Pathfinder	Accelerator
Management	▪ European Commission assisted by EIC Advisory Board and supported by an executive agency: – **EIC Advisory Board**: Established by specific programme decision will assist the Commission in setting the overall strategy, governance of the instruments, the work programmes – **A dedicated implementation structure** with high-level programme managers (5 years non-renewable) acting as Responsible authorising officers (RAO) managing Pathfinder's portfolios of projects. RAOs will consult with the EIC Advisory Board. RAOs decide on Pathfinder's transition activities and steer their beneficiaries. Pathfinder and Accelerator projects may be amended or terminated by RAO if milestones are not met.	
Aim	▪ Strengthening the emergence and development of breakthrough science/technology leading to breakthrough innovation	▪ Accelerating and accompanying the scale-up of enterprises carrying-out breakthrough innovation
Target group	▪ Researchers, universities, start-ups, SMEs: from single beneficiaries to multi-disciplinary consortia.	▪ Innovations / spin-offs, including those generated within the Pathfinder as well as any other part of the Framework Programme ▪ Individual entrepreneurs, mainly start-ups and SMEs, including young and women innovators.
Toolkit	▪ **Research and innovation actions (RIA):** grants to high-risk cutting-edge research projects from early technology stage (proof of concept, technology validation) to early commercial stage (early demonstration, development of business case and development strategy) Available to all legal entities. ▪ **Transition activities:** Proactive management of portfolio of related RIA projects, on theme distinct from Pillar 2 missions and industrial road-maps. Establish a critical mass of European researchers, building up and structuring new interdisciplinary research communities with the objective to bring market creating breakthrough ideas to genuine and mature innovations. Activities may consist in additional grants to existing actions, new **RIA**, **innovation actions** and **coordination and support actions** (e.g. feasibility studies for SMEs)	▪ **Innovation and market deployment actions:** blended finance (i.e. grants with direct equity financing and access to lean financing) for further development and market deployment of breakthrough and market creating innovations, to a stage where they can be financed on usual commercial terms by investors (from demonstration, user testing, pre-commercial production and beyond, including scale-up). ▪ **Business acceleration services:** access to networks of potential partners and investors ▪ **Equity and bank guarantee to other types of finances:** to be managed in close relation with InvestEU and EIB Group (service level agreements). Management of equity may entail the establishment of a dedicated **Investment Fund** in close relationship with the EIB group.
Calls	▪ Bottom-up and top-down calls, following the ethical principles of the framework programme. ▪ periodical competitive closing dates ▪ direct award (no call) of small CSA (50,000 euros) in the context of **transition activities**	▪ Bottom-up and top-down calls, following the ethical principles of the framework programme. ▪ cut-offs every two months, first come first served basis ▪ **Business acceleration** services may involve **coordination and support actions**, including procurements.

	Pathfinder	Accelerator
Selection/Evaluation	▪ Selection criteria: excellence of science and innovation, impact (market-creating nature) and excellence of delivery (quality of organisation) ▪ evaluated by expert panels	▪ Selection criteria: excellence of science and innovation, excellence of the impact (marketability), and the level of risk; ▪ Step 1: Expert panel (e.g. researchers and scientists) ▪ Step 2: Expert panel (e.g. innovators and investors) ▪ Step 3: Interviews with expert panel (e.g. innovators and investors) ▪ Projects may be amended or terminated if milestones are not met.
Links to other programme parts	▪ Selected RIA falling within the scope of Pillar 2 missions shall be managed in close relation with related mission portfolio. ▪ Close coordination with ERC and EIT KICs.	▪ Will accelerate innovations / spin-offs/ start-ups generated within Horizon Europe, in particular the ERC, EIT KICs or other parts of the Global Challenges and Industrial Competitiveness pillar following a fast-track procedure that builds on previous review.

1.7 Complementarities with InvestEU Fund

EIC support would be clearly differentiated from InvestEU products:

- **EIC would only support start-ups / SMEs where the risk profile requires a component of grant funding and strong public support to lower risks for private investors to intervene.** Innovative SMEs that can be financed through private debt or equity would be directed to the schemes provided under the InvestEU Fund (notably under its SME Window – innovative SMEs dimension).

- **EIC would be highly selective, targeting those innovations that have a breakthrough nature** (not incremental improvements to existing products, services or business models) and essentially support start-ups/SMEs where the profile requires a component of grant funding and strong public support to lower risks for private investors to intervene.

- **EIC funding would be based on specific governance.** While final financing decisions would be made by the Commission, this would follow assessments by the best independent expertise from across Europe (e.g. to judge the breakthrough nature) and strategic advice from the EIC Board.

1.8 Relevant studies

- Funding - Awareness - Scale - Talent (FAST): Europe is back: Accelerating Breakthrough Innovation, Full set of recommendations from the Independent High-Level Group of Innovators on establishing a European Innovation Council, January 2018.
- LAB-FAB-APP: Investing in the European future we want: Report of the High Level Group on Maximising the Impact of EU Research and Innovation Programmes, July 2017.
- Europe's future: Open innovation, open science, open to the world : reflections of the Research, Innovation and Science Policy Experts (RISE) High Level Group, May 2017.
- European Commission (2017), Interim evaluation of Horizon 2020, Staff Working Document (SWD).

- Improving Access to Finance for Beneficiaries of the SME Instrument, InnovFin Advisory (EIB), 2018.
- Improving access to finance for young innovative enterprises with growth potential: evidence of impact on firms' outputs JRC 2017.
- The Shortage of Risk Capital for Europe's High Growth Businesses AFME March 2017.
- Financing SMEs and Entrepreneurs 2018 - An OECD Scoreboard.
- Improving access to finance for young innovative enterprises with growth potential: evidence of impact on firms' outputs JRC 2017.
- Access-to-finance conditions for Key Enabling Technologies (KETs) companies EIB 2016.
- European Small Business Finance Outlook EIF, June 2017.

2 Research and Innovation Missions

2.1 Why do we need EU R&I missions and why should this be done at EU level?

Currently, the EU's investments in research and innovation could have a higher impact on the strategic challenges our society faces and in driving sustainable economic growth. A mission-oriented, impact-focussed approach would enable a sharper EU focus on global strategic challenges and it would enable industrial transformation towards a more knowledge-intensive economy and job creation.

Missions would be designed specifically to privilege cross-sectoral and multidisciplinary collaboration. They should capture public imagination and involvement by setting a clear and inspiring time-bound goal for Europe, which would have clear and understandable benefits on the daily lives of European citizens. A mission-oriented R&I policy can improve the flow of knowledge across disciplinary and sectoral 'silos', and it can involve end-users and citizens much more closely in EU research and innovation activities. Missions can also stimulate system-wide transformation across many different sectors. Developing strategic research and innovation missions at EU level is a way to provide the necessary scale, scope and wide mobilisation of resources required to address pressing common challenges that cross national borders.

Challenges

Europe's R&I investments directed to tackling societal challenges are spread thinly

Europe invests significant resources in tackling global societal challenges through research and innovation activities providing solutions to those challenges. Around €30 billion from 2014 to 2020 is allocated for collaborative R&I under seven Societal Challenges within Horizon 2020, while a number of other EU-level initiatives (public-private partnerships, EIT Knowledge and Innovation Communities, Industrial Leadership pillar of Horizon 2020) address major challenges facing our society. However, a key finding of the Horizon 2020 interim evaluation is that investment is fragmented across different funds, schemes and instruments. Thus a mission-oriented approach would create more impact by concentrating EU investments in priority areas with a transformative potential for the economy, society and/or environment.

Citizens are disengaged from EU research and innovation

The Interim Evaluation of Horizon 2020 emphasises the clear need for greater outreach to citizens. Involving citizens, customers and end-users in the future R&I programme's agenda-setting (co-design) and its implementation (co-creation) will lead to more innovation by stimulating user-driven innovation and greater demand for innovative solutions. This is one of the major opportunities afforded by adopting a more impact-focused, mission-oriented approach in the future.

What do we have now in Horizon 2020?

Within a dedicated Societal Challenges pillar, **seven societal challenges** with a budget of around €30 billion support collaborative research and innovation tackling specific challenges facing our society and economy.

Within Horizon 2020, over **20 Focus Areas** were introduced in key areas where priorities cut across different parts of the programme (i.e. blue growth, circular economy, Internet of Things, smart and sustainable cities, Digital Security). Focus Areas concentrate resources and efforts on areas of high policy and political relevance and societal concern. The interim evaluation of Horizon 2020 found that the programme's coherence was reinforced by the use of focus areas, even if their multiplication has also resulted in some confusion.

Under the Future and Emerging Technologies scheme, Horizon 2020 supports **two FET Flagship initiatives** on Graphene and the Human Brain (with a third Flagship, Quantum, planned to become fully operational under the future programme). These large-scale partnerships are expected to run for about 10 years, with a total budget of around €1 billion each. A key overriding aim is to establish a close link between related activities (at European, national and regional levels) of the research activities that contribute to the Flagship.

What have we learned from the Horizon 2020 Interim Evaluation?

"The EU should not spread its investments in R&I too thinly. Instead, it should prioritise investing in areas where the EU added value is greatest and where the benefits of economies of speed, scale and scope can be reaped. The post-2020 EU R&I programme should thus translate global societal challenges into a limited number of large-scale R&I missions. These would define expected impacts across an entire portfolio of activities, rather than at the level of individual call topics…. Missions should be open to all actors in the research and innovation cycle, easy to communicate and capture public imagination and involvement. They should mobilise many actors and investors, including at national level, and induce action across disciplines, sectors and institutional silos".
(*'LAB-FAB-APP: Investing in the European future we want' - Report of the High Level Group on Maximising the Impact of EU R&I Programmes, July 2017*)

In the conception and design of future research and innovation missions, it is also important to take into account lessons learned from ongoing mission-like initiatives across EU countries. These include the "Energiewende" plan to clean the energy system in in Germany by 2050, or the "Fossil fuel-free vehicles by 2030" mission in Sweden. In the USA, the 'Cancer Moonshot' initiative unveiled in 2016 aims to accelerate cancer research to achieve in 5 years (by 2023) research and treatment gains that otherwise might take at least a decade, while the Apollo programme in the 1960s is estimated to have generated more than 400,000 jobs and over 1,800 spin-off companies[153].

What do stakeholders say?

A wide range of stakeholders back the idea of adopting a mission-oriented approach in the future EU R&I programme. Examples of specific feedback within stakeholder position papers include:

- "We need to look beyond the short-termism of the current 3-year project cycle. Many of the problems to be tackled through the missions will require contributions from across research fields and involve a wide variety of stakeholders".
- "The concept of 'missions' looks attractive as it captures the objective of prioritising investments in areas with a clear EU added value and of defining expected impacts for each of them. It also has the potential to strengthen the link between research-driven and industry-driven EU level activities".

[153] Source: Joint Institute of Innovation Policy, see 'References' section.

- "Continuing the explicit alignment of the United Nations Sustainable Development Goals with the future Framework Programme's missions is warranted for Europe to become the global leader in research and innovation. Europe and its trading partners need a Framework Programme that is mission-oriented, addresses both current and future global challenges, and encourages bottom-up solutions".
- "The potential added value of missions in the Framework Programme can contribute to making the results of research and innovation more tangible for society at large. For these missions to be successful, however, it is crucial that they have well-defined thematic goals. Missions should focus on topics where a European approach has a distinct added value, and should be generated bottom-up and top-down in broader national and European policy initiatives".

The Economic and Societal Impact of Research and Innovation (ESIR) expert group has emphasised that a future EU mission-oriented approach would substantially increase private investment in R&D and increase the economic impact of research and innovation through deployment diffusion and accompanying spill-overs. In short: a more holistic approach which effectively supports the whole innovation cycle.

A structured consultation process to obtain stakeholder input on future EU R&I missions has taken place, including the opening of a public call for expressions of interest from February 2018 until April 2018. In addition, as part of the Joint Institute for Innovation Policy study (referenced on the final page), over 1800 responses were submitted to an online survey and 40 stakeholders were interviewed. The responses, submitted by all types of stakeholders, strongly emphasise that a mission-oriented approach would increase the impact achieved by the future programme.

2.2 What do we want to achieve with missions?

The need to create more impact from, and generate more citizen involvement within, EU research and innovation activities through mission-orientation has been identified as one of the key improvements to be made in the design and execution of the future EU R&I programme[154].

A mission-oriented approach in the future EU R&I programme will aim at:

- Prioritising investments where the EU added value in addressing a global challenge (social, economic, environmental) is greatest:
- Focussing on areas with a transformative potential for science, technology, industry or society;
- Inducing cross-sectoral and multi-disciplinary collaboration in achieving mission goals, including the social sciences and humanities;
- Stimulating demand for innovative solutions and support user-driven innovation through co-design and co-creation of missions with citizens and civil society (including by taking into account the local context and smart specialisation, where relevant);
- Improving communication and outreach on the contribution of R&I to providing solutions to major global challenges;
- Inspiring, enthusing and mobilising citizens (and citizen groups)[155] around a clear time-bound goals;
- Set the direction for public and private sector research and innovation activities in Europe, thereby leveraging further investments and improving societal uptake of innovative solutions.

[154] See section 3.4 of the Commission Communication on the Interim Evaluation, January 2018 (COM(2018) 2 final), and the recommendation of the ex-post evaluation of FP7 on: "bringing science closer to citizens" (COM(2016) 5 final).

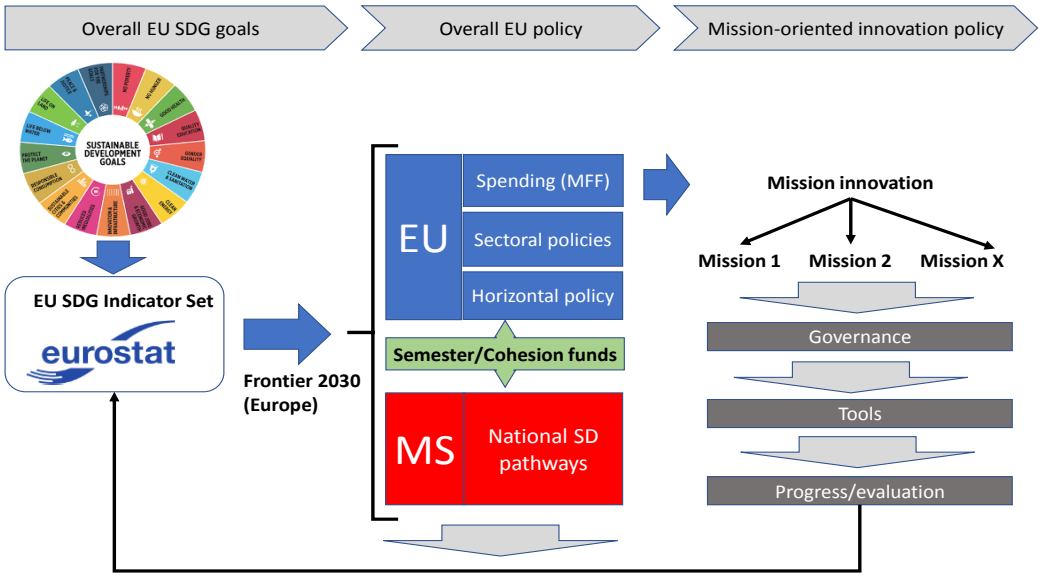
[155] "The process of engagement needs to make the best use of networked technologies, reach a wide number of citizens across the European Union, and show clearly that people in every part of the Union have an opportunity to participate in setting priorities, and opportunities to become further involved in the future". Citizen Participation in FP9: A model for mission and work programme engagement. Democratic Society, February 2018, p.18. .

This approach would put into practice a number of key recommendations of the Horizon 2020 Interim Evaluation and the High Level Group report, thus demonstrating that missions would be an appropriate tool of delivery for Horizon Europe.

2.3 What changes and what are the expected implications?

The legal proposal for Horizon Europe will lay down the selection criteria and methodology that will frame a mission-oriented approach, while missions as such will be identified and chosen during the implementation phase. The starting point and reference framework for defining a mission-oriented approach are the UN's Sustainable Development Goals. The SDGs are a powerful point of departure for rethinking Europe's efforts, instruments and approaches to promote research and innovation (as illustrated by the figure below), including through a mission-oriented approach.

Figure 18 From SDGs to mission-oriented innovation policy



Based on recommendations made by Prof M. Mazzucato, the criteria proposed for selecting missions are:

- Bold, inspirational with wide societal relevance
- A clear direction: targeted, measurable and time-bound
- Ambitious but realistic in terms of research and innovation
- Cross-disciplinary, cross-sectoral, and cross-actor activities
- Multiple bottom-up solutions.
- Strong EU added value

Horizon Europe will introduce a limited number of highly visible R&I missions. Missions will replace and build on the current "focus areas" used within Horizon 2020. They will be well-defined[156] and self-standing programme parts, as opposed to the focus areas which are 'virtually linked calls' within the Horizon 2020 programme structure.

This will more clearly and directly incentivise cross-sectoral and cross-disciplinary cooperation. Clear objectives and a clear rationale will be established at the mission's inception (addressing a

[156] Over 20 Focus Areas were introduced in Horizon 2020, and the interim evaluation found that "their multiplication resulted in some confusion" (p.149, In-Depth Staff Working Document on Horizon 2020 Interim Evaluation, SWD(2017) 220 final).

specific weakness identified in the focus areas approach) in order to define targets, clear time-bound goals and expected impact. Non-prescriptive calls will underpin the missions, as opposed to the 'top-down' focus areas. Finally, missions will be co-designed with end users and citizens, thus prioritising public engagement and involvement. As is generally accepted, governance regarding the implementation of innovations and technologies "is both inevitable and desirable, helping to develop shared ownership and responsibility of outcomes and risks"[157].

At the implementation stage, missions will be managed by a clearly identified and empowered Mission Board that is responsible and held accountable for their progress and achievements. Governance will be flexible, in order to adapt to changing challenges and to monitor critical issues in real time for the purpose of reaching the final goals. Mission Boards will be involved in co-designing the missions involving stakeholders and the wider public, providing input to the content of the call for proposals and the evaluation of project proposals and in monitoring missions. A mission manager will be appointed for each mission with the task of ensuring that the mission objectives are reached through a portfolio approach. By involving citizens and stakeholders in the definition, selection and monitoring of missions, a sense of urgency and collective commitment will be created while also ensuring societal ownership of the missions158.

Future missions could accelerate technological, social or industrial change; or they could transform entire systems. One type of missions could aim to accelerate progress towards a set technical or societal solution, focusing large investment on a specific target with the aim of accelerating the achievement of innovative – often disruptive – solutions (for example, efforts to accelerate market uptake of post Li-ion battery and energy storage solutions). Another type of missions could focus on transforming an entire social or industrial system within an established timeframe, for instance the transformation of the entire energy system or a mobility system in cities (in line with major EU policy goals). The distinctive feature would be a clear and measurable target set from the outset for the complete transition linked to a year of achievement. This overall EU objective would articulate new R&I solutions with regulatory, infrastructure, financial or social initatives initiated outside the future EU R&I programme.

Figure 19 Characteristics of missions that accelerate and missions that transform

Missions that accelerate	Missions that transform
• Can be scientific, technological, social or industrial • More narrowly defined missions that are linked to specific breakthroughs. • Targets will aim to speed up developments already in the pipeline (e.g. lifesaving drug to market in 5 rather than 10 years) • The cross-sectoral and cross-disciplinary dimension will be important • The need to involve coordination with policy and regulation may still exist, but will be less strong than with transformer missions. • Relevant targets to be defined by straightforward indicators (xKW per hour for €y by 20XX) or targets (vaccine for malaria by 20XX)	• Address European societal challenges: aiming at achieving truly transformative change in how economic sectors and organisations work, and how citizens live. • Will contain a number of accelerator missions aimed at achieving related scientific, technological, social or industrial aims • Aligned with wider policy and regulatory measures and demand-side stimulus (procurement) • Broad coherence with wider European and international policy agenda • Require research and innovation achievements, but also changes in regulation and user behaviour. • Cover coordinated R&I activities in several sectors, across thematic policies (i.e. energy, transport etc.) and may require public sector innovation, social innovation, behavioural change. • The relevant targets will concern broad societal

[157] Democratic Society (2018), p.17.

[158] "Missions require to set up specific governance structures with full-time professionals and to keep close contacts with all stakeholders. A balanced system of separation of powers between steering, strategic and financial decision-making and the day-to-day management is a must to establish from the outset" MOP2 study.

	indicators, presupposing a wide uptake of new technologies, products and processes. • Strong multi-level governance and coordination is required (EU, national, regional and urban level)

The success of missions hinges on the timely and due consultation and dialogue with stakeholders, to avoid the risk of disengagement and lack of follow-up. At implementation phase, a challenge will be to ensure that evaluation and monitoring mechanisms can capture the long-term impacts of missions. Finally, the uptake and roll-out of innovative solutions arising from the missions would ultimately be dependent on wider framework conditions – this can be mitigated through policy actions in the spirit of the Innovation Principle or through Innovation Deals[159]. A mission-oriented approach in Horizon Europe will thus require new adaptations and learning.

What are the expected implications?

- **Improved cross-sectoral and cross-disciplinary cooperation**. Missions will require expertise from different sectors and disciplines to come together: climate change cannot be fought by the energy sector alone; it will also require changes in transport, nutrition, and in many other areas[160]. Because global challenges are complex and "wicked"[161], and their solutions imply system transformations[162] and creating instead of fixing markets[163], mission-oriented R&I initiatives targeting them must ensure that the many technologies will be developed and deployed across sectors[164]. The mission-oriented approach will work across clusters to promote these system-wide transformations. This is confirmed by the large majority of stakeholders as an appropriate support to mission orientation[165].

- **Increased impact on global challenges and EU policy priorities**. Missions are expected to be more effective in delivering societal impact for end-users and citizens, because they prioritise investments and set directions to achieve objectives that are relevant for the society. Directionality and intentionality are core features of mission-oriented R&I initiatives, and this differentiates them from other types of policy initiatives like challenge-oriented and systemic policies. Lack of directionality can impede system transformations and lead to the failure of mission-oriented initiatives, as shown by many case studies from across the globe that are driven by urgent societal challenges[166]. In addition, instituting a mission-oriented approach with visible targets is

[159] https://ec.europa.eu/research/innovation-deals/index.cfm
[160] Mazzucato M. (2017), Mission-Oriented Innovation Policy: Challenges and Opportunities, Working Paper IIPP WP 2017-01.
[161] Nelson, Richard R. "The Moon and the Ghetto Revisited." *Science and Public Policy* 38, no. 9 (2011): 681–90.
[162] Weber, K. Matthias, and Harald Rohracher. "Legitimizing Research, Technology and Innovation Policies for Transformative Change: Combining Insights from Innovation Systems and Multi-Level Perspective in a Comprehensive 'Failures' Framework." Research Policy 41, no. 6 (2012): 1037–47.
[163] Mazzucato, Mariana. "From Market Fixing to Market-Creating: A New Framework for Innovation Policy." Industry and Innovation 23, no. 2 (2016): 140–56.
[164] Foray, Dominique, David C. Mowery, and Richard R. Nelson. "Public R&D and Social Challenges: What Lessons from Mission R&D Programs?" Research Policy 41, no. 10 (2012): 1697–1702.
[165] A survey conducted for the Joint Institute for Innovation Policy-coordinated survey recorded 80% of respondents agreeing that cross-disciplinary and cross-sectoral calls for projects and proposals in the future is an appropriate tool for mission orientation.
[166] Weber, K. Matthias, and Harald Rohracher. "Legitimizing Research, Technology and Innovation Policies for Transformative Change: Combining Insights from Innovation Systems and Multi-Level Perspective in a Comprehensive 'Failures' Framework." *Research Policy* 41, no. 6 (2012): 1037–47. See also the Joint Institute for Innovation Policy study for a profiling of different missions and their various drivers (including also geopolitical and technological challenges).

likely to provide a reliable long-term framework incentivising private firms and the public sector to invest in R&I, thus reaping new markets. Public R&I investments have a higher economic impact if they are directed to specific missions, with targets set by policy in close interaction with both public and private actors[167].

- **Decreased gap between science/innovation and society.** R&I missions should be easy to communicate, in order to mobilise citizens and end-users in their co-design and co-creation. In turn, this increases the relevance of science and innovation for the society and it would stimulate the societal uptake and deployment[168] of innovative solutions and leverage business investment.

2.4 What alternatives were considered?

- Replacing Societal Challenges with missions: an option would be to replace the current seven societal challenges of Horizon 2020 with a similar number of missions, thus for instance having a mission on energy and one on health. This would require large-scale missions that would need to be broad in scope. This alternative was discarded because it is not suitable to meet the operational objectives. Defining broad, large-scale missions entails a significant risk that they would not provide sufficient focus. Furthermore, if missions become very broad there is a risk that the involved stakeholders find it more difficult to feel ownership of the mission. Very broad missions also have the disadvantage that they would be difficult to measure since they would need to cover many different aspects.
- Continue with the Horizon 2020 focus areas: according to the interim evaluation of Horizon 2020, the focus areas in Horizon 2020 have boosted the programme's internal coherence and its capacity to provide interdisciplinary solutions to multiple societal challenges. However, adopting over 20 focus areas with limited overall coordination resulted in confusion among stakeholders. Furthermore, the current strategic programming process for choosing focus areas and priorities for the challenge pillar involves end-users and citizens only to a limited extent. This leads to low awareness and acceptance of R&I driven societal transformation. Because the focus areas are virtual and do not always have clear objectives, they do not provide the necessary impetus to set the direction for public and private actors.
- Accelerator-type missions only: this alternative would imply that the 'Global Challenges' pillar would allocate funding exclusively to future accelerator missions. Each call in the challenge pillar programme would focus on one clear scientific, technological or industrial mission, with a clearly defined target and timeline to achieve it. The lack of focus on entire systems means that the transformative potential of accelerator missions would be smaller compared to transformer missions, which could mean not delivering on EU strategic challenges, contributing to EU policy-making and increasing cross-sectoral and cross-disciplinary cooperation. Furthermore, the accelerator missions would often be less relatable to citizens.
- Transformer-type missions only: under this scenario, the Challenges pillar would be structured to invest in future transformer missions, with a very large funding allocation. In the EU framework programme for R&I each call in the challenge pillar would be defined as a transformer mission, contributing to the overall EU policy agenda and a sustainable development. The complexity of transforming entire systems entails a fairly high risk of not

[167] This is the view of the ESIR expert group. In other words, contrary to the approach of previous EU Framework Programmes, setting up visible targets from the outset so that the future programme provides a reliable long-term framework incentivising private firms to invest in R&I reaping new markets. Public R&I investments have a higher economic impact if they are directed to specific missions, with targets set by policy in close interaction with both public and private actors.

[168] Foray, Dominique, David C. Mowery, and Richard R. Nelson. "Public R&D and Social Challenges: What Lessons from Mission R&D Programs?" *Research Policy* 41, no. 10 (2012): 1697–1702.

reaching the set mission, which could lead involved stakeholders to find it more difficult to see exactly what their role would be.

More widely, if the Global Challenges pillar only is implemented via missions, many of the current topics and calls that address specific policy needs could not be implemented since they do not require a large-scale intervention. Furthermore, many current R&I areas would no longer be tackled leading to a significant decrease in the capacities in these areas. This would make it difficult to pave the way for new missions in areas not covered by current ones.

2.5 How will the mission-oriented approach be implemented?

Only a part of the Global Challenges pillar would be implemented through missions, thus leaving room to operate more 'traditional' calls for proposals as in Horizon 2020. Future missions will often cut across the different programme parts for collaborative research, and thus they will require flexibility in implementation.

- Co-creation of potential missions with Member States, stakeholders, citizens and other actors will be a key part of the strategic programming process, while the choice of missions should be adaptable to future needs and policy priorities at EU level.
- Aligned with the guiding principles of Responsible Research and Innovation in ensuring that governance of science is fully transparent, citizens will thus be involved in the priority-setting of the missions.
- Missions will define the expected impact at call level, meaning that the calls for proposals can be more open than is the case in Horizon 2020 work programmes.
- If needed to achieve a particular mission, work will also be carried out to provide input to put in place a proactive regulatory framework that can be conducive to innovation.
- Involvement of end-users could be defined as an award criterion, or alternatively as an eligibility criterion, for project proposals.

Missions will be implemented using the existing Executive Agencies of the Commission and will largely use the same evaluation criteria as the rest of the Framework Programme. However, some specific features are foreseen as regards the evaluation of proposals under a specific future mission:

- The project proposers should be able to choose the most suitable instrument out of a given toolbox
- When evaluating project proposals under missions higher weighting for contributing to the mission impact could be introduced
- At the level of selecting project proposals, it should be possible to select proposals that are not in the ranking order as established by the evaluators, on the grounds that they are more likely to achieve the mission objectives;
- At the level of project management there should be an option to easily amend/terminate projects

2.6 Relevant studies

- Mission-Oriented Research and Innovation: assessing the impact of a mission-oriented research and innovation approach. The Joint Institute for Innovation Policy, Joanneum Research, Tecnalia, TNO, VTT, the Danish Technological Institute, and Valdani Vicari & Associati (2018).
- Citizen Participation in FP9: A model for mission and work programme engagement. Democratic Society, February 2018.
- Mission-Oriented Research and Innovation in the European Union: A problem-solving approach to fuel innovation-led growth, by Mariana Mazzucato. February 2018.
- Mission-Oriented Research and Innovation Policy: A RISE Perspective, February 2018.
- Towards a Mission-Oriented Research and Innovation Policy in the European Union: An ESIR Memorandum, December 2017.
- LAB-FAB-APP: Investing in the European future we want: Report of the High Level Group on Maximising the Impact of EU Research and Innovation Programmes, July 2017.
- European Commission (2017), Interim evaluation of Horizon 2020, Staff Working Document (SWD).

3 International R&I cooperation

3.1 Why do we need international R&I cooperation and why should this be done at EU level?

International cooperation in R&I is key to ensure that researchers and innovators in the EU have access to knowledge, knowhow and facilities that lie outside the Union. They need to collaborate with their counterparts worldwide to tackle increasingly interlinked global societal challenges and to ensure that companies in the EU stay competitive. EU-level action can more effectively shape multilateral R&I policy agendas and actions and framework conditions for cooperation.

The increasing scope and interconnectivity of global societal challenges require more international joint R&I action and coordination of R&I agendas. This is also seen in the increasing number of multilateral initiatives that have emerged in the last decade such as the Belmont Forum[169] and Mission Innovation[170], shaping the global R&I policy agenda and coordinating efforts.

With growing dominance of international collaborative research in knowledge production and the emergence of new countries as major R&I players, the EU needs to intensify its access to, and benefits from, the world's best talents, expertise and resources. Over the last decade, the EU's share of the world's gross expenditures in R&D has dropped from one fourth to one fifth. The EU's share of scientific publications has dropped from one third to one fourth and the EU share of patents has also dropped from one third to one fourth[171].

International cooperation is important to support to the internationalisation of innovative EU companies and their global scale-up, by removing barriers to enter global value chains and foreign markets. International co-invention of patents has increased significantly across almost all technologies over the last decade, and most countries have experienced significant increases in the share of foreign value added in exports and final consumption.

There are clear benefits of intensifying international R&I cooperation at EU level, compared to what can be achieved by Member States alone. Openness of the Framework Programme to third countries enhances the EU added value of the Programme itself, allowing EU participants to collaborate with the best minds in the world. The EU can more effectively shape policy agendas when represented as a single voice in multilateral fora and international organisations. The EU has a comparative advantage as compared to single Member States when negotiating bilateral agreements with third countries regarding framework conditions such as mutual openness of funding programmes or issues related to Intellectual Property Rights (IPR) protection. Thanks to the Framework Programme, Member States are enabled to cooperate with several third countries, including countries with which they do not have bilateral agreements.

What do we have now in Horizon 2020?

Association to the programme is limited to countries geographically close to Europe: Enlargement, EFTA and European Neighbourhood Policy countries, as well as countries already associated to FP7. Legal entities from Associated Countries can participate in actions under the same terms and conditions as entities from Member States.

[169] https://ec.europa.eu/research/environment/index.cfm?pg=belmont
[170] http://mission-innovation.net/
[171] Science, Research and Innovation performance of the EU (2016); World Intellectual Property Indicators, WIPO (2015).

Legal entities from non-associated third-countries can participate in projects in all parts of the programme, e.g. for mono-beneficiary grants, specific close-to-market innovation activities and actions for access to risk finance.

Third-country nationals are eligible to apply for ERC grants when the host institution is in a Member State or Associated Country. Third-country nationals are eligible for all MSCA actions except for Global Fellowships and for the European Reintegration Panel.

Except for a few cases, only participants from low- and middle-income countries are automatically eligible to receive EU funding. EU funding can be exceptionally granted to other third-country entities whose participation is deemed essential for carrying out an action.

What have we learned from Horizon 2020 Interim Evaluation?

Targeted international R&I cooperation initiatives are needed to pursue strategic cooperation.

Targeted activities are important incentives to attract international engagement. While topics that are particularly relevant for international cooperation correspond to around 25% of all Work Programmes' topics, they attract around 75% of international participation. Moreover, the established co-funding mechanisms with countries that are not eligible for funding have proven more effective in increasing their participation to the programme when combined with targeted activities, such as those with China that have to a high degree restored the initial drop of the country's participation. Much participation from countries eligible for funding is also due to targeted actions.

Association agreement with the programme does not necessarily lead to increased participation.

The programme's highly competitive, excellence-driven nature has led to noticeable disparity in the engagement of associated countries: participation of those with less advanced R&I systems is far more challenging than those with strong R&I systems. On the other hand, policy support, mobility and coordination actions have proven beneficial for some of the underperforming countries. For example, Switzerland, Norway, Iceland, Israel have long-standing participation in the EU Framework Programmes and a very strong performance. For ENP countries, the association has contributed to the integration of their R&I systems in the ERA, despite lack of national capacity needed to fully benefit from their association.

Secured (EU and third country) funding for R&I is an important incentive to attract international engagement.

EU funding has proven to be an important incentive for engaging third countries in the programme. The discontinuation in Horizon 2020 of the automatic funding to organisations from Brazil, Russia, India, China and Mexico caused an important decrease of their participation. Most countries for which the rules of funding remained the same did not experience such a significant drop. Third-country co-funding mechanisms can lead to increased participation. However, effectiveness depends on their implementation and successful communication to potential third-country applicants.

Investing in global multilateral R&I partnerships brings important benefits, but implementation can be improved.

Horizon 2020 shifted towards investing more on programmatic cooperation and multilateral instruments. This has contributed to better international coordination and leverage of investments from other countries. However, there is need for further rationalisation of funding schemes and there is space for improvement in the implementation of EU support to international initiatives.

What do stakeholders say?

Stakeholder provided the following recommendations for EU support to international R&I cooperation:

- Strengthen international R&I cooperation in the Framework Programme while encouraging reciprocity.
- Explore synergies between the Framework Programme and national R&I strategies, structures, instruments and networks to support strategic coordination of international cooperation in the Framework Programme.

- Use the Sustainable Development Goals to frame large-scale R&I missions and stimulate and steer international R&I cooperation on common global challenges.
- Organise the Framework Programme to facilitate access to and benefits from talent, knowledge, ideas and markets across the globe.
- Associate third countries to the Framework Programme based on their excellence in R&I, not confined to one part of the world.

3.2 What do we want to achieve with international cooperation?

International cooperation in R&I is indispensable for effectively tackling global challenges and for implementing global commitments. It will aim at:

- Attracting the participation of the world's top researchers, innovators and knowledge-intensive companies.
- Shaping the global R&I policy agenda, in particular for addressing common challenges and for achieving the Sustainable Development Goals.
- Contributing to Europe's efforts to harness globalisation by establishing fairer framework conditions with international partners.

3.3 What changes and what are the expected implications?

International cooperation will be intensified based on the following:

- Extend association to the Framework Programme, beyond EU enlargement, EEA countries and ENP countries, to include all countries with proven science, technology and innovation capacities to make cooperation and funding of joint projects as smooth as possible.
- Intensify support to international large-scale flagship initiatives, partnerships, bilateral and multilateral initiatives and joint programmes and calls, to increase EU access to researchers, knowledge and resources worldwide and optimise benefits from cooperation.
- The programme will continue to fund entities from low-mid income countries, and to fund entities from industrialised and emerging economies only if they possess essential competences.

What are the expected implications?

- **Improved excellence of the Programme.** Attracting and collaborating with the world's top researchers, innovators and knowledge-intensive companies reinforces the EU's science and technology base. Evidence shows that international collaboration increases the impact of scientific publications[172].

- **Higher influence of the EU in shaping global R&I systems.** This approach will enhance the EU leading role in setting the policy agenda, in particular for addressing common challenges and for achieving the Sustainable Development Goals. The mutual benefits of international cooperation strengthen EU leadership in the knowledge-intensive economy. The Programme will be an effective instrument in Europe's efforts to harness globalisation by removing barriers to innovation and by

[172] Within the Programme, peer-reviewed publications with at least one associated or third country have a higher impact than other ones: European Commission (2017), Interim Evaluation of Horizon 2020, SWD(2017) 220, book, p. 115.

establishing fairer framework conditions with international partners.

- **More impact from the Programme**. Increased international cooperation will reinforce EU R&I excellence and the creation and diffusion of high-quality knowledge in the EU. Cooperating internationally is indispensable as the scope and interconnectivity of global societal challenges increase and require more international joint action and coordination of agendas International openness of the innovation eco-systems will strengthen EU competitiveness by promoting a level playing field and enhancing supply and demand of innovative solutions. The association agreements with countries having excellent R&I capacities will facilitate mutual access to European and third-country know-how and markets as cooperation with top third country innovators facilitates access to expertise that is increasingly developed outside the EU.

3.4 What alternatives were considered?

The international dimension of the Framework Programme depends on its openness to association, participation and funding of third countries, as well as the scale of targeted international cooperation actions. Alternatives to a Framework Programme less 'Open to the World' than Horizon 2020 include, for instance, a Framework Programme without targeted actions, which would mean losing opportunities to pursue strategic international cooperation in line with EU priorities; a Framework Programme that would not fund entities from developing countries, which would be damaging since many of these countries play a major role in global efforts on tackling global challenges; and a Framework Programme excluding third-country entities from close-to-market activities, which would hamper prospects of EU-based companies to exploit growing supply of and demand for innovative solutions in new and emerging markets outside Europe.

3.5 How will international cooperation be implemented?

- The future Programme will be open to association of EU enlargement, EEA countries and ENP countries, as well as other countries with proven science, technology and innovation capacities. The rules governing their financial contribution should ensure a close approximation between payments and returns.

- The Programme will promote and integrate cooperation with international partner countries based on common interest and mutual benefit and identified based on their science and technology capabilities, market opportunities and impact on EU competitiveness, contribution to international commitments, and framework conditions for cooperation.

- The Programme will intensify synergies with EU external policies, e.g. to help build R&I capacity, support diffusion and uptake of innovation, and contribute to the EU's economic and development policy objectives.

- The general opening for participation of entities from all third countries will be maintained, while encouraging comparable reciprocal access to third country programmes.

- The Programme will continue to fund entities from low-mid income countries, and to fund entities from industrialised and emerging economies only if they

possess essential competences or facilities.

- Cooperation through strategic targeted initiatives will be reinforced with a wider use of a range of implementation tools:
  - Programme co-funds for supporting international partnerships, multilateral initiatives and joint programmes;
  - Joint, coordinated and twinning calls for bilateral and multilateral cooperation;
  - Calls for proposals on topics of broad scale and scope mandating or strongly encouraging third-country participation.

3.6 Relevant studies

- OECD Science Technology and Industry Scoreboard (2017).
- Science, Research and Innovation Performance of the EU (2016).
- "Global Catastrophic Risks ", Global Challenges Foundation (2017).
- "Rates of return to investment in science and innovation", prepared for the UK Dept. for Business, Innovation and Skills (2014).
- World Intellectual Property Indicators, WIPO (2015).
- European Commission (2016), Analysis of the International Positioning of the EU Using Revealed Comparative Advantages and the Control of Key Technologies.
- "Global Startup Ecosystem Report", Startup Genome LLC. (2017).
- "EU Industrial R&D investment Scoreboard", EC (2016).
- "Analysis of ERA-NET Cofund actions under Horizon 2020", Expert Group Report (2016).
- LAB-FAB-APP: Investing in the European future we want: Report of the High Level Group on Maximising the Impact of EU Research and Innovation Programmes, July 2017.
- European Commission (2017), Interim evaluation of Horizon 2020, Staff Working Document (SWD).

4 Open Science

4.1 Why do we need Open Science and why should it be supported at EU level?

Open Science entails a general shift towards a more open, collaborative, data-intensive and networked way of doing research and sharing research results. It supports the early sharing of research outputs in open access modes, empowers the participation of non-academic scientists in the research process (e.g. citizen-scientists), and. promotes an active engagement with the public.

Among stakeholders in Europe and internationally there is a shared understanding of the potential benefits of Open Science and of the fact that Open Science is the direction that research policy should be advancing. EU Member States are gradually establishing strategies for open access and Open Science, and have endorsed politically the transition towards an Open Science system in the Competitiveness Council Conclusions adopted in May 2016.

Open Science contributes to swiftly advancing research and addressing societal challenges, helps fight against unnecessary duplication, non-reproducibility of research, fraud and scientific misconduct. Traditional, closed scientific practices, on the other hand, are obstacles to scientific progress and limit the economic and social impact of science.

Open Science is needed to enhance the efficiency of EU support to R&I by facilitating the circulation and re-use of the excellent research and innovation funded by the Framework Programme. Supporting it at the EU level will accelerate the transition to Open Science in Europe, and its positive effects will be amplified by the wider scale at which they are implemented (e.g. more research data openly accessible leads to less duplication). Moreover, the European Commission already supports through Horizon 2020 Work Programmes the development of the European Open Science Cloud as the underpinning research data infrastructure for Open Science in Europe.

Challenges

Only some two thirds of scientific publications supported by the EU Framework Programme are openly accessible, locking them away from innovative SMEs, interested citizens, and fellow researchers.

There is a very large economic potential of opening up access to research outputs (including data) from publicly supported research. The estimated economic return on investment made for the Human Genome project is close to 10.

What do we have now in Horizon 2020?

Open access to publications: Open access to publications is mandatory, i.e. self-archiving ('Green OA') only or the combination of open access publishing with self-archiving ('Gold OA' combined with 'Green OA'). Open access publishing is encouraged and relevant costs eligible. Beneficiaries are encouraged by guidelines to keep enough (copy)right to self-archive but are not legally empowered to do so.

Open access to research data: Participation in the Open Research Data Pilot is the default for Horizon 2020 projects, and it requires them to develop a Data Management Plan (DMP). Under specific conditions it is possible to opt out from the Pilot at any stage of the proposal/project. There is no reference to FAIR data (Findable, Accessible, Interoperable, Re-usable). Data is 'as open as possible, as closed as necessary'.

What have we learned from Horizon 2020 Interim Evaluation? What have we learned from Horizon 2020 Interim Evaluation?

While Horizon 2020 has made great progress in terms of making the scientific publications and data it generates openly accessible to the wider scientific community and public, more can be done in this respect. In addition to further efforts for mainstreaming open access and open data practices, much remains to be done to promote broader Open Science practices.

Only ~61-68% of publications funded by Horizon 2020 appear to be actually available in open access. Participation rates in the Horizon 2020 Open Research Data Pilot for the years 2014-2016 were 68% of projects in the pilot's core areas, with an additional 9% voluntarily opting in (from non-core areas). For 2017, preliminary data indicates a participation rate of 62%.

What do stakeholders say?

- In the context of the Open Science Policy Platform established by the European Commission in 2016, representatives of the main stakeholders have issued detailed and consensual advice on how to further elaborate and implement Open Science policies.
- Adopting policies towards Open Science is recommended by the RISE high level advisory group for policy development, which supports the Commissioner in setting the policy agenda.
- Open Science and the significance of open data has been underlined in the G7 Science Communiqué in Turin (September 2017).
- Research performing organisations increasingly require open access to publications and data resulting from their funding, and incentivise Open Science practices through specific programmes or awards. Increasingly, universities are considering new ways to assess researchers' careers and requiring new types of research skills from researchers.

4.2 What do we want to achieve with Open Science?

The rather limited progress at the EU level in the transition towards Open Science, including on open access to research outputs, has been identified as one of the specific improvements to be made in the new Framework Programme. A reinforced support to Open Science will contribute to the Framework Programme objectives. More specifically, Open Science will aim at:

- Increasing the circulation of openly accessible high-quality scientific content to stimulate the rapid creation and diffusion of more high-quality scientific information;
- Improving the reproducibility and re-use of research data, and decreasing unwanted duplication;

- Participating in the globalisation of Open Science through G7/G20, GRC, initiatives on research data – both general (RDA) and sector specific, and as an integrated component of multilateral bilateral agreements (e.g. with CERN).
- Increasing and improving the level of openness, transparency and networked collaboration leading to a higher degree of responsiveness of the research community to societal challenges;
- Sponsoring trustworthy and more accessible science from the point of view of citizens and civil society organisations, by engaging with them in the programming and conduct of scientific activities.
- Fostering innovation, in particular among innovative SMEs by facilitating and accelerating access to cutting edge discoveries.

4.3 What changes and what are the expected implications?

- The open access mandate for publications will be simplified with more straightforward provisions; enabling conditions will be put in place for authors/beneficiaries to be able to comply with it.
- Open access to research data will be disambiguated from Data Management Plans (DMPs) and emphasis will be placed on sound research data management. While the open data mandate will continue to apply by default but with opting-out possibilities in duly justified cases under the principle 'as open as possible, as closed as necessary', the development and implementation of a DMP will be an obligation for all projects producing data.
- Emphasis will be placed on supporting as much as possible the proliferation of data that is Findable, Accessible, Interoperable and Re-usable (FAIR).
- The Programme will fully embrace and support Open Science as the new research *modus operandi*.

What are the expected implications?

- **Increase the availability of scientific output in open access**. A higher percentage of projects will make their outputs (publications, data, algorithms etc.) available in open access because of the simplification of provisions, the stricter formulation of exceptions, and financial support provided through the Programme.

- **Higher levels of excellent research and innovation.** Placing high quality content in the open, and stimulating knowledge diffusion, improves science communication and enables interdisciplinary research. Large bodies of peer-reviewed scientific information will be made available to everyone and across global challenges.

- **Increased accessibility to high quality digital content**. Data are increasingly becoming the starting point for innovation, with high returns. With digitisation, it can be expected that SMEs and other companies will base new business models on digital content, hence will reap the benefits of a strengthened Open data environment in Europe and maximise the exploitation of digital resources through reusability.

- **Higher societal impact.** The Programme will improve reach-out and involvement of citizens in the research process, contributing to building a society based on knowledge and education. Open science allows citizens to be part of the research process (for example through citizen science), helping lifelong learning and developing an informed society for the 21st century challenges.

4.4 What alternatives were considered?

Alternatives consisting of softer policy or no open access policy were ruled out for a variety of reasons: firstly and most importantly, they do not contribute towards but rather go against the objectives of the Framework Programme for the circulation of knowledge and enhancing open science. Studies show that non-binding funder and institutional open access (as opposed to mandates), lead to limited uptake of the policies.[173] It is therefore to be expected that going back on the requirements of the current policy would result in less uptake than we currently observe (roughly 61% for publications) with all the relevant disadvantages for research, innovation and society described above (cf. section on problem definition). Further, discontinuing an open access policy, or open research data policy, would be against coordinated initiatives of funders and MS described earlier and is not expected to enjoy political support.

4.5 How will Open Science be implemented?

- Open access will be adapted to the evolving scholarly communication environment. Open access to all scientific publications will continue to be mandatory and requirements will be introduced for beneficiaries to ensure that they or the authors retain sufficient intellectual property rights to ensure compliance with the open access requirements. Early sharing of publications (pre-prints) will satisfy open access requirements. Article Processing Charges will be eligible for purely open access publishing venues (i.e. not 'hybrid' journals)..
- Data Management Plans will be required of all projects producing research data in view of making Data Management an integral part of the research process.
- Open access to research data will be the general rule following the principle 'as open as possible, as closed as necessary'; possibilities for exceptions will be available for duly justified reasons (e.g. concerns related to commercial exploitation, protection of personal data or confidentiality/security).
- Open access to other related research outputs will be promoted (e.g. to software, algorithms).
- Mandatory technical standards will be crafted to ensure that scientific information, publications, data and other outputs, as well as the metadata about them is available for re-use in the long term. This includes the use of persistent and unique identifiers, the use of certified repositories that are compliant to the standards of the European Open Science Cloud; finally, it includes complying to the FAIR principles for the management of research data produced by projects.
- Requirements for recognized good Open Science practices for the entire research cycle will become embedded in select work programmes, depending on the scientific discipline and their particular focus.
- Financial incentives to encourage Open Science practices may be deployed in some work programmes as incentives for full compliance with good Open Science practices. This will also concern training and development for researchers seeking to acquire and improve their skills in Open Science.
- As to rewards for Open Science, a label will be introduced to recognise universities which embody modern, collaborative practices.
- Research integrity will be fully incorporated in guidance documents and likewise

[173] A. Swan, 2015. *Open Access policy effectiveness: A briefing paper for research institutions*, PASTEUR4OA project policy resources, DOI: 10.5281/zenodo.54748 (Open Access Policy Alignment STrategies for European Union Research (611742)).

the Commission will promote the adaptation of the European Code of Conduct for Research Integrity in order to accompany the support of Open Science. Minimum scientific quality requirements (e.g. publishing research protocols) will also be foreseen.

- In order to build effective co-operation between science and society, funding will be ensured for Citizen Science, as well as dedicated parts of the Framework Programme. Specific Key Performance and Impact Indicators linked to citizen science activities will also be set.
- Combined with qualitative expert assessment, next generation metrics will be used to accurately capture the uptake of Open Science.
- Open Science will be an element to consider in the evaluation of proposals.

4.6 Relevant studies

- Tennant JP, Waldner F, Jacques DC et al. (2016), The academic, economic and societal impacts of Open Access: an evidence-based review. F1000Research 2016, 5:632 (doi: 10.12688/f1000research.8460.3).
- Kittrie E, Atienza AA, Kiley R, Carr D, MacFarlane A, Pai V, et al. (2017) Developing international open science collaborations: Funder reflections on the Open Science Prize. PLoS Biol 15(8): e2002617. https://doi.org/10.1371/journal.pbio.2002617
- LAB-FAB-APP: Investing in the European future we want, Report of the High Level Group on Maximising the Impact of EU Research and Innovation Programmes, July 2017.
- European Commission (2017), Interim evaluation of Horizon 2020, Staff Working Document (SWD).

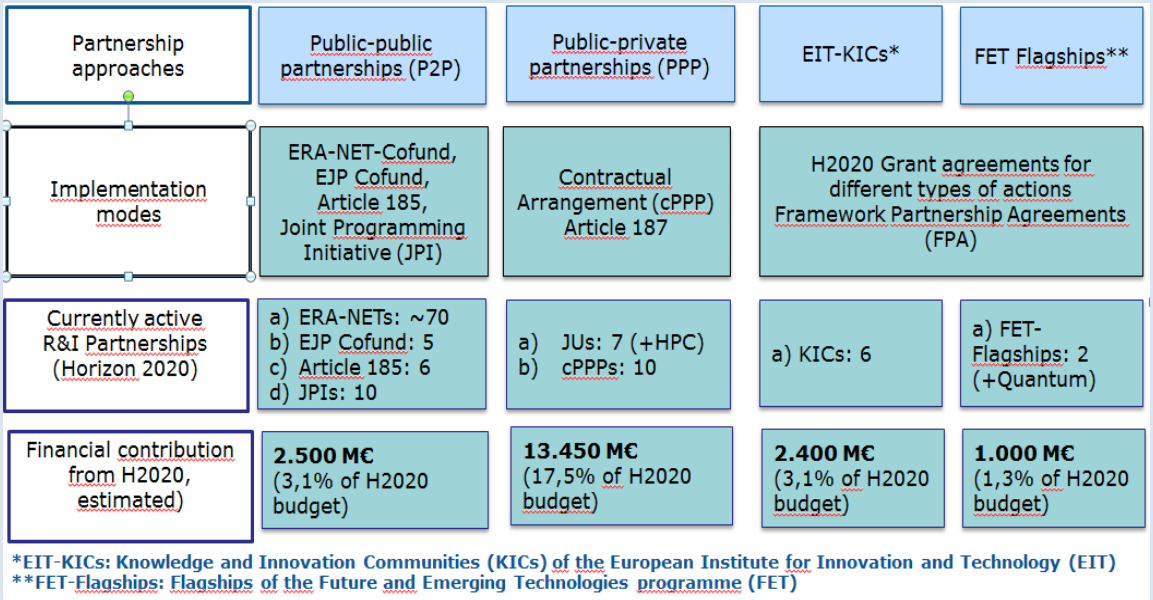
5 European Partnerships

5.1 Why do we need research and innovation partnerships at EU level?

Through research and innovation (R&I) partnerships, the Framework Programme since 2002 pools resources between the European Union (EU), the private sector and the Member States to tackle big challenges, support competitiveness and jobs, develop closer synergies with national and regional programmes, and encourage greater public and private investment in research and innovation. Beyond supporting the development of a true European Research Area (ERA), EU-wide partnerships provide EU added value by contributing to the openness and transnational cooperation in R&I in Europe. They also provide leverage and directions for European R&I investments to address common policy objectives.

What do we have now in Horizon 2020?

Figure 20 Overview of R&I partnerships supported under Horizon 2020, including their implementation modes



Horizon 2020 supports two broad categories of partnerships:

- **Public-private partnerships** (PPP): mainly involving industry, i.e. Article 187 initiatives and contractual PPPs (cPPPs); and
- **Public-public partnerships** (P2P): involving mainly Member States, i.e. Article 185 initiatives, ERA-NET Cofund, European Joint Programming-Cofund (EJP-Cofund) and Joint Programming Initiatives[174].

In addition it supports **other types of partnerships** through the Future and Emerging Technologies (FET) Flagships and the Knowledge and Innovation Communities of the European Institute of Innovation and Technology (KICs).

What are the criteria for the identification of R&I partnerships under Horizon 2020?

Public-private partnerships (Article 25 of Horizon 2020 Regulation)

1. Horizon 2020 may be implemented through public- private partnerships where all the partners concerned commit to supporting the development and implementation of pre- competitive research and of innovation activities of

[174] Not included here are the European Innovation Partnerships (EIPs) as they do not entail EU support for direct R&D activities.

strategic importance to the Union's competitiveness and industrial leadership or to addressing specific societal challenges. Public- private partnerships shall be implemented in such a way that full participation of the best European players is not impeded.

2. The involvement of the Union in public-private partnerships shall make use of the pre-existing and lean governance structures and may take one of the following forms:

(a) financial contributions from the Union to joint undertakings established pursuant to Article 187 TFEU under the Seventh Framework Programme, subject to the amendment of their basic acts; to new public-private partnerships established pursuant to Article 187 TFEU; and to other funding bodies referred to in points (iv) and (vii) of point (c) of Article 58(1) of Regulation (EU, Euratom) No 966/2012. This form of partnerships shall only be implemented where the scope of the objectives pursued and the scale of the resources required justify it taking full account of the relevant impact assessments, and where other forms of partnerships would not fulfil the objectives or would not generate the necessary leverage;

(b) contractual arrangements between the partners referred to in paragraph 1, which specify the objectives of the partnership, respective commitments of the partners, key performance indicators, and outputs to be delivered, including the identification of research and innovation activities that require support from Horizon 2020.

With a view to involving interested partners, including, as appropriate, end-users, universities, SMEs and research institutions, public-private partnerships shall make public funds accessible through transparent processes and mainly through competitive calls, governed by rules for participation in compliance with those of Horizon 2020. Exceptions to the use of competitive calls should be duly justified.

3. Public-private partnerships shall be identified and implemented in an open, transparent and efficient way. Their identification shall be based on all of the following criteria:

(a) the demonstration of the added value of the action at Union level and of the choice of the instrument to be used;

(b) the scale of impact on industrial competitiveness, job creation, sustainable growth and socio-economic issues, including societal challenges, assessed against clearly specified and measurable objectives;

(c) the long-term commitment, including a balanced contribution from all partners based on a shared vision and clearly defined objectives;

(d) the scale of the resources involved and the ability to leverage additional investments in research and innovation;

(e) a clear definition of roles for each of the partners and agreed key performance indicators over the period chosen;

(f) complementarity with other parts of Horizon 2020 and alignment with the Union research and innovation strategic priorities, in particular those of the Europe 2020 strategy.

Where appropriate, complementarity between priorities and activities and the involvement of Member States shall be ensured in public-private partnerships.

4. The research priorities covered by public-private partnerships may, where appropriate, be included in regular calls in Horizon 2020 work programmes, in order to develop new synergies with research and innovation activities of strategic importance.

Public-public partnerships (Article 26 of Horizon 2020 Regulation)

Horizon 2020 shall contribute to the strengthening of public-public partnerships, as and when appropriate, where actions at regional, national or international level are jointly implemented within the Union. Particular attention shall be paid to Joint Programming Initiatives between Member States. Joint Programming Initiatives receiving support from Horizon 2020 shall remain open to the participation of any Member State or associated country.

Public-public partnerships may be supported either within, or across, the priorities set out in Article 5(2), in particular through:

(a) an ERA-NET instrument using grants to support public- public partnerships in their preparation, establishment of networking structures, design, implementation and coordination of joint activities, as well as Union topping-up of no more than one joint call a year, and of actions of a transnational nature;

(b) Union participation in programmes undertaken by several Member States in accordance with Article 185 TFEU where the participation is justified by the scope of the objectives pursued and the scale of the resources required.

For the purposes of point (a) of the first subparagraph, top-up funding shall be conditional on the demonstration of the added value of the action at Union level and on prior indicative financial commitments in cash or in kind of the participating entities to the joint calls and actions. One of the objectives of the ERA-NET instrument may, where

possible, be to harmonise rules and implementation modalities of the joint calls and actions. It may also be used in order to prepare for an initiative pursuant to Article 185 TFEU.

For the purposes of point (b) of the first subparagraph, such initiatives shall only be proposed in cases where there is a need for a dedicated implementation structure and where there is a high level of commitment of the participating countries to integration at scientific, management and financial levels. In addition, proposals for such initiatives shall be identified on the basis of all of the following criteria:

(a) a clear definition of the objective to be pursued and its relevance to the objectives of Horizon 2020 and broader Union policy objectives;

(b) indicative financial commitments of the participating countries, in cash or in kind, including prior commitments to align national and/or regional investments for transnational research and innovation and, where appropriate, to pool resources;

(c) the added value of the action at Union level;

(d) the critical mass, with regard to the size and the number of programmes involved, the similarity or complementarity of activities and the share of relevant research they cover;

(e) the appropriateness of Article 185 TFEU for achieving the objectives.

Proposals for Article 185 initiatives shall be identified on the basis of all of the following criteria:

a) a clear definition of the objective to be pursued and its relevance to the objectives of Horizon 2020 and broader Union policy objectives;
b) indicative financial commitments of the participating countries, in cash or in kind, including prior commitments to align national and/or regional investments for transnational research and innovation and, where appropriate, to pool resources;
c) the added value of the action at Union level;
d) the critical mass, with regard to the size and the number of programmes involved, the similarity or complementarity of activities and the share of relevant research they cover;
e) the appropriateness of Article 185 TFEU for achieving the objectives.

Other partnerships – EIT Knowledge and Innovation Communities (EIT Regulation and SIA)

The European Institute of Innovation and Technology selects and designates partnerships into Knowledge and Innovation Communities according to the priority fields and time schedule defined in the EIT Strategic Innovation Agenda. This selection and priority-setting process is governed by the EIT Regulation[175].

The interim evaluations of Horizon 2020-supported partnership initiatives show how effective they are in leveraging significant additional private and public funding and in aligning R&I priorities across Europe.

Public-public partnerships under Article 185, e.g. Eurostars2, European and Developing Countries Clinical Trials Partnership 2 (EDCTP2) have created long-term R&I partnerships and networks between research funders and governments, thus contributing to the European Research Area (ERA). They mobilise significant investment in transnational research projects in important policy areas, with an increasingly global action remit. The key strength for all **public-private partnerships** under Article 187, e.g. CleanSky2 JU, Bio-Based Industries (BBI JU), is their ability to engage and leverage strategic industry partners in priority areas of action for the Union, across borders and business sectors, and their direct contribution to competitiveness and EU policy goals. They link activities across the innovation cycle, and help overcome fragmentation in their respective sectors by creating long-lasting precompetitive collaborative networks that bring together previously unrelated stakeholders. **Contractual PPPs**, e.g. Factories of the Future (FoF), Energy-efficient Buildings (EeB), were found to have broadly achieved their goals, being flexible and efficiently managed, bringing together major industrial partners in EU-driven strategies, with mutual understanding of deliverables by industry and a high level of transparency, and openness in participation, including of SMEs**. The KICs of the EIT** succeeded in creating a portfolio of nearly 250 supported star-ups and scale-ups and were able to raise nearly 300 M€ of equity investments.

[175] https://publications.europa.eu/en/publication-detail/-/publication/cc76ff75-6bff-11e3-9afb-01aa75ed71a1/language-en

Challenges

Need to rationalise the European R&I partnerships landscape

There are so far close to 100 different R&I partnerships, of which around 80 Public-Public Partnerships, in Horizon 2020. Multiple partnership structures and networks are established without clear exit strategies for the EU funding. This results in the risk of a static system that gives preference to the continuation of existing partnerships without self-sustainability, instead of creating opportunities for new ones of greater relevance.

Need to improve the openness and transparency to launch future European R&I partnerships

Smaller actors and R&D less-intensive countries and regions often do not have necessary (human) resources to participate on equal terms. 46 % of Horizon 2020 funding in Joint Undertakings goes to 3 Member States and 18% of PPP funding go to SMEs (23% in the case of cPPPs). This is a barrier for a more optimal and inclusive participation of all types of stakeholders, favouring rather closed incumbents networks from a limited number of countries and hampering the diffusion of knowledge across borders, sectors, disciplines and along the value chain.

Need to link European R&I partnerships to future EU R&I missions and strategic priorities

There is limited coherence between R&I partnerships within certain thematic fields (including obvious thematic overlaps) and between the R&I partnerships and priorities of the Framework Programme: This tends to favour partnerships which have a strong political support, without ensuring a selection towards partnerships with the highest impact probability in complementarity with actions of the Framework Programme.

What have we learned from evaluations on the areas for improvement for R&I partnerships?

The **Horizon 2020 Interim Evaluation** concludes that the overall partnership landscape has become overly complex and fragmented. While the overall number of R&I partnerships in Horizon 2020 is about 100, they represent on average about 25% of the available Horizon 2020 budget with PPPs (cPPPs and JTIs) accounting for about 17.5% of the Horizon 2020 budget. The interim evaluation identifies the need to rationalise the overall European research and innovation partnership landscape, improve their openness and transparency, and link them with future EU R&I missions and strategic priorities.

The **Article 185 evaluation** finds that the EU public-to-public cooperation (P2P) landscape has become crowded, with too many similar initiatives working with insufficient coherence among the P2Ps, as well as between the P2Ps and Horizon 2020.

The **Article 187 evaluation** points out that Public-Private Partnership (PPP) activities need to be brought more in line with EU, national and regional policies, and calls for a revision of the Key Performance Indicators.

The **contractual PPPs** (cPPPs) review identified challenges of coherence among cPPPs and the need to develop synergies with initiatives such as **KICs.**

The EIT evaluation identifies the need to develop further synergies with other EU initiatives (at programming and implementation level) such as other parts of Horizon 2020 and the thematic smart specialisation platforms (TSSPs), funded through the Structural funds.

5.2 What do we want to achieve with a new approach to European R&I partnerships?

The objective for the use of partnerships under Horizon Europe is to improve substantially the quality and impacts of R&I investments in Europe by supporting more coherent and integrated use of public and private investments at programming level.

A more effective and smarter use of Partnerships requires a more strategic and ambitious approach that is impact-oriented and ensures complementary with the Framework Programme, with the

Commission as active facilitator for selection and set-up of partnerships. A revised approach for R&I partnerships aims at:

- Preparing for a new generation of R&I partnerships based on common guiding principles and an objective- and impact driven intervention logic in order to achieve impacts from EU funding that cannot be achieved with other action under the Framework Programme or national action alone;
- Setting and applying clear criteria for the establishment, implementation, monitoring and phasing out of partnerships under the Framework Programme, including clear exit strategies thus contributing to a rationalisation of the European R&I partnership landscape;
- Catalysing a more open and integrated use of public and private R&D investments on common EU strategic priorities, in particular future R&I missions and EU strategic priorities;
- Ensuring more participation of different types of stakeholders from different countries and regions in R&I partnerships.

5.3 What changes and what are the expected implications?

An overall R&I partnership strategy based on an objective- and impact driven intervention logic will be developed and implemented in order to ensure that R&I partnerships are established only in cases where impacts need to be created that cannot be achieved by other Framework Programme's action or national action alone. The strategic planning process of the Framework Programme will frame the establishment of European Partnerships. This will ensure that the next generation of partnerships will support agreed EU priorities and will lead to a rationalised R&I landscape, with fewer, but more targeted initiatives receiving co-funding/investment from the Framework Programme. All future European Partnerships will be designed on the basis of the same guiding principles of Union added value, transparency, openness, impact, leverage effect, long-term financial commitment of all the involved parties, flexibility, coherence and complementarity with EU, national, regional and international initiatives.

The design and implementation of future European Partnerships will include an improved coherence between Framework Programme's actions and R&I partnerships, as well as among initiatives. In addition, communication and outreach will be strengthened by a clear, easy-to-communicate architecture under the umbrella term "European Partnerships". This encompasses all Partnerships with Member States, Associated or Third Countries and/or other stakeholders such as civil society/foundations and/or with industry (including small and medium sized enterprises), with greater openness to international cooperation. European Partnerships will only be developed on agreed EU policy priorities in the context of the Framework Programme, and subject to the commitment of partners to align their own investments, programmes and priorities, and will be limited in time with clear conditions for phasing out from the Framework Programme funding.

There will be only three types of intervention modes (i.e. several Horizon 2020 labels like P2P, PPP, ERA-NET, FET Flagship and cPPP will be discontinued):

i) co-programming between the EU, Member States, and/or other stakeholders, based on Memoranda of Understanding or contractual arrangements with partners;
ii) co-funding of R&I activities, based on a single, flexible programme co-fund mechanism;
iii) institutionalised partnerships (based on Art. 185 or 187 TFEU, EIT regulation for KICs).

Table 15 European Partnerships – a simplified implementation for more impact

	Co-programmed European Partnerships	**Co-funded** European Partnerships	**Institutionalised European Partnerships**
Objective	To **encourage** public and private stakeholders to co-programme, co-invest and coordinate their R&I priorities together with the Commission	To **provide EU support to a joint programme of** public and/or private stakeholders to tackle EU strategic priorities through research and innovation	To **commit** in the long-term for shared investments in research and innovation with public and private stakeholders in key strategic areas with international visibility and impact
Coverage of FP support	Parts of the FP work programme largely defined by the partners but implemented through FP rules	Co-funding and policy collaboration between the EU, Member-States/ associated countries and other private non for profit organisations such as foundations to achieve impacts that FP action alone cannot achieve	EU commitment for shared investments with public and private stakeholders based on individual legal acts.
Changes compared to schemes existing under Horizon 2020	Replaces cPPP	Replaces ERA-NETs, EJP, FET Flagships	Art 185 of the Treaty on the Functioning of the European Union (TFEU): institutionalised public-public partnerships Art 187 TFEU: institutionalised public-private partnerships
Thematic coverage	Delivering on FP global challenges and R&I missions across the whole FP		
Target groups	Member States, industry (including small and medium sized enterprises) and civil society organisations/foundations		
Changes in priority setting process	Only developed on agreed EU priorities in the context of the FP, based on pre-defined criteria		
Changes in implementation mode	Memoranda of Understanding and/or contractual arrangements FP contributions for coordination costs through the Work Programme (incl. comitology), e.g. through Coordination and Support Actions	Cofund actions implemented through the Work Programme (incl. comitology) conditional to partners fulfilling their commitments and obligations. More flexibility in support for joint actions, including financial support to third parties in the form of grants, prizes and investments/loan guarantees.	Art 187: Implemented via a Council Regulation Art 185: Implemented via a Decision by European Parliament and Council
Changes in governance model	An overall 'strategic coordinating process' will advise on selection, implementation, monitoring and phasing out of future European Partnerships as part of the overall strategic programming process for the Framework Programme.		

What are the expected implications?

- **More coherence and better impacts through limited number of partnerships with clear intervention logics and fully applied criteria for establishment, implementation, evaluation and phasing-out.** The new generation of R&I partnerships, both renewed and new ones, will be based on a clear rationale for the use of R&I partnerships, the elaboration of distinct and clear intervention logics based on policy objectives and the application of an impact-based criteria framework along the life cycle of R&I partnerships, including their phasing-out. This revised policy approach will lead to a smaller number of R&I partnerships and thus improve the overall coherence and readability of the European R&I ecosystem. The toolbox will be simplified with three types of intervention under the umbrella "European Partnerships": co-programming of R&I agendas; co-funding of research and innovation activities between the EU and public and private stakeholders to deliver on EU strategic priorities; institutionalised R&I partnerships under Article 185 and Article 187 TFEU, respectively.

  The main implications besides an overall smaller number of European Partnerships will be that more public and private R&I investments in Europe will be directed towards commonly shared European policy objectives, thus reducing the R&I related risks for business and strengthening the societal impacts stemming from R&I investments in Europe. The strengthening of cross-border R&I cooperation within European Partnerships will have positive implications for the excellence of the European science system and contribute to the deepening of the single market for knowledge based activities.

- **More openness and flexibility through partnerships open to all types of stakeholders (Member States, civil society/foundations and industry, including small and medium sized enterprises) with no entrance barriers for newcomers, smaller R&I players**. The future generation of R&I partnerships will respond better to the needs and priorities of all EU Member States and other stakeholders, notably industry and foundations. Overall openness will be strengthened by a more strategic and revised policy approach, closely linked to the overall strategic programming of the Framework Programme. Flexibility will be encouraged with the simplified toolbox and a life cycle based planning and implementation approach.

  The main implications will be that more Member States and more stakeholder groups, in particular foundations will be active partners in the European Partnerships. A broader set of joint actions beyond joint calls between the partners will substantially increase the flexibility of the partnership initiatives according to the specific needs and objectives and thus increase impacts, in particular policy and societal impacts.

Enhance impact and visibility of EU R&I funding. R&I partnerships have the potential to substantially expand the impacts of EU R&I funding by leveraging additional R&I investments on EU priorities, by providing 'directionality' to public and private R&I investments and by

reaching out to broader stakeholders thus improving the uptake of innovative solutions and enhance the visibility of the Framework Programme. The future design of R&I partnerships will ensure that these potentials for additional impacts will be exploited by encouraging a broader scope of joint activities, by ensuring clearer intervention logics for the use of R&I partnerships and by encouraging more open participation pattern in R&I partnerships. The main implications will be that the up-take of innovative solutions will be facilitated, both in national/regional policies and in new products and processes. Overall, EU support to partnerships will have quantitative and qualitative impacts on the further completion of the ERA and thus on the quality of Europe's R&I ecosystem. The more strategic use of partnerships on EU level will be echoed at national and industry level and contribute in turn to higher and better commitments from partners and to a better recognition and visibility of EU's R&I policy and support measures. The overall 'absorptive capacity' for uptake of innovative solutions in Europe will be strengthened.

5.4 What alternatives were considered?

Taking into account the stakeholder suggestions on the improvement of the EU R&I partnership landscape, the following policy alternatives have been considered and discarded:

- Discontinuation of EU R&I partnerships. Support to any kind of partnerships in the future Programme would be discontinued.
- Continuation of approach to partnerships as implemented under Horizon 2020. The forms and criteria for establishing EU R&I partnerships under Horizon 2020 would continue to exist. The development of a more coherent and strategic partnership approach would not be addressed, as transaction costs and potential impacts are assessed as being not balanced. Still, a substantive part of the available budget of the Framework Programme (between 25-40% according to Horizon 2020 experience) would be "locked" in continuing existing partnerships. The scope of activities would continue to be largely limited to the implementation of joint calls and the management of corresponding transnational R&I projects. The existing partnerships would be mostly continued and their growing maturity would raise the risks of a rather closed set of beneficiaries with limited openness and transparency.
- Simplification: limitation of EU R&I partnerships to coordination. The EU R&I partnership landscape would be simplified by limiting the number of different forms of partnerships. Two sub-alternatives were identified:

  a) Only coordination actions: 'Coordination and support actions (CSAs)' would be used to facilitate and catalyse the alignment of national and/or industry related R&I programmes in Europe. In contrast to the second alternative, this would be organised in a competitive way and not linked to the strategic priorities of the EU Framework Programme . This new approach would facilitate the emergence of new networks and topics to addressed in a coordinated way and have a stronger impact on the overall 'openness' of national and/or sectorial R&I systems.

  b) Only joint co-funding: the EU Framework Programme would co-fund joint efforts by Member States and/or industry sectors in a small number of overall EU priorities, clearly linked to the priorities of the Framework Programme. On the other hand, the EU Framework

Programme would discontinue support coordination of national and/or sectorial R&I priorities. As a result, the number of co-funded R&I partnerships would decrease and thus the complexity of the partnership landscape. The focus of co-funding on the priorities of the Framework Programme would substantially improve the strategic positioning of the R&I partnerships in the overall priorities of the Framework Programme and thus the coherence and complementarity between the direct EU action and the corresponding partnerships. The mandatory co-funding, following largely the rules for participation of the Framework Programme, might however discourage industry and other private non-for-profit stakeholders such as foundations, to participate in the R&I partnerships, as they prefer an administratively simple and relatively fast cooperation framework.

- Maximising EU R&I Partnerships. Partnerships would be used as default option for Framework Programme implementation with direct funding as exception.

All alternatives presented are legally feasible, as they are covered by the TFEU and would not require additional new legislative action (except for articles 185/187 TFEU initiatives). The technical feasibility of the alternative 4 'Maximising EU R&I partnerships' is regarded as limited as it would require a complete overhaul on the currently applied and tested priority setting procedures for the next Framework Programme. The political feasibility to discontinue support is regarded as very low, as political resistance in Member States and by industry would be high. The coherence with other EU policy objectives is for the two policy alternatives 'discontinuation' and 'maximising partnerships' limited, as the potential of R&I partnerships to address broader EU policy objectives, notably growth and competitiveness and tackling global challenges jointly, would not fully be used.

5.5 How will the revised research and innovation partnerships be implemented?

In order to implement the changes the following elements need to be developed:

- The establishment of European Partnerships framed by the strategic planning process of the Framework Programme to ensure delivery on agreed EU strategic priorities;
- The development and use of an objective- and impact-based criteria framework along the life cycle of European Partnerships - developed together with Member-States - for the selection, implementation, monitoring, evaluation and phasing out of European Partnerships ;
- New modes of governance for European Partnerships, in order to ensure the value, Union visibility and outreach of all European Partnerships.

The revised approach to European Partnerships will limit them to three different types:

a) Co-programmed European Partnerships:

- This mode is the simplest, fastest and least bureaucratic in implementation, with the legal basis for the European Partnerships being political Memoranda of Understanding (MoU)/ contractual arrangements with public and/or private partners (extended cPPP model), specifying the objectives of the partnership, related commitments for financial and/or in-kind contributions of the partners, key performance and impact indicators, and outputs to be delivered and comitology for the respective contributions from the Framework Programme;
- The MoU specifies the partners' commitment to invest in the area and coordinate programmes and activities. They implement their programmes, activities and investments under their responsibility;

- The Commission implements its part in the Work Programme with calls for proposals, based on indicative commitments for ring-fenced budgets. In addition, if necessary, the coordination between partners can be supported via the standard instrument, i.e. the Coordination and Support Action.

b) Co-funded European Partnerships:

- This implementation mode will be applied if the integration of all activities in a single programme is necessary to achieve the objectives;
- The legal basis will provided under the respective Work Programme (comitology), providing Framework Programme funding for Programme Cofund actions (simplified instrument, open also to civil society organisations such as foundations);
- It will be used to co-fund the European Partnerships for the implementation of a joint programme of activities, based on the commitment of the partners for financial and in-kind contributions and integration of their relevant activities;
- The initiatives will be implemented on the basis of Annual Work Plans, subject to the approval by the Commission Services as part of their supervision of the grant agreement. The programme of activities may support networking and coordination, research, innovation, pilot and market deployment, training and mobility, awareness raising and communication, dissemination and exploitation, or a combination thereof, directly implemented by those entities or by third parties to whom they may provide financial support in the form of grants, prizes, procurement, as well as financial instruments such as investments or loan guarantees.

c) Institutionalised European Partnerships[176]:

- This implementation mode, based on Article 185 and 187 of the TFEU, is the most complex in preparation and will be implemented in cases required by the Treaties and where a political validation outside the comitology is necessary via a Council Regulation (or Decision by EP and Council, for Article 185 TFEU initiatives), and where other forms of European Partnerships would not fulfil the objectives or would not generate the necessary expected impacts, and if justified by a long-term perspective and high degree of integration including central management of all financial contributions;
- The legal basis is the respective basic act, the delegation agreement with a Dedicated Implementation Structure or Joint Undertaking, and Annual Work Programmes, as requested by the Financial Regulation and Financing Decisions requiring Commission Decision.

5.6 Relevant studies

- European Commission (2017), Interim evaluation of Horizon 2020, Staff Working Document (SWD).
- European Commission (2017), Participation of the EU in research and development programmes undertaken by several Member States based on Article 185 of the TFEU, Staff Working Document (SWD).
- European Commission (2017), Interim Evaluation of the Joint Undertakings (JUs) operating under Horizon 2020, Staff Working Document (SWD).
- European Commission (2017), Interim evaluation of the European Institute of Innovation and Technology (EIT), Staff Working Document (SWD).
- European Commission (2017), LAB – FAB – APP: Investing in the European future we want, Report of the independent High Level Group on maximising the impact of EU Research & Innovation Programmes.
- European Commission (2017), FET Flagships – Interim evaluation.
- European Commission (2017), Mid-term review of the contractual Public Private Partnerships (cPPPs) under Horizon 2020, Report of the independent expert group.

[176] As the EIT/KICs are set-up along clear mechanisms specified in the EIT regulation, they are not included here.

- European Parliament (2017), REPORT on the assessment of Horizon 2020 implementation in view of its interim evaluation and the Framework Programme 9 proposal.
- European Research Area and Innovation Committee (ERAC) (2017), ERAC Opinion on the Interim Evaluation of Horizon 2020 and preparations for the next Framework Programme.

6 Strengthening the European Research Area - Sharing excellence

6.1 Why do we need to share excellence and why should it be supported at EU level?

The Framework Programme is based on excellence and every entity, regardless its origin, can benefit from the Programme as long as all the criteria are met. While pockets of scientific excellence exist in all EU countries, they are scattered. Moreover, despite serious efforts deployed at national and European level, disparities in terms of research and innovation performance persist among EU Member States, as confirmed by the European Innovation Scoreboard 2017[177]. The ERA Progress Report 2016[178] also concluded that large disparities, both in performance levels as in growth rates between countries in the field of research and innovation exist and that there is still much room for further progress on European Research Area (ERA).

Different analyses[179] agree on a number of reasons for these disparities, the most important being: 1) low national and regional R&I investments; 2) insufficient creation and diffusion of high-quality knowledge and innovation; 3) insufficient connectivity and visibility and international cooperation; 4) inadequate R&I framework conditions; 5) sub-optimal functioning R&I systems; 6) low involvement and information of beneficiaries and lack of skills in participating in Framework Programmes.

Additional obstacles[180] often highlighted are information and language barriers; lack of research networks; lack of leading Universities and Research organisations leaders in proposal matters; weak training in preparing successful proposals and in project management; little experience in cross-country cooperation; generally low focus on R&I in policy and in business; few options for exploitation of research results at the national level. Furthermore, there is a cognitive distance[181] between the scientific and technological portfolio of prospective participants from the countries which joined the EU after 2004 (EU13) and the portfolio of the more successful EU15 and prospective participants from the EU13 are not good enough relative to the EU15. Both the Horizon 2020 interim evaluation and other studies highlight that, while EU13 have lower rate of participation and success compare to EU15, the dichotomy is not so clear and the two groups are not homogeneous in their inside. In addition, the problems are not specific to all the EU13, nor absent from the EU15 countries.

What do we have now in Horizon 2020?

- Horizon 2020 introduced three specific measures addressed to low R&I performing Member States: teaming (institution-building), twinning (networking institutions), ERA Chairs (bringing excellence to institutions).

- Additionally Horizon 2020 provides funding for the Policy Support Facility (PSF) – tailor-made services to reform national R&I systems and COST (Cooperation in Science and Technology) – European intergovernmental

[177] http://ec.europa.eu/growth/industry/innovation/facts-figures/scoreboards_en
[178] European Commission (2017), ERA progress report 2017: The European Research Area: Time for implementation and monitoring progress, COM(2017) 35
[179] Commission analysis of September 2011, at the request of the Polish Presidency, see http://register.consilium.europa.eu/doc/srv?l=EN&f=ST%2014728%202011%20INIT . Similar findings have been confirmed by other studies, analysis and public discussions, for instance STOA Report 'how to overcome the innovation gap' (Jan 2018) and the FP7 MIRRIS project http://www.mirris.eu/.
[180] High Level Expert Group on the Ex-post evaluation of FP7 (2015) https://ec.europa.eu/research/evaluations/pdf/fp7_final_evaluation_expert_group_report.pdf.
[181] European Parliament - STOA-Project "How to overcome the innovation gap in Europe: Structural shortcomings in the EU-13 and recommendations for a better performance in Horizon 2020"- February 2018

framework to promote networking.

Widening National Contact Points network is also supported in its endeavour to promote spreading excellence and widening calls and build the skills by organising brokerage events, workshops and conferences.

What have we learned from Horizon 2020 Interim Evaluation?

The interim evaluation of Horizon 2020 provides evidence that participation of low R&I performing countries remains low in absolute terms. However, taking into account the size of the population, the number of researchers and national investments in R&D the performance differences are more nuanced and the targeted countries are affected by these problems in various intensity. Moreover, there are clear performance differences and heterogeneity among the EU13 countries and across Horizon 2020.

The current actions have demonstrated already a positive impact: ERA Chair and Twinning projects already resulted in substantially increasing the attractiveness of the institution for international excellent researchers, the capability of the institution to compete for international funding. Teaming, whose second phase related to the creation of centres of excellence, has started in February 2017, has already leveraged significant amounts of Structural funds, as proposers were expected to mobilise from national/regional public. COST actions demonstrated effectiveness in including excellent researchers from low R&I performing countries with a steadily increasing participation rate. The recurrent feedback on the Policy Support Facility work received from national policy-makers and stakeholders has shown that the operational recommendations formulated by leading experts and policy practitioners prove valuable as catalysers of national R&I reforms.

What do stakeholders say?

Stakeholder provided the following recommendations for EU support to sharing excellence:

- synergies with ESI funds and ring-fenced budget dedicated to "spreading excellence" objective,
- continued support to teaming, twinning, ERA-Chairs, COST, NCP networks, EIT Regional Innovation scheme (EIT RIS),
- targeted measures to promote pockets of excellence in low R&I performing countries .

Stakeholders input was used to improve activities addressed to low R&I performing countries set up in Horizon 2020.

6.2 What do we want to achieve with the sharing excellence strand?

The overriding goals of consolidating the Spreading Excellence and Widening Participation actions under Horizon 2020 is to reinforce EU R&I capabilities through the creation and diffusion of high-quality knowledge, by sharing and connecting excellence across Europe and increasing cross-sectorial, cross-disciplinary and cross-border cooperation.

The Sharing Excellence strand will aim at:

- Helping in creating new or upgrading existing centres of excellence;
- Strengthening a defined filed of research by linking entities with different experience in the area with internationally-leading research institutions;
- Helping in attracting and maintaining excellence in the institution;
- Stimulating networking and cooperation between researchers from targeted countries and well R&I performing countries.

6.3 What changes and what are the expected implications?

Following the results of the interim evaluation of Horizon 2020 and stakeholder views, the main set of activities launched in Horizon 2020 under a part called "Spreading Excellence and Widening Participation" will be kept with a few changes following the structure of the Framework Programme, changing R&I landscape in the targeted countries and importance of the issue. The title of these activities becomes Sharing Excellence.

In **Horizon Europe**, the Sharing Excellence strand, with four key activities (Teaming, Twinning, ERA Chairs, COST), is included in the "Strengthening the European Research Area" part. The Sharing Excellence activities are focused on addressing disparities in R&I performance in targeted countries. The second strand (i.e. Reforming and Enhancing the European R&I system) is open to all the EU Member States and focuses on reforms and enhancement of the European R&I system and institutional changes in research funding and performing organisations including universities, citizen science, gender as well as implementation of the Programme.

For Teaming, Twinning and ERA Chairs under Sharing Excellence a dedicated indicator will be used to **identify low R&I performing countries;** only constituencies from these countries and from Outermost Regions would be **eligible** as coordinators[182].

Taking into account importance of sharing excellence across Europe, as well as existing support in Horizon 2020 “Spreading excellence and widening participation” mechanisms, the budget of this strand will be **ring-fenced and increased** in comparison to Horizon 2020.

Following the Horizon 2020 interim evaluation, stakeholders views and the feedback received from coordinators and reviewers of current Teaming, Twinning and ERA Chairs projects, there are several issues which improve these three instruments under the Framework Programme:

- **Sustainability:** To address the sustainability during the project implementation, specific arrangements could be considered (e.g. COFUND to allow better combination and exploitation of synergies between the Framework Programme and structural funds. To address the current beneficiaries' concern of ensuring continuity after the project funding is finished, the Framework Programme could require a sustainability plan.
- **Preparatory scientific activities:** The utility of networking, staff exchanges, expert visits can only reach a certain level, which is why stakeholders recommend supporting preparatory scientific work (i.e. starter kit) under these instruments.
- **Strengthen research management:** One of the issues coming from the different analyses is the lack of experience with regard to research management and administration in certain countries. There is a need to reinforce the institution building component of these instruments by putting emphasis on the staff preparation and training on proposal preparation and project management.
- For ERA Chairs, following some feedback from implementation so far, it is under consideration to include an Advanced Partner, as it is currently the case for the other “Spreading excellence and widening participation” actions.

COST, under Sharing Excellence, will continue (open to all the countries) while expanding the focus on targeted low R&I performing countries (80% of the COST budget devoted to countries

[182] In its Communication "A stronger and renewed strategic partnership with the EU's outermost regions" (COM(2017) 623 final) the Commission recognizes that participation of most of the outermost regions in the EU research programmes is still insufficient and could be significantly increased. To this end and in the context of Article 349 of the TFUE, which recognises the EU Outermost Regions specific social and economic situation, it is recommended the full eligibility of Outermost Regions for the Sharing Excellence actions.

identified as low R&I performing countries). COST will provide opportunities for participation, giving organisations from these countries the opportunity to build experience, accumulate a reputation, and strengthen their network position. The continuation of the COST actions with a higher budget devoted to the targeted countries will address this need and give the opportunity to strengthen collaboration across Europe.

The implications of these changes are the following:

- **Better R&I performance**. Increasing the excellence of the science base, strengthening knowledge transfer, the innovation creation and diffusion, building knowledge, skills, and co-operation. Tapping into the unexploited research and innovation potential of Member States with a lower R&I performance, increasing their ability to participate in the Framework Programme and integrate the European Research Area and single market will maximise the quantity, quality and impact of R&I investment, benefitting each Member State concerned and Europe as a whole.

- **More cooperation.** Forging cooperation and links across national borders and across sectors, while fostering open science and open innovation practices which help the diffusion of excellence and know-how across the Europe.

- **Better impacts of R&I investments.** Improved quality and impact of R&I systems on productivity, economic growth, job creation and well-being. Although the impact of measures addressed to targeted countries varies across regions, regions from all the Member States are impacted, in some cases with up to 0.18% of GDP[183].

6.4 What alternatives were considered?

The following options were considered and discarded following the stakeholders' views and interim evaluation of Horizon 2020 results:

- **Discontinuation** of core measures under a ring-fenced budget and alternative financing for similar actions would be established mainly under the structural funds. With this approach opportunities for overcoming the participation gap and innovation divide by improving connectivity and networking would be missed. The partnering dimension by knowledge circulation between a catching-up and advanced partner would be constrained because the financial support to the advanced partner would require the use of Art. 70 of the ESIF regulation. However, the latter does not fully align with the political objectives of the current Teaming instrument. Twinning with more complex consortia would be even more difficult to implement under this constraint and the continuation of COST networks with on average 27 participants would be also virtually impossible.

6.5 How will the this be implemented?

Sharing Excellence will be implemented as in Horizon 2020 via calls for proposals. The list of eligible countries will be included in the work programmes.

[183] Based on the RHOMOLO model. European Commission, DG JRC.

7 Support to policy-making: activities of the Joint Research Centre in Horizon Europe

7.1 Why do we need support to policy-making and what is the role of the JRC?

People rightly expect political leaders to be honest with facts when making decisions that impact on their everyday life or their future, especially in an era when the role of scientific evidence, rational enquiry and fact-based conclusions are being challenged as never before. This is why scientific support to policy-making is so important for Europe. EU policies and activities must be based on robust scientific evidence that is transparently formulated, independent of political interests and includes insights from different disciplines and approaches. This will enhance the credibility and legitimacy of those policies, and their impact in addressing our most pressing challenges.

As the science and knowledge service of the European Commission, the JRC contributes to ensuring that policy-makers have the best available, independent, scientific evidence when taking important decisions that have an impact on EU citizens' daily lives, whether when preparing policies or implementing them. The JRC's research supports priorities of the EU's policy agenda including jobs and economic growth, digital transformation, the Energy Union, the Sustainable Development Goals, civil protection and security, and consumer protection and safety.

What do we have now in Horizon 2020?

The JRC shall contribute to the general objective and priorities of Horizon 2020 by providing customer-driven scientific and technical support to EU policies, in collaboration with relevant national and regional research stakeholders, where appropriate, while flexibly responding to new policy demands[184].

The JRC undertakes research and innovation activities, known as "direct actions" and supported by the programme. Around €2 billion of the Horizon 2020 budget is allocated to the JRC, which is approximately 2.5% of the overall programme budget.

What have we learned from evaluations of the JRC?

Ex-post external evaluations of the JRC in previous EU research programmes have consistently rated the JRC's performance, as well as the quality and impact of its scientific outputs, as high, and concluded positively on its effectiveness[185] Following a key recommendation of the FP7 ex-post evaluation in 2015, the JRC developed a long-term strategy for 2016-2030 and initiated a large number of improvements proposed by the external evaluation panel. The Horizon 2020 interim evaluation report on the JRC, published in July 2017, commended the JRC on the rapid implementation and follow-up of the recommendations made in 2015.[186]

What do stakeholders say?

The JRC is a trusted partner in global research and innovation partnership initiatives, including in the framework of the EU-African Union partnership, the UN (work on climate change and on biodiversity), EU institutions (Science for Parliament, and Science for the Regions). In a survey of national and regional authorities, the JRC-operated Smart Specialisation Platforms (which support regional growth in specific priority areas) received a high satisfaction score (4.5/5); it received the Best Practice European Public Sector Award (EPSA Award) in 2017.

[184] Horizon 2020 Regulation, Article 4.
[185] FP7 (http://publications.jrc.ec.europa.eu/repository/handle/JRC96870), FP6 (https://ec.europa.eu/research/evaluations/pdf/jrc.pdf#view=fit&pagemode=none)
[186] Available at: http://data.europa.eu/doi/10.2760/459053

7.2 What do we want to achieve with the JRC in the next Framework Programme?

The JRC aims to become a global leader in the creation, management and communication of fit-for-purpose knowledge for public policy, for example through helping to address the concerns raised by the current 'post-fact' debate and leading the campaign for evidence-informed policy.

Whilst retaining its focus on excellent scientific support to policy, the JRC aims to better position and focus its research to address the complex, multi-sectoral societal challenges facing Europe. Another goal is to initiate new ways of bringing the JRC's own research, new open access policy and strategic partnerships tapping into the wealth of knowledge within and outside Europe. This will reinforce the JRC's role as a core provider of high-quality scientific evidence to the Commission. The overall ambition is to enhance the scientific evidence base for, and its use in, policy making, while also enhancing the "responsible research and innovation"[187] agenda in the activities of the JRC.

7.3 What will change compared to Horizon 2020 and what are the expected implications?

The JRC will increasingly co-design its programme of activities with the policy departments of the Commission to maximise the relevance and impact of its activities. The JRC's knowledge and competence centres (see below) will be an important feature of JRC activities post-2020. They are a new way of working across policy areas, scientific disciplines and sectors, bringing together expertise from many Commission departments and the scientific community. They support multidisciplinary research, thereby delivering integrated advice which strengthens the knowledge base required to propose policy recommendations.

New initiatives to extend JRC's collaboration with academia and develop a new generation skilled at the science policy interface, together with a policy of open access to its world class research infrastructure will build closer links to Member States, industry and the scientific community. Member States' and regions' participation in JRC research activities will be promoted via new platforms, such as a proposed set of '**Science4Policy platforms'** which would bring the JRC's rich data resources, knowledge, services and networks closer to end-users and citizens.

7.4 What alternatives were considered?

Following a key recommendation of the ex-post evaluation of JRC in FP7, the JRC adopted its Strategy 2030 in 2016. The interim evaluation of the JRC, conducted in the context of the Horizon 2020 interim evaluation in 2017, concluded that the JRC should continue to implement this strategy. Alternatives (business-as-usual with the JRC's activities in FP7) were considered when drafting the strategy, but discarded because they would not have adequately responded to the need for more integrated approaches (cross-silo, cross-disciplinary, incorporating social aspects), nor would have enabled an enhanced capacity to respond to emerging challenges and for a broader knowledge base in order to address the increasingly complex policy needs.

7.5 How will this be implemented?

The knowledge management strategy will be implemented through better management of scientific knowledge in the process of delivery of evidence for policy-making, and in specific areas through the establishment of Knowledge Centres and Competence Centres.

The JRC has established four **Knowledge Centres** in the fields of territorial policies, migration and demography, disaster risk management and bioeconomy, which bring together experts and knowledge to

[187] Responsible Research and Innovation is defined as an approach whereby societal actors (researchers, citizens, policy makers, business, third sector organisations, etc.) work together during the whole research and innovation process in order to better align both the process and its outcomes with the values, needs and expectations of society.

inform policy-makers about the status and findings of the latest scientific evidence, and which have already produced innovative tools, such as, the Migration Data Hub used by the Commission and professionals in the Member States. Similarly, JRC **Competence Centres** have been created which focus on analytical tools and providing services across the Commission, such as, improving quantitative evidence for impact assessments. New knowledge and competence centres will be established, where appropriate.

Finally, the JRC will reinforce its activities in supporting a social Europe by exploring the drivers behind 'fairness' and the resilience of societies. The JRC will also invest in maintaining and further developing its scientific excellence in order to ensure that its scientific advice is based on the best and most robust available evidence.

7.6 Relevant studies

- Joint Research Centre Implementation Review 2017: In the context of the Interim Evaluation of Horizon 2020. DG JRC, July 2017.
- Joint Research Centre Strategy 2030. DG JRC, May 2016.
- Strengthening Evidence-Based Policymaking through Scientific Advice. European Commission, DG Research and Innovation, May 2015.

8 European Institute of Innovation and Technology (EIT)

8.1 Why do we need the European Institute of Innovation and Technology?

The European Institute of Innovation and Technology's overall mission is to contribute to sustainable European economic growth and competitiveness by reinforcing the innovation capacity of the Member States and the Union. Started in 2009, and since 2014 part of Horizon 2020, the EIT's specific objective is to integrate the knowledge triangle of higher education, research and innovation and thus to reinforce the Union's innovation capacity and address societal challenges. The EIT is designed to achieve these goals primarily through its Knowledge and Innovation Communities (KICs), which are large-scale European partnerships that operate within specific societal challenges.

From 2010 until 2017 six KICs operated in the fields of:

- Climate Change (Climate-KIC, established in 2010)
- Energy (KIC InnoEnergy, established in 2010)
- Digital (EIT Digital, established in 2010)
- Health (EIT Health, established in 2015)
- Raw Materials (EIT Raw Materials, established in 2015)
- Food (EIT Food, established in 2017).

In January 2018, the EIT launched a new call for the selection of two additional KICs in the field or Urban Mobility and Added-Value Manufacturing. These will be the last two KICs within the Horizon 2020 framework and are planned to be designated in December 2018.

EIT KICs vary in size and have between 50 (recently established KICs) and more than 200 (mature KICs) partners each. Overall there is more than 1000 partners from research, business and education directly involved in operation of current 6 KICs. Each KIC is also organised around a small number of co-location centers that are intended to act as geographical innovation hubs for the practical integration of the knowledge triangle188. Building on the existing labs, offices or campuses of some of a KICs' core partners, each co-location center offers a physical location where people and teams from research, business and education meet and work together on common innovation initiatives. This facilitates a trusted face-to-face collaboration across KIC members and serves as a gateway for potential partners. Each co-location center provides regional access to the knowledge, expertise and talent pool of the KIC's community and carries out education activities.

In particular, each KIC aims at reinforcing innovation capacities by running a portfolio of activities in three areas:

1. Research/ Innovation projects: they encompass a range of activities broadly related to supporting and developing new innovative products, services and solutions that address societal challenges in the KICs areas of activity. Each KIC launches its own research and innovation project portfolio linking

[188] For example, the EIT Raw Materials is based in Berlin and has Innovation Hubs in Belgium, France, Finland, Italy, Poland and Sweden and counts 116 formal Partners and another 125 participants as affiliated entities (linked third parties).

universities, research institutes and businesses taking a market-led approach, in order to make solutions market-ready. These projects may comprise demonstrators, pilots or proofs of concept.

2. Education: The development of human capital is supported through a range of innovative educational and training programmes offered by each KIC in the form of post-graduate (MSc/ PhD) programmes, executive/ professional development courses, lifelong learning modules, summer schools and more. The courses are based on a multidisciplinary approach, significant business involvement in the development of learning outcomes and cross-border mobility. The EIT Label aims to ensure quality and recognition within the EIT Community and beyond.
3. Business creation and support activities: The KICs offer a range of business support services such as start-up and accelerator schemes to help entrepreneurs translate their ideas into successful business. These business support services focus on access to market, access to finance, access to networks, mentoring & coaching.

EIT KICs engage also in a range of outreach, communication, dissemination and horizontal cross-sectoral activities., In 2014, the EIT has developed the EIT Regional Innovation Scheme[189] to help increase the innovation capacity in areas and regions in Europe not participating in KICs.

The EIT regulation sets out the general objectives and the scope of the EIT's functioning. The EIT's specific objectives, its rationale, EU added value, the broad lines of activity and the EIT's performance indicators are defined in the Horizon 2020 Regulation. The strategic, long-term priority fields and financial needs for the EIT for a period of seven years is laid down in a Strategic Innovation Agenda which include detailed modalities on the operation of EIT such as the selection and designation of the partnerships into KICs and their performance monitoring. This selection and priority-setting process is governed by the EIT Regulation.

The EIT addresses specific structural weaknesses in the EU's innovation capacity which are common across Member States. Amongst them are: the under-utilisation of existing research strengths for creating economic or social value; the lack of research results brought to the market; low levels of entrepreneurial activity and mind-set; low leverage of private investment in research and development; an excessive number of barriers to collaboration within the knowledge triangle of higher education, research, business and entrepreneurship on a European level. The EIT addresses these challenges through the KICs.

By providing coordination and steering, the EIT has tailored its support structure to the specific needs and goals of the KICs (i.a. requirements for setting up KICs, performance based funding, simplification). Through systematic focus on cross-KIC activities, sharing of best practices and integrating lessons learnt from the past, the EIT has built up knowledge and experience on which each KIC can draw (i.a. framework for guidance to set up new KICs). In turn, the KICs provide the EIT with practical insights and feedback on what works on the ground and what does not (thus increasing effectiveness and synergies).

The total budget for the EIT under Horizon 2020 is EUR 2.4 billion[190]. Of this overall EIT funding allocation a fully mature KIC is expected to receive on average between EUR 70 million and EUR 90 million annually to cover its portfolio of activities presented in its annual Business Plan. The duration of EU funding is expected to last up to 15 years and after such a period the KICs should be able to pursue their activities without EU funding.

[189] The EIT Regional Innovation Scheme (EIT RIS) is the EIT Community's outreach scheme. The scheme enables the transfer of good practices and know-how from the EIT's unique approach to boosting innovation. The EIT Regional Innovation Scheme was introduced in order to share good practices and experience emerging from EIT Community activities and to widen participation in these activities across Europe.

[190] reduced from EUR 2.7 billion following the set-up of the European Fund for Strategic Investments (EFSI).

Lessons learned and future challenges

The **Horizon 2020 interim evaluation Staff Working Document** identifies the need to rationalise the overall European research and innovation partnership landscape, improve their openness and transparency, and link them with future EU R&I missions and strategic priorities. The EIT/KICs are unique type of partnerships based on knowledge triangle integration with the education at its core and thus they are different in nature to other partnerships.

The **EIT interim evaluation Staff Working Document** concluded that it contributes to addressing structural weaknesses in the EU's innovation capacity. The EIT evaluation highlights the need to develop further synergies with other EU initiatives from the programming stage. It also identifies scope for streamlining the relevant goals the EIT and the KICs are expected to achieve with clear and measurable objectives. It notes that the role of the KICs in the EU R&I landscape needs to be better defined. The integration of the KICs into local innovation ecosystems need to improve.

The **Commission Opinion on the EIT independent evaluation** also stresses the rationale behind the establishment of the EIT and its contribution to the development of the Community and Member States innovation capacity in order to tackle societal challenges, through the integration of the knowledge triangle. It confirmed to target major structural weaknesses of the innovation capacities in the EU (in key thematic areas) such as the limited entrepreneurial culture, the low level of cooperation between academia and industry and the insufficient development of human potential, and aims to contribute to closing the innovation gap between the EU and its key competitors.

The **Lamy High-Level Group** recommends that KICs could be more coherently deployed to address global challenges, and be directly incorporated into the post-2020 EU R&I programme. It recognises that education plays a central role in the KICs and it calls for Europe's universities to stimulate entrepreneurship, tear down disciplinary borders and institutionalise strong non-disciplinary collaborations between universities and industry.

The **Communication on the Interim Evaluation** outlines recommendations for the future guiding principles of the EIT and the KICs:

- Streamlining the relevant goals which the EIT and the KICs are expected to achieve through clear and measurable objectives;
- The role of the KICs in the EU R&I landscape also needs to be better defined;
- Improving the openness and transparency of the partnerships (including KICs) and link them with future EU R&I missions and strategic priorities.

The **High Level Group on the EIT** identified a clear need to strengthen the role of the EIT headquarters as a provider of shared services and expertise to the KICs.

8.2 What do we want to achieve with a revised role for the EIT/KICs in the next Framework Programme?

The focus of the EIT on the knowledge triangle integration through developing KICs remains valid as well as its added-value in providing a support mechanism to the KICs and in setting the framework conditions to create innovation. In order to reinforce the role of the EIT and the KICs in the overall European R&I support system and in light of the overall rationalisation of the European R&I partnerships (see dedicated Annex), a revised role for the EIT/ KICs under the Framework Programme will aim at achieving the following objectives:

- Reinforce the focus of current and future EIT KICs on delivering on EU strategic priorities, in particular global challenges through the integration of education, research, business and entrepreneurship. It will **foster, grow and strengthen ecosystems for addressing global challenges through research and innovation across Europe** by connecting people, disciplines, sectors, organisations and resources.

- EIT KICs will play a stronger role in **reinforcing the research and innovation capacity in regions** with modest or moderate innovation activity through its innovation hub co-location centers and their networking.
- Reinforce the links between higher education and the innovation ecosystem by scaling up the knowledge triangle model established by the EIT beyond the KICs and by mainstreaming support for the **renewal of European universities.** This will be achieved by stimulating entrepreneurial education, fostering strong non-disciplinary collaborations between industry and academia; and identifying prospective skills for future innovators to address global challenges, which includes advanced digital and innovation skills but also skills specific to each thematic area.
- Ensure **complementarity and synergies between the EIT and the KICs, the European Innovation Council (EIC)**, and other research and innovation instruments for a seamless support to research and innovation in Europe.

8.3 What is changing in practice under the next Framework Programme for the EIT and the KICs?

Towards a European seamless support to innovation ecosystems through complementarity with the EIC

The EIT will play a reinforced role in strengthening sustainable innovation ecosystems across Europe. The EIT midterm evaluation has confirmed the relevance of the EIT model. Stronger integration of the EIT in the Framework Programme will be sought through a focus on synergies with key instruments such as the EIC Accelerator, i.e. via EIT-supported start-ups, which can be scaled up through the EIC or offering ecosystem support such as mentoring or coaching for EIC funded scale-ups in the KICs' thematic fields. The EIT will ensure complementarity with other instruments in the Framework Programme though its distinctive focus on entrepreneurial education, skills identification and reinforcement, and strong multidisciplinary collaborations between industry and academia.

The role and visibility of the KICs innovation hub co-location centres as physical places for experimentation and co-creation around global challenges and future R&I missions ((incl. direct feedback loops with potential users and citizen) will be reinforced. This will help developing innovations in line with societal needs and support their market uptake, as well as reinforce the international visibility of European physical hubs for addressing key challenges/missions.

Stronger alignment with FP strategic priorities and European R&I partnership approach

EIT and KICs will be a core part of the future Framework Programme with its key focus on strengthening innovation ecosystems. EIT and KICs will also play a key role in addressing global challenges and will strive to contribute to achieving the objectives of future R&I missions (Pillar 2) as well as the Open Science (Pillar 1).

The alignment of the EIT's activities with others in the future Framework Programme will improve through the strategic planning, in compliance with the EIT's regulation and its specific governance structure. As regards the broad strategic orientations and setting-out multi-annual Commission corporate priorities for the Framework Programme implementation, the EIT will help inform the broad areas and themes of the future partnerships, thereby ensuring complementarities and synergies with other relevant Framework programme initiatives and EU programmes.

Reinforced role of the KICs for education and training and the modernisation of universities

The EIT has played a pioneering role in integrating education and training in the innovation ecosystems across multiple societal challenges. In order to strengthen the role of the EIT, a better integration of the education aspects into the European innovation ecosystems through increased support to European universities by stimulating the entrepreneurial and open science education and fostering multidisciplinary collaboration between industry and academia is necessary. This implies a structured approach on support actions for driving innovation and entrepreneurship agendas in universities in order to achieve a systemic effect.

Such an approach will also build on the successful outreach activities by the EIT Regional Innovation Schemes that target modest and moderate innovators and help create network effects from existing excellence.

Through the knowledge triangle integration, the identification by KICs of prospective skills needs/curricula for innovation to solve global challenges and R&I missions will be encouraged. New types of profiles and competences might indeed need to be developed and reinforced in key thematic areas. Following the identification of emerging skills needs, EIT and KICs could develop dedicated training offers in partnerships with the knowledge triangle actors.

What will we be the implications of the changes?

More coherence: Through an overall limited number of European R&I partnerships – including the KICs - with clearer intervention logics based on FP objectives; complementarity with the innovation support provided through the European Innovation Council; and reinforced education focus of the KICs.

More impact: Through a more strategic and revised policy approach for the priority-setting of the KICs, closely linked to the overall strategic programming of the Framework Programme to deliver on global challenges and EU research and innovation missions.

More openness and transparency: Through the application of an impact-based criteria framework for the selection, implementation, monitoring and phasing out of the KICs, as for other R&I partnerships.

8.4 How will the changes be implemented?

The EIT Regulation will be amended:

- To align EIT with the objectives of the next Framework Programme;
- To align the programming of the EIT with Horizon Europe strategic programming;
- To reinforce the role of the EIT in developing innovation capabilities through addressing global challenges;
- To seek an enhanced role for the EIT in embedding innovation and entrepreneurial capabilities, prospective skills identification and talent development in Higher Education Institutions (HEIs).

8.5 What alternatives were considered?

Taking into account the stakeholder suggestions on the improvement of the EU R&I partnership landscape, the following policy alternatives have been considered and discarded:

- Reduction/Discontinuation of EIT KICs interventions

  The EIT is highly relevant and has a clear EU added value as there is no other instrument that builds EU-wide ecosystems of education, research, business and other stakeholders (EIT interim evaluation). The reduction of the EIT scope of its intervention or a full or partial phasing out of KICs from the current operating model would bear severe implications and negative impact on the knowledge triangle integration development, the research and innovation performance and the overall research and innovation landscape in Europe.

- Continuation of strategic approach to EIT/KICs as implemented under Horizon 2020

  EIT/KICs would operate on the basis of initial objectives, scale and operating modes. The key challenge of rationalization of the European R&I partnerships landscape in line with the overall objectives of the future Framework Programme would not be realised. The coherence between the EIT and other EU innovation policy initiatives and instruments at programming as well as implementation level would not be matched.

- Direct integration of KICs into the Framework Programme (without EIT)

  As confirmed by the past evaluations, the EIT model comprising the EIT and its Knowledge Innovation Communities (KICs) is valid and working well. The EIT has tailored its support structure to the specific needs and goals of the KICs by providing coordination and steering (i.a. requirements for setting up KICs, performance based funding, simplification). Through systematic focus on cross-KIC activities, sharing of best practices and integrating lessons learnt from the past, the EIT has built up knowledge and experience on which each KIC can draw (i.a. framework for guidance to set up new KICs). In turn, the KICs provide the EIT with practical insights and feedback on what works on the ground and what does not (thus increasing effectiveness and synergies).

  The EIT/KIC model is based on a long-term approach to innovation, i.e. KICs are set up bearing in mind a long-term perspective to achieve the impact and their sustainability beyond the direct public financial support. The EIT provides a wide range of services, from education, training and coaching, building and maintaining networks where young entrepreneurs and enterprises connect with future partners and investors in order to take up the research results and bringing them to the market. This goes far beyond the management of EU contracts and projects. The EIT has thus built up a wealth of knowledge and experience on innovation that is unique at a European scale and decoupling of EIT and KICs would cause the effectivity loss. The gradually built-up EIT Community of regular exchange, mutual support and trust would disappear. Further, the current efficiency at the EIT central management level as well as in the management of KIC operations would be lost.

8.6 Relevant studies

- European Commission (2017), Interim evaluation of Horizon 2020, Staff Working Document (SWD).
- European Commission (2017), Interim evaluation of the European Institute of Innovation and Technology (EIT), Staff Working Document (SWD).

- European Commission (2017), LAB – FAB – APP: Investing in the European future we want, Report of the independent High Level Group on maximising the impact of EU Research & Innovation Programmes.
- European Parliament (2017), REPORT on the assessment of Horizon 2020 implementation in view of its interim evaluation and the Framework Programme 9 proposal.
- European Research Area And Innovation Committee (ERAC) (2017), ERAC Opinion on the Interim Evaluation of Horizon 2020 and preparations for the next Framework Programme.

9 Support to education in Horizon Europe

9.1 Why do we need support to education in the Horizon Europe

The European Research Area (ERA) is designed to be the backbone of a well-performing science and innovation system in Europe. Through it, knowledge and a highly skilled workforce circulate freely, 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 R&I are understood and trusted by informed citizens and benefit society as a whole. Without a strong and well-performing ERA, we would miss opportunities to set common agendas, instil a culture of cooperation, and establish and achieve the funding scale required for tackling important societal challenges.

Demand for highly skilled, socially engaged people is both increasing and changing. Driven by digital technology, jobs are becoming more flexible and complex. People's capacities to be entrepreneurial, manage complex information, think autonomously and creatively, and use digital resources are more crucial than ever. European higher education must simultaneously respond to the moving targets of education and training, and prepare the next generation of skilled digital natives to be resilient in the face of rapidly evolving societal challenges.

The skills mismatch in Europe is well documented, and Europe's need to address it is more urgent than ever. The unmet demand for graduates in the science, technology, engineering and maths (STEM) fields is great, as is the need to ensure our students have the transversal skills necessary to be successful in an increasingly competitive labour market. Moreover, the increasing prominence of carrying out research in a collaborative, transparent and accessible manner is transforming the research landscape. Universities need to address these issues in order to maintain the flow of skilled graduates.

A coherent approach of EU policies on education, research and innovation is crucial to create 'jobs, growth, investment, and competitiveness'. Education will have to play an important role in the future Europe as investing in skills, competences and knowledge is essential to boost Europe's resilience. Investing in stronger links between education and research will support the development of human talent, which is the fundamental driver of innovation. The importance of the human capital in addressing the future global challenges will be enhanced in the next generation of European programmes. Universities, as leading centres of innovation, need to be empowered to create more innovation impacts, across all their core functions, notably education, research, knowledge transfer, engaging with citizens in science and other public services.

This is in concordance with the Communication on Strengthening European Identity through Education and Culture, the renewed EU agenda on Higher Education and the Communication on the Digital Education Action Plan.

Europe's **high-level skills needs** must be addressed through investments in the development of competences, inter-disciplinary, transferable and entrepreneurial skills in forward-looking fields or

disciplines that are strategic for smart economic and social development (such as science, technology, engineering and mathematics, climate change, clean energy, artificial intelligence, robotics, data analysis, design, etc.).

The innovation performance of the EU is growing, but not fast enough to ensure our future welfare. **Modern universities as leading centres of innovation** need to be empowered to create more innovation impacts, across all their core functions, notably education, research, knowledge transfer, engaging with citizens in science and other public services. This has to be nurtured by the culture of the university and its institutional set-up. The core attributes and functions of modern universities should enable excellence, innovation and openness to the world. Excellence must be at the centre of research – including incentives for inter- and trans-disciplinarity. Openness must be at the centre of the research mind-set. Internationalisation and cross-border open research practices must be embedded in programmes.

In the current and future world of research it will be important to adapt education models and experiment with new forms of open education and learning empowered by digitisation. It is essential to provide, train and reward young talent with future skills for the jobs of tomorrow. Universities should go beyond their educational missions and become regional hubs for education and innovation exchange, promoting joint curricula with industry. Structural collaboration with local and regional stakeholders will further facilitate science-industry cooperation. Stronger links and coherence between European Research Area and European Higher Education Area by better aligning the objectives and priorities is crucial.

Until recently, education and culture have not been centre stage in the debate about the future of Europe but, since leaders decided to put them on the agenda at their meeting in Gothenburg in November 2017, they come increasingly to the fore. The discussion among leaders has been informed by a contribution of the Commission on "Strengthening European Identity through Education and Culture"[191], which set out a number specific actions, i.e. a vision to create a European Education Area by 2025. Key goals include stepping up investment in education to 5% of EU GDP. It includes the establishment of a European Universities initiative, and taking forward the mutual recognition of higher education diplomas. The importance of ensuring that higher education contributes to innovation is also emphasised in the Renewed EU Agenda for Higher Education, published in May 2017.

What do we have now on education in Horizon 2020?

Marie Skłodowska-Curie Actions (MSCA) is a bottom-up, competition-for-excellence based research programme focusing on frontier science, research excellence, human capital training and career development, inter-sectoral and international mobility and good working conditions for researchers. At the level of postgraduate training, MSCA is mainstreaming innovation in learning context for researchers and fostering new skills and will strengthen its efforts to do so in the future: MSCA equip researchers with training in transferable competences such as a creative mind, an entrepreneurial outlook and a diversity of skills, including teaching of students, that will allow them to face current and future global challenges, as well as match the future needs of the labour market and enabling the transmission to, and take-up of research results by, society and economy.

The educational dimension has been a major focus of the **European Institute of Innovation and technology** (EIT) since its creation. The EIT has always stressed the importance of an adequate mix of technical and entrepreneurial skills as drivers of innovation. Through its KICs, the EIT supports a variety of education, and more generally human capital development activities, aiming at training the next generation of innovators and entrepreneurs. The offer, with the EIT Label as its flagship, is targeting primarily Master and PhD students, as well as a growing number of professionals. Students are awarded degrees from partner universities, on top of which comes the EIT Label. This Label aims to be a guarantee of quality for innovative programmes bridging universities and industry. Students are exposed to new cross-sectorial curricula with innovative pedagogical models of teaching and learning, aiming at developing at the same time both their technical knowledge and their entrepreneurial mind-sets and skills. These new

[191] COM(2017) 673 final.

programmes go beyond what is being normally offered by the universities partners in a KIC, usually research-intensive universities, in particular in terms of mobility, industry exposure, networking opportunities and, more broadly, learning experience.

Science with and for Society part on 'Accelerating and catalysing processes of institutional change' contributes to implementing the RRI keys (public engagement, science education, ethics including research integrity, gender equality, and open access) through institutional governance changes in Research Funding and Performing Organisations (RFPOs) in an integrated way and to disseminate good practices. Results contribute to the implementation of ERA priorities, a greater involvement of all stakeholders in R&I, and a better and more sustainable engagement with society.

What have we learned from evaluations

According to the Lamy Group, a fundamental reform of the role of education should **systematically embed innovation and entrepreneurship in education** across Europe[192]. Europe's universities need urgent renewal, to stimulate entrepreneurship and tear down disciplinary borders. Strong non-disciplinary collaborations between universities and industry should become the rule and not the exception. The next Framework Programme needs to incentivise for the modernisation of universities. Research and higher education institutions that actively promote open science, open innovation and openness to the world (e.g. through new ways of teaching, promoting cross-disciplinarity and entrepreneurship, or attracting researchers and students from around the world) should be rewarded.

The MSCA have contributed to making the science system of the Union more competitive and attractive on a global scale. Evidence shows that the MSCA not only have a **positive structuring impact** on individuals, organisations, and at system level, but also yield high-impact and breakthrough research results and contribute significantly to societal as well as strategic challenges.

The EIT fills a gap in the system of support for innovation provided by the Member States and bring **unique perspectives to education programmes**[193]. EIT-label educational courses provide graduates with hard and soft entrepreneurial skills, a unique access to businesses and a stronger level of competence in delivering innovation. Some linkages in KICs´ knowledge triangle activities are still underexploited, e.g. those between education and innovation-support and acceleration services, and require further efforts in the future. KICs´ should better monitor their education offer in view of ensuring a high quality having in mind the goal of increasing the outreach of their educational activities. Its mandate was to develop 'flagship' education as a model for excellence throughout European higher education, i.e. reach out and influence higher education beyond those individuals, faculties and institutions directly involved. In order to broaden the added value, the EIT and its KICs should re-examine their actual contribution towards **a systemic transformation of the education landscape**[194]. It is likely that additional efforts will be required, for example through an alternative offer based on better quality (more specific, efficient and cost effective), on broader targeted groups (beyond young Master and PhD students), and the export of the EIT educational model to a broad audience of education providers.

What do stakeholders say?[195]

- Seek a stronger alignment of policies for education, research and innovation, stronger links between the European Research Area and the European Higher Education Area.
- Linking education, research and innovation through an alignment of the next Framework Programme and the successor of Erasmus+ should be explored.
- While keeping the main focus on research, introduce into EU grant agreements the possibility of linking research to education and sharing research results with students.
- Researchers funded through Marie Skłodowska-Curie Actions (MSCA) and the ERC, for example, should be permitted to engage in high-level teaching activities and to include these activities in their time sheets.

[192] LAB-FAB-APP, Investing in the European future we want, Lamy High Level Group Report (2017)
[193] COMMISSION STAFF WORKING DOCUMENT on the Interim evaluation of the European Institute of Innovation and Technology (EIT) {SWD(2017) 352 final}
[194] The Future of EIT, Report by Commissioner Navracsics' High Level Group on the EIT, 2016
[195] http://eua.be/Libraries/publications-homepage-list/eua-next-framework-programme-for-research-and-innovation-(fp9).pdf?sfvrsn=2; https://www.leru.org/publications/excellent-education-in-research-rich-universities; …

- Consider introducing a funding stream within the MSCA instrument for doctoral schools, in order to enhance the capacity of universities in the education and training of the next generation of researchers.
- The emphasis on education in the report of the High Level Group on maximising the impact of EU R&I programmes has resonated amongst stakeholders[196]. The call to "educate for the future and invest in people who will make the change", including the need for universities to better support innovation and entrepreneurship, generated a lively debate on universities as enablers of innovation in the 21st century[197].

9.2 What do we want to achieve on education in the next Framework Programme?

Integrate research and education across borders. In order to do so, strong links between the European Research Area (ERA) and European Higher Education Area (EHEA) agendas need to be developed. EU programmes on research and innovation, and on education need to provide incentives for higher education institutions and research institutes to integrate education, research and innovation across borders and to facilitate knowledge transfer from higher education institutions to companies or spin-offs. Member States, regions and higher education institutions need to be incentivised to work together to upgrade curricula to match changing skills needs, revise career incentives for academics to recognise entrepreneurial achievements or reward institutions for new ways of teaching that promote trans-disciplinary and entrepreneurial skills. Synergies also need to be developed between research and innovation activities on the one hand and students' education on the other hand. It will be crucial to establish the future programmes in such a way that they do not only promote the transfer of research results to companies and other societal actors, but also the **transfer of research into teaching**, thereby enabling students to connect better with and learn from research and researchers. Teaching and professional development for teaching need to be promoted and integrated into an academic career as early as possible, through future research funding schemes such as the European Institute for Innovation and Technology (EIT) and the Marie Skłodowska-Curie Actions (MSCA). Synergies need to be exploited across all relevant funding programmes, both nationally and at European level.

Facilitate knowledge transfer from higher education institutions and research institutes into existing companies or spin-offs and introduce **rewards for academics' entrepreneurial achievements**. To achieve this, the following could be considered:

- regard excellent teaching and education-focused scholarship as activities equal to excellence in research.
- regard excellent service to society, innovation activities or transfer of knowledge outside academic sector.
- establish reward systems for academics for their 'service to society' in general and for their entrepreneurial achievements in particular; reward any type of innovation and entrepreneurial activities, not excluding the social and non-profit sector.

Reward new ways of teaching towards transdisciplinary and entrepreneurial skills:

- Programmes like MSCA and EIT Knowledge & Innovation Communities already ensure the establishment of training and career development systems that equip students and researchers, including many future academics, with skills based on the 'Triple I' principle, i.e.. international, interdisciplinary, inter-sectoral. MSCA and EIT will continue to do so.
- EU programmes could consider including incentives that enable its participating higher education institutions to reward and promote excellent university teachers and education-focused

[196] '*We recognise the importance of the modernisation agenda and of stimulating the open science agenda, including in universities'*. League of European Research Universities, Response to HLG Group report, July 2017

[197] The debate was in motion following the publication of the Renewed EU Agenda for Higher Education.

leaders, in order to empower students to become agents of change, and to encourage higher education institutions introducing such systems into their general practice.

Upgrade curricula to match changing skills needs. Well-designed higher education programmes and curricula, centred on students' and researchers' learning needs, are crucial for effective skills development. A wider range of course choices and options for continuous professional development will help higher education respond better to people's needs. As much teaching in higher education takes place in research-performing institutions, research must be better exploited as input for teaching, while undergraduates should be more involved in research such that they are afforded opportunities to explore contemporary issues and develop their research skills. Digitally-enabled open science provides for new possibilities to address this. The programme should explore ways to enhance the quality and relevance of learning and teaching as well as to promote a stronger link between teaching, learning and research at all study levels, and should consider ways to provide incentives for institutions, teachers and students to intensify activities that develop creativity, innovation and entrepreneurship. This could for example happen through the **European Universities** [198] working across borders and fostering development of 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.

9.3 What will change compared to Horizon 2020 and what are the expected implications?

Horizon Europe will explore ways to put a greater emphasis on human capital and skills development. A coherent approach on human capital across all parts of the future Programme should be ensured and the links between education on the one hand and research and innovation projects on the other should be strengthened. Follow-up and monitoring of the results of the human capital and skills development as part of the research and innovation projects should be reinforced.

The European Universities initiative, the MSCA and the EIT Community could help universities to become more entrepreneurial, innovation oriented educational institutions, supportive of open science practices, i.e. through developing a complete portfolio of education activities not only at higher level (bachelor, masters and doctoral programmes) but also in a life-long-learning perspective. This would reduce skills mismatch and boost skills uptake across the whole education chain. **European Universities** will promote cross-border cooperation among higher education institutions, boost mobility for students and teachers and facilitate language learning. The idea is to promote bottom-up alliances of universities across the EU, bringing together people who can cooperate in different languages, across borders and disciplines. European Universities will pioneer studies across disciplines and sectors. This approach will help address big societal challenges and skills shortages. The aim of European Universities is to drive innovation in education and research in Europe whilst making use of the most innovative pedagogies and digital technologies. European Universities will act as models for other higher education institutions in the EU, progressively increasing the international competitiveness of European higher education. Synergies should be explored between Horizon Europe and the future Erasmus programme to see whether it would be possible to co-fund higher education institutions which are partners in alliances of the European Universities initiative.

The role played by EIT in relation to strengthening the innovation ecosystem landscape across Europe and in **mainstreaming its educational support for the renewal of European higher**

[198] The European Council debated the issue in December 2017 and called for the establishment of bottom-up networks of universities across the EU with the broad aim to strengthen research, innovation and education in Europe and to bring about more European integration through higher education.

education institutions will be crucial. Actions aiming at fostering the Europe's innovation capacity and the innovation in higher education and business should allow the EIT Community to test and share the outcome of their experimental educational activities beyond their direct beneficiaries and offering students, entrepreneurs and professionals across and beyond Europe the cross-cutting programmes where specialist and sector specific knowledge is combined with entrepreneurial and innovation oriented skills. Synergies will concern also activities that **support sectoral vocational training** in order to tackle also the needs identified at single KIC and cross-KIC level. Aiming at equipping the next generation of innovators with the relevant technical and transversal skills to thrive in a fast changing economic environment, the EIT's education programmes include physical and cross-sectoral mobility of students. The synergies with Erasmus are evident and some elements of EIT programmes, in particular the mobility components, could be also supported by Erasmus when relevant.

9.4 How will this be implemented?

Options will be explored to ensure that **every researcher** recruited on any R&I project in the next Framework Programme gets proper training & career development and good working conditions at the same high standards. This could entail establishment of Career Development Plans for young researchers & innovators, the mandatory implementation of the European Charter and Code for Researchers[199] to ensure good working conditions, as well as a 'best effort' to implement an open, transparent, and merit-based recruitment (OTM-R) mechanism in all projects.

The cost for trainings and skills development should become eligible in programmes where it is relevant, such as projects related to specific missions, global challenges or specific innovation activities, in addition to MSCA and EIT that already implement this. The role of teaching for researchers and feeding back research results into teaching will be general points of attention. Feeding back results from Framework Programme projects into teaching should be requirements in dissemination & exploitation and will be closely followed-up, monitored and ex-post evaluated.

MSCA and EIT educational programmes can support training & career development for the rest of the Framework Programme. As the missions will require highly interdisciplinary skilled people, proper training is likely to be a strong prerequisite to fulfil a mission's goal. In this respect, the missions could very well profit from the MSCA and EIT educational activities and use it as and implementing tool to support relevant interdisciplinary skills training activities. Such skills will include a creative mind, an entrepreneurial outlook, but also teaching of students, transferring back research result into teaching, engagement with society in general, which will allow researchers to face current and future global challenges and enable the transmission to, and take-up of research results by, society and economy.

Together with the Framework Programme's part on 'Sharing Excellence', measures should be considered under that can stimulate brain circulation also to Widening countries, without compromising on the excellence principle. The future Euratom Programme could fund MSCA to provide training & career development in the sector of nuclear research.

The **European Universities** initiative will be a catalyst for R&I activities and projects, innovation hubs and human capital development. The alliances will bring together a new generation of Europeans, who are able to cooperate in different languages, across borders and disciplines, to address the big societal challenges and skills shortages that Europe faces, underpinned by European higher education institutions which seamlessly cooperate across borders. The alliances will act as a game changer in Europe progressively increasing the international competitiveness of European higher education institutions by

[199] https://euraxess.ec.europa.eu/jobs/charter

- fostering development of 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;
- being drivers of educational and research innovation by making use of the most innovative pedagogies and digital technologies;
- creating new joint curricula based on innovative research output forward looking skills and multidisciplinary and inter-sectoral approaches;
- attracting the best talent, students, teachers and researchers across the world and acting as role models for other higher education institutions and the business sector throughout Europe by committing to implement policies on education, research and innovation;
- fostering opportunities for talent, students, teachers, researchers and other public and private actors to co-create knowledge and innovation together (e.g. working together to address global challenges or other priorities identified by the Framework Programme).

Annex 9 - Rules for Participation

1 Single set of rules

1.1 What is the current situation under Horizon 2020?

FACTS
A **single set of participation rules** exists for participants in the programme, for example concerning eligibility criteria for the calls for proposals and the reimbursement rate. This applies to the different types of R&I support provided under the programme.
The rules are **aligned as much as possible to the EU Financial Regulation,** in order to ensure coherence with other EU funding programmes. Some **derogations** from the rules do, however, exist for specific initiatives.
Under FP7, the previous programme covering the 2007-2013 period, different rules including eligibility criteria and reimbursement rates, depending on the programme part and on the type of organisation, were used.

A single set of rules was put in place under Horizon 2020 with the aim of ensuring a coherent framework for participation, including within programmes managed by the European Institute of Innovation and Technology (EIT), public-private partnerships managed by Joint Undertakings under Article 187 of the Treaty on the Functioning of the EU (TFEU) and public-public partnerships under Article 185 TFEU.

Following the inter-institutional discussions on Horizon 2020, flexibility was sought by introducing a number of limited derogations, which exist for both Joint Undertakings (under Article 187) and public-public partnerships (Article 185).

For Joint Undertakings, the scope of derogations from the Rules for Participation is set out in the Rules themselves and developed further through delegated acts – a means by which the Parliament and the Council maintained control on the detailed content of these derogations. For Article 185 initiatives, derogations from the Rules are laid down in the respective basic acts, adopted by the Parliament and Council by ordinary legislative procedure.

Compared to FP7, the single set of rules under Horizon 2020 was a major simplification. Under FP7, participants had to comply with different rules depending on the programme part. The different funding bodies applied a variety of diverging rules, with different eligibility criteria or funding rates. This triggered fragmentation, reduced legal certainty and increased the administrative burden and resources required to participate. As highlighted in the ex-post evaluation of FP7, the level of complexity and the lack of consistency between different parts of the programme meant that the rules were too complex. This explains, at least in part, the relatively high error rate associated with FP7 which the Court of Auditors attributed to risks inherent in the programme's design and implementation.[200]

[200] Ex-post evaluation of FP7, 2016.

Lessons learnt from Horizon 2020

The application of the single set of rules is widely seen by beneficiaries as advantageous: it contributes to increased legal certainty, coherence and simplification of the rules. For example: "One single set of simplified EU rules for participation is essential to safeguard a level playing field across borders given the big differences in national legislation….we welcome the introduction of a single set of rules".

(CESAER position paper on FP9: "How You Can Boost Worldwide Research and Innovation", January 2018).

"Within the EU funding programmes landscape, Horizon 2020 has achieved remarkable simplification. It has made access to the programme easier, reduced costs for applicants and made the programme more attractive"

(p.18, LAB-FAB-APP: Investing in the European future we want. Report of the High Level Group on maximising the impact of EU research and innovation programmes, July 2017).

The interim evaluation of the Article 185 initiatives indicates that "initiatives with fully centralised implementation are considered as more efficient in their programme implementation" while the reporting requirements for participants in decentralised initiatives[201] were identified "as a challenge"

(p. 32, Staff Working Document on Evaluation of the Participation of the EU in Research and Development Undertaken by Several Member States Based on Article 185 of the TFEU, September 2017).

The interim evaluation of Joint Undertakings also indicates that uniform application of the Horizon 2020 Rules contributed to the improved operational efficiency of JUs, but this progress was in some cases hampered by the design of the individual JU.

(p. 36, Staff Working Document on Evaluation of the Participation of the EU in Research and Development Undertaken by Several Member States Based on Article 185 of the TFEU, September 2017).

1.2 What are the changes?

The new EU Financial Regulation will be used as a common reference. Derogations should be kept to a minimum and are clearly justified in every case..

The Rules for Participation will aim for further simplification, increased legal certainty and reduced administrative burden - for beneficiaries, for other stakeholders and for programme administrators. This will uphold the single set of rules while introducing further improvements. All bodies implementing the programme will be brought together under one roof, including the EIT. Derogations for Article 185 and 187 initiatives, which will adhere to the common set of funding rules and the central management of all financial contributions, will be minimised.

The Participant Guarantee Fund[202] (renamed Mutual Insurance Mechanism) will also be extended to cover actions under Horizon Europe managed not only by the Commission, the EU agencies and the EU funding bodies (i.e. JUs and the EIT), but also by non-EU funding bodies (i.e. the bodies

[201] Fully centralised implementation: This model, used by EMRP and EMPIR, the successive public-public partnerships on metrology under FP7 and Horizon 2020, is the most integrated one. Here the whole programme, including the management of the grants, is implemented by the Dedicated Implementation Structure. Fully decentralised implementation: In this model (AAL2 and Eurostars2) the DIS is mainly organising the central evaluation and channels the EU co-funding to the national funding agencies that are managing individual national grant agreements for the funded projects.

[202] Under Horizon 2020, actions managed by non-Union funding bodies are not covered by the Participant Guarantee Fund (PGF). Since 2007, two Participant Guarantee Funds were created (EU and Euratom FP7) in order to protect the risk of non-recovery of sums due to the Union and to allow ongoing projects to continue in case of default of one of the beneficiaries in grants administrated by the Commission, executive agencies and the GSA (European Global Navigation Satellite Systems Agency). The positive experiences acquired during the first FP7 PGF justified its continuation in Horizon 2020 ..

implementing the public-public partnerships under Article 185). Moreover, it may also be extended to beneficiaries of any other directly managed Union programme[203].

1.3 What are the expected implications of the changes?

A single set of rules would deliver on the aim to rationalise Horizon Europe. It would streamline implementation methods and reduce administrative burden for beneficiaries. The accessibility and attractiveness of the programme, in particular for applicants with limited resources such as SMEs, would be sustained. As a result, legal certainty would increase and participation would be simplified further.

The extension of the coverage by the Participant Guarantee Fund to non-EU funding bodies would lead to more coherence in applying the rules. Provided that proper safeguards are in place, this is expected to be positively perceived by Member States, many of whom previously expressed their wish for including projects funded by Article 185 initiatives under the scope of the Fund.

1.4 What alternatives have been considered?

Keep the Horizon 2020 status quo - this would reproduce all the current programme's benefits and limitations. While this would result in a smoother transition, it would also not lead to further simplification and streamlining and would not take account of the lessons learnt from the Horizon 2020 interim evaluation.

Return to the FP7 situation - this would abandon the single set of rules principle and allow the different bodies to adopt their respective rules as they see fit. However, this flexibility would be granted at the expense of beneficiaries, who would face an excessively complicated set of diverging rules. Simplification efforts would be thwarted, and legal certainty would decrease.

The administrative burden for adjusting to different sets of rules would become prohibitive, hampering participation by beneficiaries with limited resources, in particular SMEs.

2 Funding model and types of action

2.1 What is the current situation under Horizon 2020?

FACTS

The single set of rules under Horizon 2020 features a simplified funding model. There is a **single funding rate per type of action** (up to 100% of eligible costs for research actions, but limited to a maximum of 70% for innovation actions, except for non-profit organisations) and a 25% flat rate for indirect costs. A number of different types of action exist..

Under FP7, the previous programme from 2007 to 2013, costs were reimbursed based on a complex matrix of organisation categories and activity types.

Funding model

[203] The Commission will adopt provisions for participation of beneficiaries of other Union programmes and the associated contributions to the Fund will take account of their risk profiles.

- The Horizon 2020 funding model is based on two main features: *a single funding rate* (up to 100% of eligible costs for research actions, but limited to a maximum of 70% for innovation actions, except for non-profit organisations), and *a single flat rate* of 25% for indirect costs.
- Under FP7, contrastingly, direct costs were reimbursed based on a matrix of organisation categories and activity types. The indirect costs were calculated using four different methods, including real indirect costs.
- The Horizon 2020 funding model has mobilised and largely satisfied stakeholders. In a simplification survey conducted in 2015, around 78% of respondents expressed the benefit of a single reimbursement rate in a project, and 74% felt the benefit of the single flat rate for indirect costs.
- The Horizon 2020 funding model has had positive effects on stakeholder appreciation, time to grant[204], attractiveness and has reduced administrative burden. This is reflected in the application statistics and underlined by the interim evaluation of Horizon 2020.

Types of action

The following types of action are used within Horizon 2020:

Type of action and objectives pursued	Target Groups	Changes FP7
GRANT-BASED TYPES OF ACTION		
Research and Innovation Actions (RIA): Action primarily consisting of activities aiming to establish new knowledge and/or to explore the feasibility of a new or improved technology, product, process, service or solution. It may include basic and applied research, technology development and integration, testing and validation on a small-scale prototype in a laboratory or simulated environment	Consortia of partners from different countries, industry and academia	Changes to funding model and further focus on innovation
Innovation Actions (IA): Actions primarily consisting of activities directly aiming at producing plans and arrangements or designs for new, altered or improved products, processes or services. For this purpose they may include prototyping, testing, demonstrating, piloting, large-scale product validation and market replication. They are used for areas where the scientific and technology insights are available and the focus shifts to turning these into applications.	Consortia of partners from different countries, industry and academia	New action and changes to funding model
Fast Track to Innovation (IA): Continuously open calls will target innovation projects addressing any technology or societal challenge field	Consortia of partners from different countries	New action
European Joint Programme Cofund (COFUND-EJP): Support to coordinated national research and innovation programmes in implementing a joint programme of activities (ranging from research and innovation activities to coordination activities, training and dissemination activities).	Independent legal entities from Member States or Associated Countries owning or managing national research and innovation programmes	New action
ERA-NET-Cofund: Support public-public partnerships in their preparation, establishment of networking structures, design, implementation and coordination of joint activities as well as Union topping-up of a trans-national call for proposals	Independent legal entities from Member States or Associated Countries owning or managing national R&I programmes	-
Pre-Commercial Procurements (PCP): PCP actions aim to encourage public procurement of research, development and validation of new solutions that can bring significant quality	EU funding for a group of procurers ('byers group') to undertake together one joint	-

[204] "The first three years of Horizon 2020 have shown a significant reduction of the time elapsing between the closure of a call and the signature of the Grant Agreement (i.e. Time to Grant), from an average of 303 days in FP7 to an average of 192.2 days, which is a decrease of 36.6% (more than 110 days)". *(p.55, In-Depth Staff Working Document on Horizon 2020 Interim Evaluation, SWD(2017) 220 final, May 2017)*

Type of action and objectives pursued	Target Groups	Changes FP7
and efficiency improvements in areas of public interest, whilst opening market opportunities for industry and researchers active in Europe	PCP / PPI procurement	
Public Procurement of Innovative solutions (PPI): PPI actions enable groups of procurers to share the risks of acting as early adopters of innovative solutions, whilst opening market opportunities for industry	EU funding for a group of procurers ('buyers group') to undertake together one joint PCP/PPI procurement	-
Coordination and Support Actions: Actions consisting primarily of accompanying measures such as standardisation, dissemination, awareness-raising and communication, networking, coordination or support services, policy dialogues and mutual learning exercises and studies, including design studies for new infrastructure and may also include complementary activities of networking and coordination between programmes in different countries	Single entities or consortia of partners from different countries	-
Marie Skłodowska-Curie Actions (MSCA): Bottom-up funding for international research fellowships in the public or private sector, research training, staff exchanges	Early stage researchers or experienced researchers (of any nationality), managerial, technical or administrative staff supporting the research and innovation activities, single entities or consortia of partners from different countries, industry and academia	-
MSCA Co-fund: Support for regional, national and international doctoral and fellowship programmes to foster excellence in researchers' training, mobility and career development, spreading the best practices of the MSCA	Single legal entities from Member States or Associated Countries owning or managing international/ national/regional R&I programmes, early stage researchers or experienced researchers (of any nationality)	-
European Research Council frontier research grants: Funding for projects evaluated on the sole criterion of scientific excellence in any field of research, carried out by a single national or multinational research team led by a 'principal investigator'	Excellent young, early-career researchers, already independent researchers and senior research leaders. Researchers can be of any nationality and their projects in any research field.	-
SME Instrument Phase 1 (IA): The SME Instrument is targeted at all types of innovative SMEs showing a strong ambition to develop, grow and internationalise. It provides staged support covering the whole innovation cycle in three phases complemented by a mentoring and coaching service. Phase 1 – feasibility study verifying the technological/practical as well as economic viability of an innovation idea/concept	Only SMEs can participate. Either a single SME or a consortium of SMEs established in an EU or Associated Country	New action
SME Instrument Phase 2 (IA): Phase 2 – innovation projects that address a specific challenge and demonstrate high potential in terms of company competitiveness and growth underpinned by a strategic business plan	Only SMEs can participate. Either a single SME or a consortium of SMEs established in an EU or Associated Country	New action
Specific Grant Agreement (SGA): The Financial Regulation provides the possibility of *Framework Partnership Agreements* for long-term partnerships and associated specific grant agreements. Framework Partnership Agreements and Specific Grant Agreements have been used in a limited way when in line with the objectives of the programme parts.		-
OTHER INITIATIVES UNDER HORIZON 2020		

Type of action and objectives pursued	Target Groups	Changes FP7
Prizes: Financial contribution given as a reward following the publication of a contest. Inducement prizes are a 'test-validate-scale' open innovation approach that brings together new and small players that may pursue more radically new concepts than large, institutionalised contestants. Inducement prizes offer an incentive by mobilising new talents and engaging new solver communities around a specific challenge. They are only awarded based on the achievement of the target set, solving the challenge defined. 'Recognition prizes' are used to recognise past achievements and outstanding work after it has been performed, whereas an 'inducement prize' is used to spur investment in a given direction, by specifying a target prior to the performance of the work.	Whoever can most effectively meet a defined challenge (future target or past achievement)	New action
Public-Public Partnerships also provided via the Article 185 initiatives: Article 185 of the TFEU allows the integration of national efforts into a programme undertaken jointly by several Member States, with the participation of the EU, including participation in the structures created for the execution of the joint programme.	EU Member States	-
Public-Private Partnerships: Support the development and implementation of research and innovation activities of strategic importance to the Union's competitiveness and industrial leadership or to address specific societal challenges. They take the form of Joint Undertakings under Article 187 of the TFEU and organise their own research agenda. Contractual PPPs, in which the activities take place under the umbrella of the Horizon 2020 work programmes, may also be supported.	Partnerships between public and private sector	-
Public Procurement: Supply of assets, execution of works or provision of services against payment	By means of tenders and subject to special procurement procedures	
Financial instruments: Equity or quasi-equity investments; loans; guarantees; other risk-sharing instruments. Horizon 2020's financial instruments operate in conjunction with those of COSME. Strong synergies shall be ensured with the European Fund for Strategic Investments (EFSI) to create the maximum possible impact. Shall be the main form of funding for activities close to market under Horizon 2020.	FI are not directly implemented by the Commission (nor via the WP), but via EIB/EIF.	Replacing Risk Sharing Finance Facility

Lessons learnt from Horizon 2020

"The Horizon 2020 funding model puts the focus on the costs that are directly related to the project. It was expected to simplify the financial management of projects, by a reduced complexity of the financial rules; reduce the financial error rate detected in ex-post audits; increase legal certainty for beneficiaries; increase the attractiveness and ease of access to the programme, in particular for newcomers, smaller actors, SMEs and industry; and contribute to the acceleration of the granting processes. The thematic assessments confirm that the expected benefits have largely materialised".
(p.54, In-Depth Staff Working Document on Horizon 2020 Interim Evaluation, SWD(2017) 220 final, May 2017).

"The new funding model has mobilised and largely satisfied stakeholders. It can also be assumed to have contributed to the attractiveness of Horizon 2020 as reflected in application statistics. For around 90% of universities and more than half of research organisations which have used in FP7 the 60% flat rate method for indirect costs, the Horizon 2020 funding model has brought little change compared to FP7 in terms of funding rate and has therefore not had any major impact on the participation pattern of research organisations and universities".
(p.56, In-Depth Staff Working Document on Horizon 2020 Interim Evaluation, SWD(2017) 220 final, May 2017).

Further simplification efforts and more flexibility are needed, for example concerning the additional remuneration scheme and the broader acceptance of beneficiaries' accounting practices. The additional remuneration scheme has been perceived by Member State representatives and stakeholders as being difficult to implement (*see p.56 of the Staff*

Working Document), and as having a negative financial effect on those beneficiaries whose usual remuneration practices are based on very variable levels of remuneration. Broader acceptance of usual accounting practices (strengthening the current cases under Horizon 2020, with the future possibility to have other cases where the usual cost accounting practices of the beneficiary could be accepted) will be further explored.

2.2 What are the changes?

Funding model

The current funding model will be maintained. The Rules for Participation provisions will be complemented by clear guidance on use of the maximum funding rate, and the possibility to lower this in justified cases.

Types of action

The types of action under Horizon Europe, for example in the area of public-private and public-public partnerships, will be rationalised and will provide more flexibility for the applicant. An overview of continued, discontinued and new funding instruments can be found in Table 16 below.

For the forms of funding and types of action to be maintained under Horizon Europe, the level of detail within the current Rules for Participation, with some adjustments in the area of prizes, will be maintained. There will be no duplication with the EU Financial Regulation, which will serve as a single rulebook for all actions financed from the EU budget.

Table 16: Mapping of continued, discontinued and new instruments in Horizon Europe

CONTINUED Without Changes	CONTINUED With Changes	DISCONTINUED	NEW
Design – Priorities			
	• Excellent Science: *becomes* Open Science pillar and does not include the FET specific objective • Societal Challenges: *becomes* Global Challenges and Industrial Competitiveness pillar and covers the LEITs specific objective of the Industrial Leadership pillar • EIT: *becomes* part of the newly created Open Innovation pillar	Industrial Leadership as a separate pillar	• Open Innovation pillar • ERA foundation ("Strengthening the ERA") : covers SWAFs, Widening, which were separate specific objectives
Design - Specific objectives			
• European Research Council • Marie Skłodowska-Curie Actions • Research Infrastructures • Direct Actions (Joint Research Centre) • Support to the European Institute of Innovation and Technology	• Leadership in enabling and industrial technologies (*becomes* cross-cluster, though in particular in Digital and Industry cluster) • Innovation in SMEs, (*included* in European Innovation Council) • Societal Challenges 1-7 (*becomes* Clusters in the Global Challenges pillar) • Science with and for Society (*becomes* intervention areas within ERA foundation) • Spreading Excellence and Widening Participation (*becomes* Sharing Excellence, within ERA foundation)	• Future and Emerging Technologies as separate label, but activities included in other parts • Fast Track to Innovation • Access to Risk Finance (moved to InvestEU programme)	European Innovation Council (building on EIC pilot)
Implementation - instruments			

• Research and Innovation Actions • Innovation Actions • ERC frontier research • Training and mobility actions • Programme co-fund actions • coordination and support actions • inducement prizes • recognition prizes • public procurements • ERA Chairs • Twinning • Teaming • Policy Support Facility	• Pre-commercial procurements (PCP) and Public procurement of innovative solutions (PPI) (becomes Coordinated innovation procurement) • SME Instrument (integrated into EIC Accelerator and transition activities) • Future and Emerging Technologies (FET) Open (becomes EIC Pathfinder) • Future and Emerging Technologies (FET) Flagships (incorporated within missions concept) • Support to Joint Programming Initiatives, ERA-NETs, Contractual Public Private Partnerships, Institutionalised public-private partnerships (Art. 187) and Institutionalised public-public partnerships (Art. 185): incorporated within European Partnerships initiative.		Missions EIC pathfinder EIC accelerator EIC transition activities
Implementation – concepts			
• Key Enabling Technologies • Integration of social Sciences and Humanities • Responsible Research and Innovation (Trying to drop this term – better to treat the components separately) • Communication • Gender Equality • Ethics standards	• International cooperation (new criteria) • Strategic planning – widened to include the R&I activities from other funding programmes • Governance		

2.3 What are the expected implications of the changes?

Funding model

The proposed changes would:

- Provide continuity with the current situation, complying with the principles of the Financial Regulation.
- Be positively perceived by recurrent Horizon 2020 beneficiaries
- Facilitate access to the programme for beneficiaries who have difficulties to get other sources of funding for their projects, possibly increasing the number of newcomers and covering a wider range of potential beneficiaries.

However some of the difficulties experienced in Horizon 2020 to date, notably on oversubscription to calls, would most likely continue (alternative ways to address oversubscription are also identified in section 3.4 of the Impact Assessment).

Types of action

The proposed changes would ensure stability while taking account of the lessons learned from Horizon 2020 so far, for example the need to rationalise the number of existing EU funding

instruments for research and innovation. It would better suit participants' needs by applying simplified forms of funding; thus streamlining further the EU R&I funding landscape. Thus, the result would be a more user-friendly set of EU funding schemes for R&I, coherence with the EU Financial Regulation and greater complementarity between instruments.

2.4 What alternatives have been considered?

Funding model

A single reduced funding rate for all projects (75% funding rate) and linking the flat rate for indirect costs to personnel costs based on an optional unit cost was considered. This could reduce oversubscription (as a higher number of beneficiaries could benefit from EU funding), further simplify the current rules (i.e. no differentiation between funding rates for Research and Innovation Actions and Innovation Actions) and enhance opportunities for newcomers. However, the reduction of the funding intensity would lower the overall attractiveness of the programme, especially for non-profit entities and SMEs, and would negatively affect the principle of excellence.

Different levels of funding for industry compared to other types of beneficiaries were also considered. The funding rates for industry evolved from 50% in FP7 (with a possibility to charge real indirect costs) to 100% (70% in innovation actions) in Horizon 2020 (with a 25% flat rate for indirect costs). Doubling of the nominal funding rate in Horizon 2020, in combination with the 25% flat rate for indirect costs (and no real indirect costs), has had a positive effect in attracting industry and only a minor impact on the effective funding rate for industry. Having a separate (lower) rate for industry could release funds to increase the number of grants and to offer further possibilities for newcomers. However, the introduction of a different funding rate for industry would have a negative impact on industry participation, time-to-grant and would work against the drive for simplification.

3 Forms of grants

3.1 What is the current situation under Horizon 2020?

FACTS

Different **forms of grants**[205] are provided for under the current EU Financial Regulation and used by the Horizon 2020 programme.

To reduce the complexity of the funding rules, Horizon 2020 features a "simplified cost reimbursement system with enhanced use of lump sums, flat rates and unit costs"[206].

Actual costs (i.e. costs actually incurred by beneficiaries) are the most widely used. Unit costs are used in relation to personnel costs (i.e. for average personnel costs and SME owners without a salary), other direct costs (i.e. internal invoices) and for MSCA, while flat rates are used for the indirect costs. Lump sums are used, for example within Phase 1 of the SME Instrument).

Lessons learnt from Horizon 2020

[205] Art. 125 of the new EU Financial Regulation refers to "forms of Union contribution", however the more user-friendly "forms of grants" term is used in this section of the annex.
[206] Recital 13 of the Horizon 2020 Regulation. The flat-rate for indirect costs, the unit cost for the owners of SMEs and the unit cost based on average personnel costs also all mentioned in the core text of the Horizon 2020 Rules for Participation.

"The range of funding schemes for R&I across the EU budget is numerous, complex and not accessible enough…a minimum objective should be to eliminate one third of R&I funding schemes, instruments and acronyms across the landscape" (*LAB-FAB-APP: Investing in the European future we want, Report of the High Level Group on maximising the impact of EU research and innovation programmes, July 2017*).

"The use of new instruments such as the pre-commercial public procurement (PCP), public procurement for innovation (PPI) and inducement prizes clearly aim at leveraging demand for future solutions. Evidence of outputs so far is however still lacking on the effects of the PCP and PPI, since the first projects were signed only in 2015….overall more could be done to support demand for innovative solutions and user-driven innovation" *(p.110, In-Depth Staff Working Document on Horizon 2020 Interim Evaluation, SWD(2017) 220 final, May 2017).*

Due to the perceived need to focus more on performance rather than auditing of spending, there is a general interest to simplify funding and shift the focus from the reimbursement of costs to the implementation of defined activities. The main step is the new Financial Regulation, whose main purpose is to facilitate and stimulate, as far as possible, the simplified forms of grants. Further simplification of the current actual cost reimbursement system is necessary, in particular in the area of personnel costs.

3.2 What are the changes?

There will be specific provisions on forms of Union contribution (as described under Article 125 of the new Financial Regulation) within the Rules for Participation. These provisions will include, as exists today, the reimbursement of actual costs, flat rate costs and increased use of lump-sum costs (building on the lump-sum pilot under Horizon 2020) and prizes. In addition, the funding of Marie Skłodowska-Curie Actions, fully based on unit costs, will be continued, and other forms of Union funding will be considered.

For projects funded mainly on the basis of incurred costs, the current unit cost options (average personnel costs, internally invoiced goods and services, SME owner unit cost, clinical studies, etc.) calculated in accordance with the beneficiary's usual practices[207] will be maintained. In addition, the unit cost for internally invoiced goods and services will allow for a higher acceptance of usual cost accounting practices. This means that beneficiaries will be able, under certain conditions[208], to calculate unit costs based on actual direct and indirect costs. Public procurement instruments will be aligned to the new Financial Regulation, while some specificities are provided for pre-commercial procurement and procurement of innovative solutions.

Issue	Planned status within Horizon Europe Programme
Actual costs	
Rules on personnel costs	The current Horizon 2020 system of reimbursement of actual personnel costs will be simplified and, where possible, further aligned with the Financial Regulation: the distinction between basic and additional remuneration will be removed and the Horizon 2020 capping on additional remuneration of EUR 8.000 per person per year abolished. At the same time, building on Horizon 2020, the costs of personnel will be eligible up to the remuneration that the person would be paid for the time worked in projects funded by national schemes.
Eligibility of costs from third parties	The system of in-kind contributions provided by third parties to beneficiaries will be further aligned to the Financial Regulation: in-kind contributions against payment will be treated and reimbursed according to the conditions set out in this

[207] The conditions for eligibility of these costs will be set out in the model grant agreement.
[208] These conditions (e.g. beneficiaries must be able to identify their actual eligible indirect costs, they must use of a fair key or driver to distribute these costs) will be further developed in the model grant agreement.

	Regulation. The possibility for beneficiaries to declare costs of in-kind contributions provided by third parties (free-of-charge) will be kept and further simplified. Beneficiaries will be able to declare costs related to in-kind contributions provided by third parties (free-of-charge) as eligible up to the direct eligible third parties' costs. Therefore, no distinction as to whether these resources (e.g. seconded persons, contributed equipment) are used on the beneficiaries or third parties' premises will be necessary any longer. In addition, the obligation to declare such costs as receipts will be removed in light of the provisions of the Financial Regulation.
Flat rate costs	
Indirect costs	The current Horizon 2020 flat rate of 25% for indirect costs will be maintained.
Lump sum costs	
	The use of lump sums will be increased based on the experience of the lump sum pilot projects under Horizon 2020.
Unit costs calculated in accordance with the beneficiary's usual accounting practices	
	The current provisions for unit costs (i.e. average personnel costs and costs of internally invoiced goods and services) will be maintained. In addition, the unit cost for internally invoiced goods and services will allow for a higher acceptance of the usual cost accounting practices by allowing beneficiaries, under certain conditions – to be set out in the grant agreement - to calculate such unit cost based on 'actual direct and indirect costs'.
Unit costs for MSCA	
	The current system of unit costs will be maintained (not excluding the use of other forms of Union funding).
EU financing not linked to costs	
	The topics where this form of Union contribution could be used will be identified in the Specific Programme or in the Work Programme. Further details will be set out in subsequent Commission procedure as indicated in the revised Financial Regulation.
Operating grants	
	No specific references in the Rules are necessary to conclude operating grants (which could be specified within the Work Programme).

3.3 What are the expected implications of the changes?

These changes would provide legal certainty and consistency by offering the complete set of forms of grants set out in the Financial Regulation to beneficiaries, but outlining the choice of the most appropriate one in the Work Programme. This is also expected to improve and simplify reimbursement of actual costs, while providing flexibility.

3.4 What alternatives have been considered?

Alternative considered	Reason not favoured
Rules for personnel costs	
Provide for an optional unit cost (hourly rate) set out by the Commission for all EU and Euratom programmes.	This would not help deliver the objective of broadening opportunities for participants of the Framework Programme and increasing the leverage effect of the EU

	funding.
Provide for a unit cost (hourly rate) calculated by the beneficiary based on the average salary of the person in the previous year.	This would require detailed rules to determine the formula to be applied.
Payment of the personnel costs against certain conditions, by fixing an amount to cover the personnel costs for the work done in the project.	This would imply replacing the actual cost system with contribution not linked to costs; however, given the diversity in salary costs across the Union, it would not be possible to set out a fixed amount for personnel across Europe.
Eligibility of costs from third parties	
Fully align to the Financial Regulation by considering in-kind contributions as part of the co-financing and therefore as ineligible costs.	This would imply a significant change and a potential financial loss for beneficiaries, in particular for universities of many Member States whose professors are paid by the ministries. Thus this would be challenged by Member States, research beneficiaries and stakeholders.

4 Further simplification/flexibility

4.1 What is the current situation under Horizon 2020?

FACTS

Simplification of rules and procedures is a central guiding principle of Horizon 2020, and is fully reflected in the programme's design, rules, financial management and ways of implementation. The aim has been to make the programme simpler and more attractive, in particular to newcomers.

Significant simplification has resulted in the single reimbursement rate, the flat rate for indirect costs, the improved Participant Portal and the electronic grant management processes.

The **Lump Sum pilot** is the main element of the second wave of simplification of Horizon 2020. It will test two options for lump sum funding in the 2018/2020 Work Programme.

Lessons learnt from Horizon 2020

The Lamy Report recognises the "remarkable simplification achieved" in the context of Horizon 2020. It identifies areas for further simplification for Horizon Europe in order to: (i) make the Participant Portal website a "one-stop-shop" for all steps from application to final reporting; (ii) give participants the choice between cost-based and lump-sum funding; and (iii) further simplifying administrative processes along the project cycle.

The Horizon 2020 Interim Evaluation highlights that simplification is a continuous endeavour, and identifies possible areas for improvement, such as the broader acceptance of beneficiaries' usual cost accounting practices or the more extensive use of simplified forms of funding (unit costs, flat rates, lump sum). This is in line with the new Financial Regulation and the EU Budget Focused on Results initiative.

The European Court of Auditors, in its briefing paper on "A contribution to simplification for research beyond Horizon 2020"[209], identifies among other things the "following proposals to be considered to bring more focus on the

[209] Briefing Paper on 'A contribution to simplification for research beyond Horizon 2020', March 2018, available at: https://www.eca.europa.eu/Lists/ECADocuments/Briefing_paper_H2020/Briefing_paper_H2020_EN.pdf

discussion in Horizon Europe that is taking place now: (i) further use of simplified cost options, such as lump sums and prizes; (ii) accepting beneficiaries' accounting practices.

4.2 What are the changes?

Based on the achievements of Horizon 2020, Horizon Europe will aim for further simplification of rules for beneficiaries. This is fully in line with the overall objective of the next EU budgetary cycle to have simple and effective common rules across Programmes, with adequate flexibility in justified cases. The changes are:

- A wider/greater cross-reliance on audits and assessments – with other EU programmes – is envisaged if the costs can be audited or assessed against the same set of rules.
- Broader acceptance of beneficiaries' usual cost accounting practices, in order to reduce the administrative burden on beneficiaries who will be able to identify their cost components via their own trusted methods.
- Increased use of lump sums is based on the lessons learned from the lump-sum pilot within the 2018-2020 calls under Horizon 2020. In addition, although not specifically mentioned in the Rules, the two current unit costs calculated in accordance with the beneficiary's practices (average personnel costs and internal invoices) will be maintained.
- The unit cost for internally invoiced goods and services will allow for a higher acceptance of the usual cost accounting practices by allowing beneficiaries, under certain conditions (to be set out in the grant agreement) to calculate this based on 'actual eligible direct and indirect costs'.
- Secure electronic system will be maintained: the use of a tool for providing secure electronic interaction (currently the Participant Portal) should be made mandatory, in accordance with the Financial Regulation. The Participant Portal will also be extended to other EU programmes.
- To address oversubscription, a broader use of multi-stage submission could be explored..
- Simplification measures should also address Article 185 initiatives, e.g. potential inclusion in the Participant Guarantee Fund and the ex-post audit coverage by the Common Audit Service.

4.3 What are the expected implications of the changes?

- The expected reduction of audit efforts should decrease administrative buden and costs for beneficiaries, as well as for Commission services.. Implementing additional automated checks and tools for simpler entry of data will also have a positive impact where beneficiaries need to submit information to EC.
- Increased alignment to the Financial Regulation on actual costs, broader use of simplified forms of costs and of acceptance of beneficiaries' usual cost accounting practices will make Horizon Europe less burdensome and more attractive. Further acceptance of the beneficiaries' usual cost accounting practices will reduce the error rate on issues that have seen recurrent and repetitive errors under FP7 and Horizon 2020.
- Further simplification due to increased use of lump sums under Horizon Europe. The use of lump sums reduces substantially the administrative burden during the lifetime of the project, shifting the focus of project monitoring from financial checks to performance and content.
- The improvements to the Participant Portal, the single entry point for information providing secure electronic interaction, will offer easier access to the programme. Further improvements of the interfaces, guidance documents, as well as the online version of the Annotated Model Grant Agreement will similarly allow for easier access to information. Integration of ex-post audit support into the Portal will enable a clearer view on the progress of audits and allow for

completely electronic exchange of documents and notifications, thus reducing administrative burden and costs.

4.4 What alternatives have been considered?

Several alternatives to the simplification measures were considered, and several additional measures may be introduced during Programme implementation.

5 Use of grants, financial instruments and budgetary guarantees

5.1 What is the current situation under Horizon 2020?

FACTS

More than **90%** of the Horizon 2020 support is grant based. Less than 10% of support is provided through financial instruments, such as debt and equity.

Horizon 2020 invests **€400 million** per year in risk financing, through the European Investment Bank. This is, however, less than 10% of Horizon 2020's overall budget.

Grants are the most widely used and appropriate form of public support for early stage research and innovation projects. Financial instruments are used for projects closer to the market.

Lessons learnt from Horizon 2020

Only a small number of companies receiving Horizon 2020 grants benefit from such financial instruments, and the programme lacks genuine connections between grant and loan-based financing for companies.

A key aim of the Horizon 2020 financial instruments is to finance R&I projects closer to the market. But the analysis of Technology Readiness Levels (used to measure the maturity level of innovation) illustrated that the financial instruments financed an equal share of projects with lover level of maturity (TRL 1-3), medium level of maturity (TRL 4-6) and higher level of maturity (7 – 8).

"Overall, the InnovFin scheme is performing well against its objectives of improving access to finance for innovative companies and projects, and helping to address related market failures. To the extent that shortcomings have been identified, these are more to do with the implementation of particular InnovFin schemes than being inherent programme design faults" *(p.467, Annex 2 of Staff Working Document on Horizon 2020 Interim Evaluation, SWD(2017) 221 final, May 2017).*

5.2 What are the changes?

Horizon Europe aims to increase the number of young, highly innovative European companies that can scale up rapidly and grow into leading, market-creating innovators worldwide.

The availability of flexible, agile funding is a key mechanism that enables scaling up. However, Europe's innovators, currently cannot access risk finance above the €10 million range. The supply of flexible funding, such as blended finance (combining grants with loans or equity) or crowdfunding, is insufficient. European investors are more cautious than their American

counterparts and are typically focused on smaller amounts. The European stock markets provide insufficient source of finance[210].

As a result, a major concern for Horizon Europe is to increase the willingness of private investors and lenders to commit to these young, highly innovative European companies. Blended finance will help. Combining grants with equity, loans, soft loans or guarantees, this allows for blending simultaneously, for example, as a grant-plus-equity package . Sequential blending is also possible, as when a grant attracts a later investment by a Venture Capital fund, business angel or corporate Venture Capital arm, or facilitates a loan from a bank or a non-bank lender.

5.3 What are the expected implications of the changes?

- Blended finance will increase the availability of large-scale risk finance in Europe;
- The leverage of EU R&I funding is expected to increase through measures put in place to stimulate private finance for instance through hard blending;
- Increased risk taking for breakthrough innovation by de-risking technical, commercial or company failure.

5.4 What alternatives have been considered?

Providing grant based support through Horizon Europe and financial instruments through the InvestEU single fund:

- In Europe, financial intermediaries (banks and investors) remain averse to the risk when investing in high-risk innovative projects. Therefore, available private and corporate financing remains small for innovation activities and market take-up for breakthrough innovations, as financial institutions must limit their risks to maintain their market rating. There is hence a necessity for direct Union intervention. Innovation will thus be reinforced by the InvestEU single fund, providing indirect financial instruments carried out through the European Investment Bank Group or other implementing partners, with a dedicated window for R&I investments and specific products for innovative companies.
- Providing grants only allows lowering the risk of operations and attracting private or corporate finance. This is only partially the case, as some activities too close to market, including deployment and scale-up, may not be covered by grants. However, the alternative of awarding blended finance to a project by allocating grant-type funding (through the Framework Programme) and financial instruments (through InvestEU) might not be fully adapted to the needs of risky breakthrough innovators who need to proceed to the market quickly..

6 Proposal selection and evaluation, including experts

6.1 What is the current situation under Horizon 2020?

The approach for the **evaluation and selection of proposals** submitted to Horizon 2020 calls is to ensure a maximum of coherence across the different implementing bodies, with three standard evaluation criteria outlined in the Rules for Participation. Details of the evaluation criteria, weighting and thresholds, as well as additional eligibility criteria, are laid out in the Work Programmes. As regards the appointment of **independent experts** to evaluate proposals (and other

[210]In 2012-2016, the average European venture capital exit via Initial Public Offering (IPO) was nearly $ 70 million versus $ 220 million for the US: https://techcrunch.com/2017/06/07/venture-investing-in-the-us-and-europe-are-totally-different-industries/85

tasks), the key provisions are set out in the Horizon 2020 Framework Programme Regulation rather than the Rules for Participation.

FACTS

Three criteria against which proposals are evaluated – **Excellence**; **Impact**; **Quality and Efficiency of the Implementation** (with Excellence only for the European Research Council calls).

There is a higher weighting for **Impact** within Innovation Actions calls.

Independent experts shall be chosen on the basis of their **skills**, **experience** and **knowledge** appropriate to carry out their tasks. When appointing, the Commission shall seek a **balanced composition** within the expert groups and evaluation panels in terms of various skills, experience, knowledge, geographical diversity and gender. Where appropriate, private-public sector balance shall also be sought.

Lessons learnt from Horizon 2020

"There is room for improvement in the current evaluation process. The thematic assessments….highlight dissatisfaction with application procedures, proposal evaluation and selection and reporting procedures. In addition they note that the quality of feedback provided to applicants is an area for improvement. This is also reflected in the stakeholder consultation results, where 62% of respondents assess the quality of the feedback from the evaluations as "good" or "very good", while 34% judged it as "poor" or "very poor". Some respondents ask for more transparency and an improved quality of the evaluation feedback they receive. Respondents complain that not enough details are provided, that the quality of the feedback varies greatly from one evaluation panel to the other, and that discordant views can be provided to the participant.

In their position papers, some stakeholders from academia, research organisations, public authorities and business commented on the evaluation process and noted that the quality of the current process should improve. A variety of issues was highlighted, in particular: the Evaluation Summary Reports are reportedly too short and provide generic and not tailored feedback. A few stakeholders noted […] evaluation committees should have a balanced representation of stakeholders including industry, business participants and SSH experts. Business representatives further noted that the selection rules of expert panels, especially around conflicts of interest, seem to dissuade industry experts as evaluators; evaluators should have the necessary expertise and training, while consensus meetings should be reintroduced". (In-Depth Interim Evaluation of Horizon 2020, SWD(2017) 220 final)

"A modernised proposal evaluation system should attract different types of evaluators. Evaluation teams should consist of top people with broad experience well-matched to the call or mission and different competences to evaluate excellence and impact. Resources should be invested in providing meaningful evaluation feedback to applicants, including on the choice of funding instrument". *(p.15, LAB-FAB-APP, July 2017).*

"The Council invites the Commission to develop the evaluation process further by e.g. promoting diversity in evaluation panels, piloting blind evaluations, where possible".

(p.8, Council Conclusions "From the Interim Evaluation of Horizon 2020 towards the Ninth Framework Programme", December 2017)

"The European Parliament calls for better and more transparent evaluation and quality assurance by the evaluators; stresses the need to improve the feedback given to participants throughout the evaluation process and urges that complaints made by unsuccessful applicants that the Evaluation Summary Reports (ESRs) lack depth and clarity on what should be done differently in order to succeed be taken into consideration; calls on the Commission, therefore, to publish, in conjunction with the call for proposals, detailed evaluation criteria, to provide participants with more detailed and informative ESRs and to organise calls for proposals in such a way as to avoid excessive oversubscription, which badly affects researchers' motivation and the reputation of the programme". *(p.13, European*

Parliament Report on the assessment of Horizon 2020 implementation in view of its interim evaluation and the Framework Programme 9 proposal, June 2017)

6.2 What are the changes?

Proposal selection and evaluation

A similar level of detail on the evaluation and selection of proposals should be maintained in the legal acts and call documents of Horizon 2020, with small changes in order to address lessons learned and the specific features of Horizon Europe. Based on the specific recommendations coming from the Horizon 2020 Interim Evaluation, the following issues will be addressed in the design of the new programme:

- Differentiate the evaluation process according to objectives of the calls.
- Allow for differentiation of expertise within evaluation stages, where appropriate.
- Provide flexibility and allow for experimentation.

Thus the **provisions** retained in the Rules for Participation include:

- Clarified time-to-grant and time-to-inform milestones.
- Outlined award criteria - Excellence, Impact, and Quality and efficiency of the implementation, with the only exception of the ERC, where the sole criterion of excellence will apply.
- The possibility for selection to take into account factors beyond proposal-by-proposal evaluation (for example, a mechanism to ensure a coherent portfolio of projects).
- Possible selection on first-come-first-served basis (i.e. no ranking of batches).
- The main aspects of the proposal review procedure.

Experts

The rules on appointment of external experts are further aligned to the Financial Regulation. Therefore, the following provisions are included in the Rules for Participation for Horizon Europe:

- Selection criteria: independent experts may be selected without a call for expression of interest, if justified, and the selection is carried out in a transparent manner;;
- Appropriate remuneration;
- The publication of the names of external experts evaluating grant applications.

6.3 What are the expected implications of the changes?

Experience under Horizon 2020 has made clear the advantage of keeping certain principles fixed across the board, while adjusting the arrangements via the Work Programme. There are no obvious reasons for departing from this approach under Horizon Europe. Furthermore, many of the deficiencies noted (inadequate evaluation feedback; need for a broader pool of experts) should be addressed by the business processes – rather than by provisions in the Rules for Participation.

More widely, the changes detailed above would ensure necessary coherence across the programme but balanced with flexibility (in line with the guiding principle of "evolution not revolution") – thus enabling further simplification, addressing the lessons learned from the interim evaluation of Horizon 2020 and the Lamy Group report, whilst preparing for expected new features under Horizon Europe.

6.4 What alternatives have been considered?

Firstly, the possibility to specify in further detail the criteria for evaluation and selection of proposals in the Rules themselves (at a similar level of detail as in current Work Programme annexes) was considered. This would ensure a high degree of coherence across Horizon Europe. Different approaches between instruments could still be included in the Rules, but exceptions and derogations would all but disappear. This would provide a measure of stability for applicants. However, it would be virtually impossible to adapt the rules according to experience gained – nor experiment with new approaches. As such, there would be significant loss of flexibility.

Secondly, the possibility to move all or most of the rules out of the Rules for Participation (to the Work Programme, for example) was considered. This would lighten the legislative process, and would be more in line with wider Commission processes. However, with a programme of the breadth of Horizon Europe, and given the experience of Horizon 2020 and previous programmes, it is important to fix certain rules to ensure overall coherence and to avoid re-opening fundamental principles with every set of calls. This approach would maximise flexibility, but it would risk a divergence of rules in practice, jeopardise smooth business processes, and lead to unpredictability for applicants.

7 Audits and controls

7.1 What is the current situation under Horizon 2020?

FACTS
A simplification measure introduced for Horizon 2020 was to **reduce the audit burden** on participants through an ex-post control strategy which emphasises risk-based control and fraud detection.
The maximum length of time for an audit after the final payment to a Horizon 2020-funded project was **reduced from five years to two years**.
The Horizon 2020 ex-post audit function has been **centralised** in the Common Audit Service within the Common Support Centre (part of DG Research and Innovation) serving all the Horizon 2020 stakeholders

The internal control system as a whole is supported by the Financial Regulation, which identifies the responsibility of the Authorising Officers for the control of budget implementation at programme level. This includes the calculation of the error level and the consequent corrective measures.

According to the existing Financial Regulation "each operation shall be subject at least to an ex-ante control". Nevertheless, the extent in terms of frequency and intensity of the ex-ante controls shall be determined by the Authorising Officer taking into account risk-based and cost-effectiveness considerations.

The ex-post financial audit rules shall be clear, consistent and transparent and that the Commission shall ensure equal treatment of beneficiaries of a programme, in particular where it is implemented by several Authorising Officers.

The Horizon 2020 control framework is based on the following elements:

- **Operational capacity and financial viability checks**: Article 15 of the Horizon 2020 Rules for Participation and Dissemination states that this is required only for project coordinators when the requested EU contribution is equal or superior to €500,000, or when there are grounds to doubt the financial capacity of participants. It will not be verified for entities guaranteed by a Member State (or an associated country), or by any other legal entity whose financial capacity shall in turn be verified, or for higher or secondary education establishments.
- **Certificate on Methodology to calculate Unit Costs**: Participants that calculate and claim direct personnel costs on the basis of unit costs, in accordance with the Horizon 2020 Rules for Participation, may submit to the Commission a certificate on the methodology (CoMUC). This must comply with the conditions set out in Article 33(2) of the Rules for Participation and Dissemination[211] and meet the requirements of the grant agreement. Where the Commission accepts a certificate on the methodology, it shall be valid for all actions financed under Horizon 2020 and the participant shall calculate and claim costs on this basis. Once the Commission has accepted a certificate on the methodology, it shall not attribute any systemic or recurrent error to the accepted methodology. However, the certificate is optional has seen very low interest to date.
- **Certificate of Financial Statements (CFS)**: In Horizon 2020, a CFS is required when an amount claimed by a beneficiary for actual/unit costs calculated on the basis of the beneficiary's usual cost accounting practices is equal or greater to €325,000. This is a derogation from the current Financial Regulation, which states that a CFS is only required if the total grant amount is EUR 750,000 or more, and that a CFS may also be demanded on the basis of a risk assessment by the Authorising Officer. The Horizon 2020 CFS (as the CFS under FP7) is based on "agreed upon procedures" instead of an "audit opinion".
- **Ex-post audits** are an important part of the overall control framework and provide inputs to the ex-ante checks. The Horizon 2020 Audit Strategy is supported by the existing Financial Regulation and the Horizon 2020 Regulation.
- **Acceptance of usual of Cost Accounting Practices**: Under Horizon 2020, the Commission set out certain unit costs on the basis of the usual cost accounting practices of beneficiaries (i.e average personnel costs and internal invoices) under certain conditions detailed in the MGA. This concept is also used when referring to beneficiaries' records in the accounts: i.e. beneficiaries must record actual costs in accordance with their usual cost accounting practices. However, those provisions have to be compatible with the other Horizon 2020 eligibility criteria..

In addition, the simplified funding model (see Annex 9, section 2) introduced for Horizon 2020 is expected to reduce the financial error rate detected in ex-post audits, although when the Horizon 2020 interim evaluation was carried out in mid-2017 no ex-post audits had yet been completed.

Lessons learnt from Horizon 2020

"In order to reduce the audit burden, the obligation to provide representative 'error rates' for the programme should be dropped. Audits should only be carried out when there is a suspicion of fraud or serious financial wrongdoing on a project". *(LAB-FAB-APP: High Level Group report, July 2017).*

"The effects on the simplification of financial management in the projects and on the error rate cannot yet be assessed, as very few financial reports were yet submitted and no ex-post audits were yet finished".

(p.57, In-Depth Horizon 2020 Interim Evaluation, SWD(2017) 220 final, May 2017).

Several beneficiaries have repeatedly expressed the need for having their processes confirmed in order to obtain comfort on their reporting. Experience has shown that the current way of auditing under both FP7 and

[211] Regulation (EU) No 1290/2013

Horizon 2020 does not necessarily provide this assurance to the beneficiaries since the current audit process focuses only on costs declared and not on the beneficiaries systems and their overall accounting practices.

7.2 What are the changes?

The overall objectives remain the following:

- Effectiveness, efficiency and economy of operations;
- Adequate management of the risks relating to legality and regularity, taking into account the multiannual character of programmes and the nature of the payments concerned.

Specific changes include:

- **Certificate on Methodology / Systems and Process audits**: Under Horizon 2020, the Certificate on Methodology to calculate Unit Costs (CoMUC) was optional and the beneficiaries have shown low interest to date, resulting in very little added value as ex-ante controls. In addition, applying for a CoMUC is complex and burdensome. Therefore, it is envisaged to remove the existing CoMUC. Alternatively, a procedure under which beneficiaries may opt to have their systems and processes audited - under conditions to be set out in the Model Grant Agreement - is proposed.
- **Certificate of financial statements (CFS)**: The new Financial Regulation does not set any limit. The CFS may be demanded by the Authorising Officer on the basis of a risk assessment. The use of CFS might be broadened in order to provide more assurance, or narrowed as a simplification measure (reduction of administrative burden). Considering the CFS has proved in Horizon 2020 to be a relatively effective ex-ante control (with cost claims with a CFS having on average an error rate 50% lower than those without), it is proposed that the CFS remains mandatory under similar conditions as under Horizon 2020 (thresholds, cost covered).
- **Ex-post audits:** the approach under Horizon 2020 is successful and should be maintained; although the intensity of ex-post controls may be adapted..
- **The cross-reliance on assessments and audits**: The explicit reference to this principle in the new EU Financial Regulation allows for broadening its use by accepting other audits (i.e. audits of other EU programmes) as a basis for the assurance to be obtained by the Responsible Authorising Officers. This requires that the costs could be audited or assessed against the same set of rules. In addition, taken into account the balance between trust and control, it is proposed that the opportunity of performing ex-post audits should be reconsidered.
- **Ensuring equal treatment of beneficiaries when implementing the Framework Programme:** In order to strengthen this common approach, a "coordination and monitoring mechanism" is currently under design and will be effective as of 2018 for Horizon 2020. This is is expected to be extended to Horizon Europe.
- **Acceptance of usual of cost accounting practices**: While attractive from a simplification perspective, the acceptance of usual cost accounting practices presents important challenges since neither international nor national standards/rules exist defining a minimum core benchmark of what is an acceptable set of “usual cost accounting practices”. As for Horizon 2020, the usual cost accounting practices of beneficiaries can be accepted under certain conditions to be detailed in the Model Grant Agreement. Those conditions have to be compatible with the new Financial Regulation and eligibility criteria of Horizon Europe.

7.3 What are the expected implications of the changes?

While the reduction of the audit burden is a shared objective for beneficiaries, Commission and implementing bodies, the expected implications are:

- An alignment of the rules with other EU funding programmes will allow the beneficiaries to apply in a harmonised way their usual accounting practices. This will result in a smoother audit approach since the costs will be audited or assessed against the same set of rules.
- Specific features on the Certificates of Financial Statements (thresholds, frequency…) are foreseen in the Rules, which will result in a lower audit burden for beneficiaries.
- Further efforts in the area of ex-ante controls (through implementing additional automated checks and tools for simpler entry of the data) will have a positive impact where beneficiaries need to submit information to the Commission. The integration of ex-post audit support into the Participant Portal will enable a better view of progress of audits andallow for completely electronic exchange of documents and notifications.

7.4 What alternatives have been considered?

It can be envisaged to identify possible common benchmarks / principles or best practices for a broader acceptance of usual cost accounting practices of beneficiaries from different sectors and/or different countries.

The concept of cross-reliance on other audits or assessments with other EU programmes was considered, however its effectiveness depends on the coherence of rules between programmes. Identifying possible common benchmarks / principles or best practises for a broader acceptance of usual cost accounting practices of beneficiaries from different sectors and different countries can be further explored as a second alternative with the aim of moving from a rule-based approach towards a principle-based one.

Such a challenging alternative would be possible, only once having taken into account the eligibility criteria of the different EU programmes.

8 Intellectual Property Rights, including “Exploit in the EU”

8.1 What is the current situation under Horizon 2020?

FACTS

498 Intellectual Property Right (IPR) applications arising from Horizon 2020 projects have been submitted, of which **212** were awarded. This mainly consists of **patents** (408 applications and 141 awards) and **trademarks** (66 applications and 50 awards). These numbers[212] will greatly increase as more projects under Horizon 2020 are completed.

The Horizon 2020 rules relating to dissemination and exploitation were largely built on the rules of the FP7 Programme: the same level of detail was maintained and the balance of interests between the different types of participants was not fundamentally altered.

Apart from simplification measures, changes were mainly introduced due to new policy objectives (e.g. open access to scientific publications), the inclusion of innovation (e.g. possibility to lay down additional exploitation obligations, publicly known as "Exploit in the EU first"), the need for

[212] 'Horizon 2020: In Full Swing – Three Years On' brochure, January 2018 (p.46).

specific rules deviating from the general framework in certain areas (e.g. security research) and new forms of funding (e.g. pre-commercial procurement).

The general rule in Horizon 2020 for exploitation obligations is that participants, having received EU funding, must use their best efforts to exploit their results, without any further conditions. 'Exploitation' is broadly defined.

Therefore, participants enjoy a large degree of flexibility when deciding how, where and by whom to exploit. Additional exploitation obligations may be laid down within the grant agreement, if foreseen in the Work Programme. Beneficiaries must report on their dissemination and exploitation activities during the project.

Lessons learnt from Horizon 2020

There is no major support for fundamentally different rules but some areas of improvement have been identified. Recently, national representatives and other stakeholders have also underlined a need to strengthen the rules requiring that Horizon 2020 project results should be exploited preferentially in the EU. Furthermore, the European Parliament resolution of June 2017 on the "assessment of Horizon 2020 implementation in view of its interim evaluation and the Framework Programme 9 proposal" stressed *that "FP9 for R&I should strengthen societal progress and the competitiveness of the EU, creating growth and jobs and bringing new knowledge and innovations in order to tackle the crucial challenges faced in Europe, as well as delivering further progress in developing a sustainable ERA".*

Feedback from R&I projects to other beneficiaries and policy-making must be strengthened, requiring also reporting after the end of the project on the dissemination and exploitation activities of beneficiaries, as those activities often take place after the end of the project. Moreover, if beneficiaries cannot successfully exploit their results, they should pro-actively seek that others are given the opportunity to exploit these results, including through an appropriate online platform.

The Horizon 2020 rules require that the Commission be given an opportunity to assume ownership of, and protect, any results that a participant would not wish to protect or for which they want to abandon protection or not extend protection (subject to various conditions). This requirement is perceived as an administrative burden and probably being complied with to a widely variable degree, as the notifications remain rather low. Moreover, experience has shown that if participants do not wish to protect, protection by the Commission is not considered appropriate either.

In Horizon 2020, joint owners may only agree not to continue with joint ownership after the results have been generated. This constraint was introduced during the legislative process to help less experienced participants (but the actual benefits are unclear). However, it means that no comprehensive agreement can be reached before the start of the project. This creates legal uncertainty having a negative impact on the cooperation required in multi-partner projects and may lead to a lower quality of projects/results. Moreover, this rule creates the illogic discrepancy that a participant may agree before the results are generated to transfer results it will solely generate but not results it will jointly generate. Restoring flexibility and offering guidance for beneficiaries to understand the issues at stake to help them to reach appropriate agreements for their specific project seems the best way forward.

8.2 What are the changes?

Most provisions of the Horizon 2020 rules will be maintained, with further simplification and improvements. This would entail:

- Reinforcing the focus on exploitation in particular in the Union, as a general rule, while keeping the possibility for exploitation outside the Union and additional exploitation obligations at Work Programme level.
- Specifying that the dissemination and exploitation plans must be updated during the project and after its end: the plan should contain a credible strategy if the expected exploitation entails developing, creating, manufacturing and marketing a product or process, or in creating and providing a service.
- Providing for the possibility to require reporting regarding the beneficiaries' dissemination and exploitation activities beyond the life time of the R&I projects.

- Removing the requirement to notify the Commission if no protection of results is sought, or if protection is abandoned or not extended.
- Removing the prohibition to agree on a regime other than joint ownership before results are generated;
- In view of the shortcomings in exploitation, beneficiaries which do not succeed in exploiting their results, need to use an appropriate online platform to seek exploitation by others.

8.3 What are the expected implications of the changes?

- These refinements to the IPR rules would help to ensure that the rules under Horizon Europe are fully fit-for-purpose.
- Improving legal certainly for participants and providing further simplification and flexibility.

8.4 What alternatives have been considered?

Alternative considered	Reason not favoured
Intellectual Property Rights (IPR) – general rules	
Not to have detailed IPR rules, but lists of principles	This would be a radical shift from recent programmes and would be criticised by stakeholders - especially since it would force participants to negotiate all IPR provisions from scratch before starting a project, and could result in projects not having the necessary rules in place with a detrimental effect on the implementation of the project and the exploitation and dissemination of its results.
Include detailed IPR rules and fundamentally alter the balance of interests between the different type of participants	Such a shift does not seem justified given that most types of participants are of the opinion that the current rules are relatively well balanced.
Exploit in the EU first	
Not to have any 'protectionist' rules or provisions	Having no rules at all is not favoured as this approach does not guarantee that the Union will benefit from the exploitation of results.
Apply more stringent 'protectionist' rules across the board.	Having a more stringent general rule was considered not justified as there may be valid reasons why exploitation occurs elsewhere (in which cases the EU often still benefits from such exploitation). Moreover, depending on the type of project the expected results are often not directly exploitable and would require systematically assessing all projects for long after the end of the project and not only those close to market. Finally, such a generalised approach would deter in particular industrial and international participation leading to a loss of excellence and a lower quality of results.

9 Dissemination and exploitation of results

9.1 What is the current situation under Horizon 2020?

FACTS

Under Horizon 2020, **a strategy for the dissemination and exploitation of R&I results** was launched in 2015 at Framework Programme level, with dedicated dissemination and exploitation activities. The strategy was reviewed in 2017 and streamlined for the remaining years of Horizon 2020. At the same time, dissemination and exploitation activities were introduced from the various parts of the programme (i.e. the ERC Proof of Concept, the FET Launchpad, the SME Instrument) that support the uptake of results and innovations in the Union.

To assist project consortia in their dissemination and exploitation activities, the Commission provides tailor-made support services in the form of the Common Exploitation Booster (**236** projects supported in 2017) and Common Dissemination Booster (**260** projects supported in 2017) and the wide use of the Innovation Radar as a methodology to identify the innovations and innovators in R&I projects.

A new methodology tracking of research results obtained through the programme is under development. A new **Horizon 2020 Dashboard** making available all project related data and outputs was also set up.

Throughout Horizon 2020, specific calls for proposals, coordination and support actions and public procurements provide targeted assistance to projects in order to increase their dissemination and exploitation capacity and activities.

The uptake of R&I results for policy making, as well as measuring the impacts of the Framework Programme's investment, is improving under Horizon 2020. The Commission is piloting additional methodologies for tracking the research results (outputs, outcomes and impacts) after the completion of the projects. The aim of this is to acquire a more comprehensive view of what the research funded under the Framework Programmes has achieved.

For external stakeholders, CORDIS is the primary public repository and portal to disseminate information on all EU-funded R&I projects and their results; providing user-friendly access to project data and results through faster and broader visibility of projects' outputs and improved search functions. Specifically, project deliverables and project beneficiary information were disseminated for the first time in the history of Framework Programmes. 'Results Packs', a new dissemination function presenting thematic collections of exploitable research results, was developed along with 'Enhanced Results in Brief', a new function that provides additional support in dissemination of research results.

In 2017, the Commission has launched a new platform for advanced visualisation of data on the Framework Programme, the Horizon 2020 Dashboard, that provides a wide range of visualisation options for Horizon 2020 projects and proposals. It allows the users to visualise the performance and evolution of the data on the Framework Programmes in terms of impact, participation, investments, international cooperation, results, etc. The 'Projects for Policy (P4P)' initiative launched in 2017 clusters and uses R&I results for evidence-based policy recommendations. In addition, the Innovation Radar was introduced as a Horizon 2020-wide methodology to identify innovations and innovators within R&I projects.

Lessons learnt from Horizon 2020

Dissemination and exploitation activities are key to demonstrate the success and the impact of the Framework Programme. The dedicated activities to beneficiaries to better disseminate and exploit their results and increase their market and technology readiness were very successful and popular. Through the optimal use of IT infrastructure and the advanced visualisation of the available data on the Framework Programme (Horizon 2020 Dashboard), the Commission demonstrated the added value of the Programme.

Although a robust framework has already put in place to help dissemination and exploitation of R&I results from Framework Programme's projects, they are still not fully accessible to all relevant stakeholders and this represents a barrier to knowledge circulation and to innovation uptake. Additional efforts required to access and make available knowledge and results from projects supported under the Programme.

Current information collection does not systematically cover research results, innovations and market uptake, and therefore does not always allow for the assessment of projects' medium- and long-term impacts. New policy challenges should be better matching by the appropriate mechanisms to collect the necessary data.

The results of most Horizon 2020 R&I projects mainly improve scientific knowledge and advance science in the field(s) in question. Some will have market or technological potential. The uneven exploitation capacity among beneficiaries hinders the market uptake of key exploitable results and incentives for market exploitation are limited once funding has stopped.

Many R&I projects produce recommendations for policy-makers in various fields. As policy recommendations are less market- and technologically ready than other key exploitable results, projects do not tend to emphasise this kind of output. This hinders the full potential for exploitation of results from the Framework Programme for policy-making at EU and national levels.
(Sources: Horizon 2020 Interim Evaluation, Review of the Strategy for an Effective Dissemination and Exploitation of Research Results in Horizon 2020, studies)

9.2 What are the changes?

Within Horizon 2020, reporting has focused mainly on input information in relation to projects launched and funding granted. However, to address the significant need to report on the impact of research and innovation investments, equal attention will be given to information on results to develop a clear picture of the number of completed projects, the fields to which these relate, what they delivered and what steps have been taken regarding exploitation of research results.

The following changes are envisaged for the future Programme:

Short term:

- Support R&I stakeholders in fully endorsing the principle of the open access and work with them to make the European Open Science Cloud a reality;
- Put in place a comprehensive go-to-market package to incentivise the exploitation of Framework Programme's results by helping beneficiaries to find the most appropriate instruments and channels for the market uptake of their innovations;
- Pilot the role of Horizon 2020 as a pan-European policy influencer through Projects for Policy initiatives, with the aim of using scientific knowledge and results created by R&I projects;
- Design a methodology for monitoring the Framework Programme's results and foster business intelligence that could build on artificial intelligence, advanced data visualisation and data mining tools to demonstrate impact.

Long term:

- Based on the positive experience of the previous dissemination and exploitation strategy, put in place a more ambitious and comprehensive strategy for increasing the availability of R&I results and accelerating their uptake to boost the overall impact of the Framework Programme and thereby strengthen European innovation.
- Strengthen innovation-friendly framework conditions that allow for unrestricted and constant knowledge circulation and create the necessary incentives for beneficiaries and innovators to share their results for reuse.
- Disseminate clusters of mature research results to EU regions for potential uptake based on their specific needs. This would maximise the benefits coming from synergies with EU initiatives, for increasing regional competitiveness and innovation.
- Provide holistic support throughout the dissemination and exploitation lifecycle to ensure a constant stream of innovations stemming from the Framework Programme.

9.3 What are the expected implications of the changes?

- No major changes envisaged for Horizon Europe's rules for participation. The obligation of beneficiaries towards dissemination, exploitation and impact demonstration shall be reinforced.

- The possibility of additional reporting specifically on dissemination and exploitation or impact demonstration might be considered within the framework of simplification. This reporting should continue beyond the lifetime of the projects.

9.4 What alternatives have been considered?

- **Additional incentives**: beneficiaries could be given additional financial or other incentives to enhance their dissemination and exploitation capacity, focus on key exploitable results and their uptake, and/or enhance the impact of their research in real-world settings.
- **More funding for 'research on research'** would allow researchers to take the time to assess the quality and consistency of scientific results, gather research on a particular topic, identify common themes and develop common responses.
- **Changes in the evaluation phase**: a different consideration of exploitation at evaluation phase, with an evaluation panel featuring clear business experience alongside academic and scientific background would help select proposals better placed for ensuring uptake of research results. For recurring participants in the Framework Programmes (i.e. having participated in previous programmes), consider introducing the requirement to submit, as part of their proposal, an *ex-post Impact or Outcome Statement* of their research conducted under previous Framework Programmes.

Annex 10: Implementation of the Strategy for international cooperation in R&I

The strategy for EU international cooperation in research and innovation (R&I) published in 2012[213] supports the objectives of strengthening the EU's R&I excellence, attractiveness and economic and industrial competitiveness, tackling global societal challenges, and supporting the EU's external policies, including enlargement, neighbourhood, trade and development policies.

It makes a significant contribution to the implementation of the Commission priority on 'Europe as a stronger Global Actor' and is crucial for delivering on the 'Open to the World' priority of the EU's R&I policy.

These were as follows: 1) There is significant room for improvement of the international dimension of Horizon 2020, in particular through work programme (WP) topics of sufficient scale and scope that are specifically devoted to international cooperation; 2) The Commission shall remain proactive in ensuring good framework conditions for international cooperation, notably including extended co-funding mechanisms; 3) Further action shall be taken to widen participation and strengthen the EU's role in global multilateral fora; 4) Stronger synergies with the actions of Member States shall be sought including by means of structured policy coordination and opening of joint programmes to international participation; 5) Science diplomacy shall be used more extensively as an influential instrument of the EU's external policies; and 6) The communication strategy shall be refined to ensure global awareness of EU science and technology (S&T) strengths and its role in international R&I cooperation.

1 Reinforcing the international dimension of the EU R&I Framework Programme

The international dimension of Horizon 2020 has been reinforced as part of priorities set for the last part of the programme covering commitments in 2018 to 2020.

Since the last progress report, Joint S&T Cooperation Committee meetings have been successfully organised with a range of countries[214]. In addition, Regional policy dialogues have notably included a Ministerial meeting with the Western Balkans, a Ministerial conference on strengthening Euro-Mediterranean cooperation in R&I, an Eastern Partnership summit, an EU-African Union high-level policy dialogue, and two EU-CELAC senior officials meetings. Multilateral work was also undertaken to ensure the coordination of the G7 Science Ministerial and Carnegie meetings.

Agreements at the S&T cooperation dialogues and high level policy dialogues have continued to serve as a basis for priority-setting in Horizon 2020 programming, continuous efforts have been undertaken to ensure that activities agreed effectively materialise, and multi-annual roadmaps for targeted international cooperation with twelve countries and six regions have been updated on a regular basis to reflect the latest status[215].

[213] COM(2012)497

[214] USA, China, India, Japan, South Korea, Brazil, Argentina, Chile, Russia, Australia, Algeria, Tunisia, Egypt, Jordan, Ukraine and South Africa.

[215] See http://ec.europa.eu/research/iscp/index.cfm?pg=countries and http://ec.europa.eu/research/iscp/index.cfm?pg=regions

Increased attention to and support of international participation in Horizon 2020 projects have been provided with the launch in October 2017 of the 2018-20 WP with more than 30 flagship initiatives of large scale and scope on topics dedicated to international cooperation in areas of mutual benefit, comprising a total budget of over 1€ billion.

Examples of large Flagship initiatives include the EU-Africa Partnership on Food & Nutrition Security & Sustainable Agriculture, the EU-China Food, Agriculture and Biotechnology flagship initiative, acceleration of energy innovation through the Mission Innovation initiative, large call on human data storage with Canada, multilateral cooperation on greener and safer aviation and road transport automation, climate action in support of the Paris Agreement, multilateral cooperation on 5G and on nanosafety, and international cooperation on migration challenges.

The latest statistics on participation of entities from non-associated international partner countries in Horizon 2020 grant agreements for collaborative actions[216] show only a slight improvement as a result of actions in the 2016-17 WP: 24 % of WP topics are flagged for international cooperation, 2.5 % of all participations are from third countries, 0.9 % of EU contribution go to third-country participants, 12.0 % of all grant agreements include one or more partners from third countries, and €44 million per year is invested by third-country participants in Horizon 2020 projects. 2.3 % of all European Research Council (ERC) Principal Investigators have come to EU MS/AC from non-associated international partner countries; 17.3 % of all grantees of Marie Skłodowska-Curie Actions (MSCA) Individual Fellowships and almost 30 % of participations in MSCA Research and Innovation Staff Exchange come from third countries making it the most international scheme in Horizon 2020[217].

For some types of action, partners from third countries are not part of the Horizon 2020 grant agreement, but sign separate (coordination) agreements. Notably, until end-2017, Horizon 2020 has launched 21 joint, coordinated and twinning calls with third countries that have led to projects with 220 European participations and a similar number of participations from non-associated third countries. Furthermore, participation of third country research programme funders in ERA-NET Cofund actions is at 5%, reflecting a similar share in the projects funded by these actions.

The Commission's Joint Research Centre (JRC) has strengthened its collaboration with international partners. Close links with partners in Horizon 2020 Associated Countries have been consolidated, e.g. via technology-transfer support to the Western Balkan countries and new arrangements with the Research Council of Norway. The JRC has concluded new arrangements such as with the USA Department of Energy, the Chinese Academy of Sciences, and the Japanese Institute for Advanced Industrial Science and Technology, and extended partnerships such as with the USA National Oceanographic and Atmospheric Administration, the South African Space Agency, and the Brazilian Ministry of Science, Technology, Innovation and Communications. The JRC has also pursed its cooperation with multilateral organisations such as United Nations Organisation, World Bank and the Organisation for Economic Co-operation and Development (OECD).Engaging internationally has positive effects. Horizon 2020 data shows that the success rate of proposals increases when the consortium takes on board international partners and international co-publications are on average more often cited than other publications.

[216] Source: CORDA, May 2018. Includes all Horizon 2020 actions, except those under ERC, MSCA, Access to risk finance, EIT, JRC, and topics using the SME Instrument .

[217] MSCA account for more than half of all third country participations in Horizon 2020 and around 80% of all US participations. Since 2014, almost 140 nationalities have received MSCA funding and around one in four MSCA fellows are researchers attracted to Europe from countries outside the EU Member States or the Horizon 2020 Associated Countries.

The significant number and size of international cooperation flagship initiatives launched for the last part of Horizon 2020 are expected to result in a step-change improvement in international involvement, be it through participation in Horizon 2020 projects, through coordinated calls, or through contributions to global multilateral initiatives.

The Commission has also continued to monitor and assess the implementation of Horizon 2020 Association Agreements and to examine measures to improve and develop cooperation. This has been done through Joint Committee meetings as well as through policy support to assist with reform agendas.

Assessments have been carried out for the Associated Countries for which the review clause was applicable. These assessments looked at Horizon 2020 budget absorbed versus contributions made to the EU budget, as well as progress towards the ERA priorities, number of researchers in the country, participation in Horizon 2020 proposals and projects, and success rate of these proposals. In case of a large degree of underperformance, the assessments also analysed the root causes of this and suggested remedies.

For the next Framework Programme, the Commission proposes to extend openness for association, beyond EU enlargement, EEA countries and ENP countries, to include all countries with proven science, technology and innovation capacities to make cooperation and funding of joint projects as smooth as possible. It is also proposed to intensify support to international large-scale flagship initiatives, partnerships, bilateral and multilateral initiatives and joint programmes and calls, so as to increase access to researchers, knowledge and resources worldwide and optimise benefits from cooperation. The programme should continue to fund entities from low-mid income countries, and to fund entities from industrialised and emerging economies only if they possess essential competences or facilities.

2 Improving the framework conditions for engaging in international cooperation

The Commission has remained proactive in creating a level playing field for researchers from across the world to cooperate smoothly with each other.

Notably, the Commission has continued to encourage and assist industrialised and emerging economies in increasing the scope and improving the functioning of mechanisms for funding the participation of their researchers in Horizon 2020.

For instance, at the 3rd EU-China Innovation Cooperation Dialogue in June 2017 agreement was reached to renew and extend the co-funding mechanism for the Chinese government to support entities from China in Horizon 2020 projects for the period 2018-20. In India, the Ministry of Earth Science has set up its own co-funding mechanism, following the path of the Ministry of Science and Technology.

Many S&T Cooperation dialogues have also discussed reciprocal access to science, technology and innovation (STI) resources, supported by monitoring, data collection and analysis. Concrete outcomes include, for example, a new Guide for EU stakeholders on Chinese national STI funding programmes that was published in January 2018.

Other bilateral and regional S&T cooperation dialogues have also tackled priorities for improvements in framework conditions. For example, in September 2017 a ministerial meeting of the Western Balkans Platform on R&I discussed how to increase national R&I capacities and progress towards integration into the European Research Area; and the two EU-CELAC senior

officials meetings in 2017 resulted in a policy advice initiative for CELAC countries, a bi-regional initiative to strengthen the management of and access to research infrastructures, a bi-regional call on cancer research, and an extension of the EURAXESS initiative to all CELAC countries.

New structures supporting European research, innovation and business organisations to establish connections and a foothold in third country markets have been established. Early 2017 grants were awarded to launch the first nodes of a Network of European R&I Centres and Hubs in the USA, China and Brazil.

Smooth mobility of researchers is another important framework condition. In addition to activities under MSCA, the Commission has supported ERC Implementing Arrangements that have now been signed with funding bodies in ten countries around the world: USA, South Korea, Argentina, Japan, China, South Africa, Mexico, Brazil, Canada, and India.

The multi-annual roadmaps for targeted international cooperation contain more detailed information on framework conditions in place for each country/region and the priorities for future improvements.

3 Leading multilateral initiatives - working with international organisations on global challenges

Action has been taken to strengthen the EU's role in global multilateral initiatives and to leverage investments in solutions to global challenges of high priority for the EU.

In February 2017, the Commission took over the chairmanship of the Steering Committee of the Mission Innovation initiative on clean energy research. It is leading two Innovation Challenges and is actively engaged in the five remaining ones. The initiative is also growing in terms of its membership, in particular from the EU Member States. Calls for proposals designed for Mission Innovation-related activities have been introduced in the 2018-2020 WP of Horizon 2020 for a total amount of nearly €150 million.

In addition, as part of the efforts towards structuring marine research cooperation, a new South Atlantic R&I Flagship Initiative was signed in July 2017 to improve the scientific knowledge of marine ecosystems and the links between oceans and climate change, food and energy systems, as well as the dynamics of the Atlantic Ocean and its interconnected circulation systems from Antarctica to the Arctic. The All Atlantic Ocean Research Alliance Flagship and the Future of Seas and Oceans Flagship have been allocated more than €80 million in the 2018-2020 WP of Horizon 2020.

Global health issues have remained top of the agenda. Multi-lateral initiatives such as the International Rare Diseases Research Consortium, the International Human Epigenome Consortium and the Global Alliance for Chronic Diseases, have continued their active role with calls published under SC1. The Coalition of Epidemic Preparedness Innovation, CEPI, was launched in January 2017. At the end of 2016, through the Global Research Collaboration for Infectious Diseases Preparedness, the EU mobilised substantial political, financial and scientific resources to help the people affected by the Zika virus and to contain, control, treat and ultimately defeat it. The 2018-2020 WP of Horizon 2020 contains topics with a combined budget of more than €250 million that will go to projects contributing to global health multilateral initiatives. The EC has continued with the contribution to the Human Frontier Science Programme, an international funding organisation for multi-disciplinary life science frontier research of 15 countries over four continents.

As climate change and the environment are global issues, EU action has continued to be coordinated with international and multilateral processes such as the Group on Earth Observation (GEO) and the Belmont Forum. Active EU involvement in these platforms has contributed to setting global agendas to implement jointly, and their feedback has been used to inform strategic programming at EU level. For example, the 2016-17 WP of Horizon 2020 included three Belmont Forum topics: sustainable urbanisation, transformations to sustainability, and biodiversity scenarios.

Moreover, the Commission has continued to play an important role in intergovernmental bodies such as the International Panel on Climate Change (IPCC) and the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES). EU projects have contributed substantially to stocktaking and knowledge generation: for example, EU action plays a key role in the development and aggregation of climate change models in coordination with the IPCC.

The Commission also continued its active role in international bodies such as the OECD and the G7/G20. For example, the joint Commission-OECD survey on STI policies, the Commission participation in a range of thematic working parties of the OECD, and the contribution of several Commissioners in the G7 Innovation Week in Italy in September 2017.

4 Reinforcing the partnership with Member States

Synergies with Member States' actions have been strengthened notably by involving third countries in joint programmes.

In particular, the Partnership for Research and Innovation in the Mediterranean Area, PRIMA, was launched in early 2018, following adoption of the PRIMA Basic Act by the co-legislators and putting in place international agreements regulating the participation of third countries that are not associated to Horizon 2020. Work is now underway to devise new R&I approaches to improve water availability and sustainable agriculture production in a region heavily distressed by climate change, urbanisation and population growth. The partnership will be financed through a combination of funding from participating countries (currently €274 million), and a €220 million contribution from the EU through Horizon 2020.

The second European and Developing Countries Clinical Trials Partnership Programme, EDCTP2, supported by nearly €700 million in EU funds, has so far launched 31 calls for proposals resulting in 125 grants worth € 264 million to accelerate the clinical development of medical interventions for poverty-related diseases in Sub-Saharan countries. In addition, projects granted € 157 million from calls in 2017 are about to start.

The EC supported Member States led initiative International Consortium for Personalised Medicine, ICPerMed, set up in 2016, which includes several non-EU partners among the current 40 members. Canada is already on board and discussions are ongoing to include institutions from Brazil, South Africa and other countries. In an effort to join forces on the fight to anti-microbial resistance, the Joint Programming Initiative on Anti-Microbial Resistance has opened up to Third countries: Argentina, Canada, Egypt, India, Japan, South Africa and South Korea have recently joined it.

The international dimension of ERA-NET Cofund actions, supporting public-public partnerships in their implementation of joint activities and topping-up of a trans-national call for proposals, has also increased. Nearly half involve third countries as full partners, and more than two-thirds include activities dedicated to establishing partnerships with third countries, e.g. through additional joint calls or through global multilateral initiatives.

The Strategic Forum for International Scientific and Technological Cooperation, SFIC, has continued its work to further develop, implement and monitor the international dimension of the ERA. In particular, in 2017, the Forum issued opinions on international cooperation in the context of the mid-term review of Horizon 2020 and the preparation of the 9th EU Framework Programme for R&I, as well as on gender aspects in international R&I cooperation.

Part of the strategic advice from SFIC also includes reports on instruments for the implementation of international S&T cooperation agreements and other international S&T cooperation activities at EU and national level. Furthermore, the Forum has continued contributing to the implementation of the ERA Roadmap, fostered peer-learning activities, and carried on work on geographic initiatives such as for China and for Brazil.

5 Intensifying the synergies with the EU's external policies

The Joint S&T Cooperation Committee meetings and Regional Policy Dialogues have been instrumental for R&I to feature prominently in several Summit discussions and conclusions, including, inter alia, those with the Eastern Partnership countries, with India and with the African Union. This is also a result of continuously close interactions between the Commission and the European External Action Service.

Further integration of the Western Balkans into existing EU knowledge networks and support for R&I capacity building for an effective participation in the EU's Framework Programmes are part of the Action Plan in support of the transformation of the Western Balkans issued in February 2018. Centres of Excellences set up with Horizon 2020 support are attracting researchers, contributing to combating brain drain in the region, and they have a direct economic impact, triggering growth through innovation, enabling joint R&I activities across borders and contributing to building trust, reconciliation and stability in the region.

The strategy has also stayed closely coordinated with EU neighbourhood policies. For instance, the EU4Innovation initiative was presented as a key deliverable of the 5th EaP Summit in November 2017. The initiative combines all EU activities that support the development of Eastern Partnership countries' innovation capacities, notably those funded under Horizon 2020 and the European Neighbourhood Instrument, bringing new mobility opportunities and fostering research-industry partnerships amongst others.

Science diplomacy action has continued as an important part of the strategy. For example, in May 2017 the SESAME synchrotron, the first major international research infrastructure in the Middle East, started operating in Jordan. With financial support to its construction, the EU has been a major contributor to SESAME, which also contributes to foster a culture of peace and cooperation through science in the region. Other examples include R&I activities with Iran in the context of the EU-Iran Renewed Partnership. Horizon 2020 has extended its support to projects analysing cases and instruments of science diplomacy and devising tools and processes for science diplomacy as part of EU external action.

Cooperation with development policies has continued. For instance, in October 2017 the 4th EU-African Union High level Policy Dialogue on Science, Technology and Innovation took stock of results of the partnership on Food, Nutrition Security and Sustainable Agriculture integrating capacity building and innovation processes and adopted the roadmap towards a new partnership focused on climate services, renewable energy and energy efficiency.

Finally, EU international S&T cooperation has been used to enhance the EU's influence on common positions within international fora that are defining global targets and regulations in various thematic fields. For example, EU-supported research has often provided the foundation for international maritime safety rules for global shipping which are applied via the International Maritime Organisation.

6 Refining the communication strategy

The Commission has continued to refine its communication strategy and strengthen its monitoring of the strategy.

In particular, the Service Facility in support of international R&I cooperation policy development, priority-setting and implementation started operating early 2017 and is now providing services for awareness raising and training, support to National Contact Points, organisation of R&I events, set-up of R&I, business and policy partnering platforms, and thematic and geographical analysis and monitoring activities.

In addition, the Commission, in close cooperation with the EU Delegations, have continued promoting Horizon 2020, raising the profile of the EU as an excellent destination for R&I and promoting the 'Open to the World' policy priority. Special emphasis has been put on the use of multipliers and on taking advantage of existing events.

Monitoring of the implementation of the strategy in Horizon 2020 has been upgraded through the 'International Cooperation' dedicated view of the Horizon 2020 Dashboard, providing real-time values of the international cooperation indicators and more.

7 Conclusions

The dominance of international collaborative research in knowledge production and the emergence of new countries as major R&I players are accelerating. This calls for further strengthening of action to ensure that the EU has access to, and benefits from, the world’s best talents, expertise and resources.

Moreover, EU international cooperation in R&I policy should contribute to the EU's economic policy objectives, enhancing EU's external competitiveness, creating a level playing field and opening up new markets for European companies via innovative solutions, making use of economic diplomacy tools where appropriate. Synergies with EU external policies should also contribute to the EU's development policy objectives, help build R&I capacity, and support diffusion and uptake of innovation.

The increasing scope and interconnectivity of global societal challenges require more international joint action and coordination of agendas. Instruments for EU support to global multilateral initiatives should be improved, and partners from the rest of the world should increasingly be invited to join EU efforts as an integral part of initiatives in support of EU action for sustainable development.

In the further implementation of the strategy, priority should be given to activities that facilitate the collaboration of European researchers with their counterparts worldwide, enable international mobility of researchers and ensure access to research infrastructures globally, so as to ensure reinforced EU R&I excellence and the creation and diffusion of high-quality knowledge in the EU.

International openness of the innovation eco-systems promotes a level playing field, opens markets for European companies and enhances supply and demand of innovative solutions. Further activities under the strategy should extend support to joint and coordinated funding of global industrial research and innovation cooperation, so as to strengthen EU economic and industrial competitiveness.

Using the EU R&I Framework Programme as a key vehicle for cooperation, activities under the strategy should continue to promote and integrate cooperation with international partner countries based on mutual benefit. Priorities should be identified based on thematic and geographical strategic intelligence and foresight of S&T capabilities, market opportunities and impact on EU competitiveness, contribution to international commitments, and framework conditions for cooperation.

In short, openness to the world remains a strategic priority for EU R&I policy as it reinforces R&I excellence, strengthens competitiveness, and helps solve global societal challenges in support of EU external action. Hence, the objectives of the strategy stay pertinent and further activities are needed to ensure that the EU benefits from latest developments.

Annex 11: Simplification checklist

This checklist is added to this impact assessment to highlight the Commission efforts in simplifying rules and procedures, based on lessons learnt under the current financial framework. It will contribute to the Simplification Scoreboard, to be added to the new MFF package.

Item	Checks
1. Scope for using Simplified Cost Options, payments based on output / against conditions	□ Can the use of these options be extended to new areas? Yes; Horizon Europe will offer the complete set of forms of grants set out in the Financial Regulation to beneficiaries and indicate the choice of the most appropriate ones in the Work Programme. Although, actual incurred costs will remain the main form of costs under the Framework Programme, the use of simplified forms of costs could be extended to other areas than currently under Horizon 2020. □ Which ones? In order to lower administrative burden, increased use will be made of lump-sum project funding against fulfilment of activities - building on the experience from the lump-sum pilot in Horizon 2020 - and other simplified forms of funding provided by the new Financial Regulation. □ Which simplified option is the most appropriate? Simplified form of costs will be used in a flexible manner across the next Framework Programme depending on the needs and specificities of the policy objectives: – indirect costs will be reimbursed via a flat-rate calculated on the direct eligible costs; – unit costs calculated in accordance with the beneficiary usual cost accounting practices will be kept (i.e. average personnel costs and costs of internally invoiced goods and services); MSCA will continue to be entirely financed by unit cost; – Lump sum will continue to be used for small-scale actions. Building on the Lump Sum pilot carried out for collaborative project under Horizon 2020, increased use will be made of lump-sum project funding against fulfilment of activities in the next Framework Programme. – Financing not linked to costs (set out under Article 125.1 (a) of the Financial Regulation) could be envisaged in order to give financial incentives to grant beneficiaries to implement specific objectives (e.g. to implement gender equality plans). □ Why? Experience has shown that simplified forms of costs have proven to be viable an appropriate for the R&I programme, in particular lump sum.
2. Budget Focussed On Results	□ Is there a mechanism to ensure delivery of results? □ Are indicators defined? □ Are they quantitatively and qualitatively appropriate? There are several mechanisms to ensure delivery of results, from strategic planning to support for dissemination and exploitation; moreover, the programme's performance towards its general objectives will be closely monitored along key impact pathways. Appropriate baselines and targets for the pathway indicators will be set; implementation data will be publicly available in close to real-time.
3. Additional externalisation to executive	□ Is room for externalisation fully exploited? Yes. Following the positive results of the last 3 years evaluations of R&I executive agencies, the

agencies, JU, PPP, decentralised agencies	intention is to further delegate to executive agencies, provided that the results of the mandatory cost-benefit analysis are positive. Partnerships will be an important part of the next R&I Framework Programme. Mandatory impact assessments will be required for partnerships established under Art. 185 and 187. □ Is the financing of the agency(-ies) foreseen? Yes, the financing of Executive Agencies is foreseen.
4. Synergies	□ How are synergies between various tools, instruments, programmes ensured? The Commission will now capitalise on the experience gained in jointly implementing the current generation of funding programmes and will focus on enhancing synergies with other EU Programmes from the programme design stage to ensure that the range of EU instruments and programmes covers the whole innovation cycle, in particular, by: - Bringing priorities more in line with each other; - Making co-funding schemes more flexible in order to pool resources at EU level; and - Improving compatibility of rules, for example, making it possible to apply the Seal of Excellence.
5. Flexibility: in programming, between management modes	□ Are all the possible flexibility margins and tools exploited in designing the programme? Horizon Europe is designed to allow the maximum of flexibility, while ensuring coherence across the board. It is intended to externalise all implementation to executive agencies. Recourse to joint undertakings and other structures to implement partnerships will be the subject of a strategic planning process, and will not form part of the legislation.
6. Non-allocated envelopes	□ Is a non-allocated envelope appropriate/foreseen? No. Considering the high oversubscription and that any urgent research needs should be covered by the next R&I Framework Programme, a non-allocated envelope is not appropriate.
7. Budget-support, SRSS	□ Is recourse to budget support/structural reform support justified/appropriate? Not applicable to Horizon Europe.
8. Fraud proof	□ Are proper mechanisms set to ensure fraud prevention? □ Are audit/anti-fraud provision clear? The R&I family has a common anti-fraud strategy for grants. This will be updated after the adoption of the new Commission Anti-Fraud Strategy in 2018. DG RTD is also developing its own anti-fraud strategy for non-grant expenditure, especially Financial Instruments, and is working with OLAF on this question. The anti-fraud strategy has been audited by the Internal Audit Service and appropriate action plans put in place to address any recommendations. Audit and anti-fraud provisions are (or will be) included as necessary in the base legislation, the Rules for Participation and the Model Grant Agreement, all based as far as possible on the standard rules of the Financial Regulation.
9. Single rule book	□ Is there any strong reason to deviate from the Financial Regulation/basic act template? The new Financial Regulation is used as a common reference for the Horizon Europe rules for participations. Compared to Horizon 2020, the rules are further aligned to the Financial Regulation and the derogations kept to a necessary minimum, justified by the specificities of the R&I ecosystem and built on the experience from past framework programmes. The main derogations concern: time to grant, treatment of in-kind contributions, financial capacity check, appointment of external experts. As an example, the system of in-kind contributions provided by third parties to the beneficiaries is further aligned to the Financial Regulation (i.e. for in-kind contributions against payment), while the specificities of the research are preserved (i.e. for in-kind contributions free-of-charge). □ Can the need be addressed by any other means than derogation? For each limited derogation, several alternatives have been considered including alignment to the Financial Regulation. However, this alignment would imply significant changes for beneficiaries, which will neither reduce the administrative burden nor enhance the

	simplification of the rules. In addition, it may reduce the attractiveness of the programme and therefore negatively affect its results.
10. Single portal	Has a single portal (e-access) for beneficiaries of the policy area been foreseen, independently from the delivery tool (Financial Instruments, grants, etc.)? Yes. As is already the case for Horizon 2020, the Horizon Europe will be managed fully electronically by a single portal. The portal will cover all actions implemented by grants, prizes and procurement, and will provide links to the instances for managing Financial Instruments.
11. Multi-annual programme	□ Is the work programme multiannual? □ If not, what is the advantage of annual programming? □ Does the advantage of annual programming outweigh multi-annual programming? The work programmes under Horizon Europe are expected to follow the pattern of Horizon 2020, spanning a period of at least two years, with the possibility to be updated within this period in case of unforeseen needs or other special circumstances. In the specific case of the European Research Council, the work programme will be adopted on an annual basis, as the Scientific Council, which is responsible for the preparation of the work programme, needs to deliberate in the light of the experience of the previous calls.
12. Error rate/high control costs	□ Have high error rate/high control controls from the previous programme been addressed under this programme? □ How? □ Is that adequate? First audit results for Horizon 2020 suggest that the error rates will be lower than those from FP7: • FP7 - 5% on a representative basis and 3% residual error rate • Horizon 2020 – 3% on a representative basis and 2.5% on a residual basis, but if all things remain equal the residual error rate will fall over time. Further simplification of rules in Horizon Europe, and especially a wider use of Simplified Cost Options, will allow for a further fall in the error rate. However, in a system based on the reimbursement of eligible costs, it is uncertain whether the error rates can be brought below 2%. One way to sharply reduce the error rate would be the wider use of lump sum funding, which is already used in Horizon 2020 for the SME programme stage 1 programme. The legislation allows for this. The work programme 2018 includes pilots of lump sum funding in some cooperation grants. In the next Framework Programme, an increased use will be made of lump-sum project funding against fulfilment of activities – building on the experience from the lump-sum pilot in Horizon 2020 The emphasis foreseen in Horizon Europe on cross reliance on audits & assessments between EU programmes (e.g. with ERDF and CF) is expected to reduce the audit burden on beneficiaries, thus the cost of control for the Commission.
13. Re-conduction of previous basic act	□ Is it necessary to propose an entirely new basic act, or could it be sufficient to propose an amendment of an existing act? A new basic act is required because of the scope of changes between Horizon 2020 and Horizon Europe for simplification and rationalisation. Moreover, the legal texts of the Framework Programme and of the Rules for Participation (currently separate) will be merged into a single text.