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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

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Table of contents

EXECUTIVE SUMMARY 3
1 INTRODUCTION: POLITICAL AND LEGAL CONTEXT 7
1.1 Scope 7
1.1.1 Political context 8
1.1.2 Legal context 9
1.2 Lessons learnt from previous programmes 9
2 CHALLENGES AND OBJECTIVES 12
2.1 Key features of Horizon 2020 and expected impacts of its continuation 12
2.2 Main R&I challenges and problems to be addressed 14
2.3 Objectives of the future Programme 16
3 PROGRAMME STRUCTURE AND PRIORITIES 17
3.1 Scope and structure of the new Framework Programme 17
3.2 Improvements and their expected implications 24
3.2.1 The European Innovation Council (EIC) 25
3.2.2 Research and Innovation Missions 30
3.2.3 International cooperation 33
3.2.4 Open Science policy 36
3.2.5 European Partnerships 38
3.3 Overall impact on the new Framework Programme 40
3.4 Critical mass 44
4 DELIVERY FOR IMPACT 45
4.1 The strategic planning process 50
4.2 The single set of rules 51
4.3 The funding model 52
4.4 Forms of funding, including simplified cost options 53
4.5 Grants, financial instruments and blended finance 54
4.6 Proposal evaluation and selection 55
4.7 Ex-ante and ex-post audits 57
4.8 Policy and rules regarding Dissemination and Exploitation 58
4.9 Delegation to Executive Agencies 59
4.10 Overall impact on the objectives of the MFF 60
5 HOW WILL PERFORMANCE BE MONITORED AND EVALUATED? 65

Glossary

Term or acronym	Meaning or definition
COSME	EU programme for the Competitiveness of Enterprises and Small and Medium-sized Enterprises
EIC	European Innovation Council
EIT	European Institute for Innovation and Technology
ERAC	European Research Area and Innovation Committee
ERC	European Research Council
ERCEA	European Research Council Executive Agency
ERDF	European Regional Development Fund
EU	European Union
FET	Future and Emerging Technologies
FP7	Seventh Framework Programme for Research and Technological Development
GDP	Gross Domestic Product
JRC	Joint Research Centre
KICs	Knowledge and Innovation Communities
MFF	Multiannual Financial Framework
MSCA	Marie Skłodowska-Curie Actions
R&I	Research and Innovation
REA	Research Executive Agency
SMEs	Small and Medium Enterprises
TFEU	Treaty on the Functioning of the European Union

EXECUTIVE SUMMARY

This impact assessment accompanies the Commission proposal for Horizon Europe, the 2021-2027 Framework Programme for EU Research and Innovation, which will succeed the current Programme, Horizon 2020 (active between 2014-2020), and the proposal for the 2021-2025 Research and Training Programme of the European Atomic Energy Community (Euratom Programme).

Research and innovation help Europe deliver on citizens' priorities, as embodied in the Sustainable Development Goals and in the Paris Agreement on fighting climate change, to bring about sustainable growth and high-quality jobs, and to solve present and unforeseen global challenges. However, Europe overall currently underinvests in research and innovation compared to its main trading partners, and so risks being irreversibly outpaced.

EU-level investment, through successive Framework Programmes, has supported the provision of public goods with a high European added value. This added value comes from the Programmes' focus on excellence through EU-wide competition and cooperation. Framework Programmes support training and mobility for scientists, create transnational, cross-sectoral and multidisciplinary collaborations, leverage additional public and private investment, build the scientific evidence necessary for EU policies, and have structuring effects on national research and innovation systems. The significant and long-lasting impact of the Framework Programmes, in particular the current Programme, is acknowledged by the EU institutions, Member States and stakeholders alike.

Horizon Europe is built on the evidence and lessons learnt from the Horizon 2020 interim evaluation, and the recommendations of the independent High-Level Group on maximising the impact of EU research and innovation. The new Programme will be an evolution, not a revolution, focusing on a few design improvements to further increase openness and impact.

Horizon Europe's general objectives stem from the Treaty on the Functioning of the European Union. These will be: to strengthen the scientific and technological bases of the Union and foster its competitiveness, including for its industry; to deliver on the EU's strategic policy priorities and contribute to tackling global challenges, including the Sustainable Development Goals. To address particular research and innovation challenges faced by the EU, Horizon Europe also has specific objectives. All objectives apply across the Programme, and all individual Programme parts will contribute to their achievement.

The evolution from Horizon 2020 is reflected in the revamped structure. The three-pillar structure will be continued, but redesigned for more coherence, both between and within pillars, in support of the Programme objectives.

Pillar 1 - Open Science will continue to focus on excellent science and high-quality knowledge to strengthen EU's science base through the European Research Council, Marie-Skłodowska Curie Actions and Research Infrastructures. As a "bottom-up", investigator-driven pillar, it will continue to give the scientific community a strong role.

Pillar 2 - Global Challenges and Industrial Competitiveness will better address EU policy priorities and support industrial competitiveness by integrating the Horizon 2020 *Societal Challenges* and *Leadership in Enabling Industrial Technologies* into five clusters (i.e. Health; Resilience and Security; Digital and Industry; Climate, Energy and Mobility; and Food and natural resources). The clusters will better support the full spectrum of the Sustainable Development Goals, and increase collaborative research and innovation across sectors, disciplines and policy fields – boosting flexibility, focus, and impact. Due to its policy focus, the pillar will be implemented "top-down", through a strategic planning process ensuring the

involvement of stakeholders and society, and alignment with Member States' activities. The pillar will give appropriate visibility to industry's essential role in achieving all the Programme's objectives, not least in tackling global challenges, including by developing key enabling technologies for the future.

Pillar 3 – Open Innovation will offer a one-stop shop for high-potential innovators with the European Innovation Council and increase cooperation with innovation ecosystems and actors. This pillar will integrate and reorganise Horizon 2020 activities, such as Innovation in SMEs (notably the SME instrument), Fast-track to Innovation, as well as Future and Emerging Technologies. Innovation will continue to be supported throughout the whole Programme, not just in this innovation-focussed pillar.

Horizon Europe will reinforce the European Research Area through: Sharing excellence (extending the Horizon 2020 actions that help tackle low research and innovation performance i.e. Teaming, Twinning, ERA chairs, and COST); research and innovation reforms and policy, covering the Policy Support Facility; foresight activities; and Framework Programme monitoring, evaluation, dissemination and exploitation of results

The new Programme will also have some new features and enhancements of existing elements. With Horizon 2020 well on track to deliver excellence, impact and openness, these changes will make the successor Programme achieve even more impact (through the European Innovation Council and mission-orientation) and more openness (through strengthened international cooperation, a reinforced Open Science policy, and a new policy approach to European Partnerships).

The European Innovation Council will help place the EU in the lead for breakthrough market-creating innovation. It will support high-risk, market-creating innovation projects that do not (yet) generate revenues, to bridge the "valley of death" between research and commercialisation and help companies scale up. The tailor-made support to innovators will be channelled through two main funding instruments. The Pathfinder for Advanced Research will provide grants from the early technology stage (proof of concept, technology validation) to the early commercial stage (early demonstration, development of business case and development of strategy). 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 place a particular emphasis on innovation generated within the Pathfinder, although it will also fund projects from other parts of the Programme, such as the European Research Council or the Knowledge and Innovation Communities. The expected implications of the role played by the European Innovation Council include more innovation that creates the new markets of the future, more companies that scale up in Europe, higher growth among SMEs, and more entrepreneurship and risk-taking.

Horizon Europe will see the introduction of a limited set of highly visible research and innovation 'missions' under Pillar 2 (but potentially also providing direction to the other pillars). Missions will prioritise investment and set directions to achieve objectives with societal relevance, thereby creating more impact and outreach, encouraging a systemic approach (moving from a view of narrow sectors to entire systems), and aligning instruments and agendas for research and innovation across Europe. Missions will either accelerate progress towards a set scientific, technical or societal solution, by focusing large investment on a specific target; or transform an entire social or industrial system within an established timeframe. They will be selected after the Programme launch, according to strict selection criteria, and co-designed with Member States, stakeholders and citizens. The expected implications of this new mission approach include more cross-sectoral and cross-disciplinary

cooperation, higher impact on global challenges and EU priorities, and a reduced gap between science and innovation, and society.

Strengthened international cooperation is vital for ensuring access to talent, knowledge, facilities and markets worldwide, for effectively tackling global challenges and for implementing global commitments. The Framework Programme will intensify cooperation and extend openness for association to all countries with proven science, technology and innovation capacities, to make cooperation and funding of joint projects as smooth as possible. The programme will continue to fund entities from low/middle income countries. Entities from industrialised and emerging economies will be funded only if they possess essential competences or facilities. The expected implications include higher excellence in the Programme, more influence for the EU in shaping global research and innovation systems, and higher impact.

Open Science will become the modus operandi of the new Programme, going beyond Horizon 2020's open access policy to require immediate open access for publications and data (with opt-out possibilities for the latter), and research data management plans. The Programme will encourage the proliferation of FAIR data (findable, accessible, interoperable, and re-usable) and support a sustainable and innovative scholarly communications ecosystem. It will foster activities to improve researcher skills in Open Science and the reward systems that promote this. Research integrity and citizen science will play a central role, as will the development of a new generation of research assessment indicators.

The new approach to European Partnerships will be more impact-focussed. The need to establish future European Partnerships or renew existing ones will be identified as part of the strategic programming process for the Framework Programme. European Partnerships will be open to all types of stakeholders (e.g. industry, Member States and philanthropic foundations) and will be limited in time, with clear conditions for the phasing out of the Framework Programme funding. They will be based on the principles of Union added value, transparency, openness, impact, leverage effect, long-term financial commitment from all parties, flexibility, coherence and complementarity with Union, local, regional national and international initiatives. The future partnership landscape will ensure optimal coherence between Framework Programme activities and partnerships. There will be only three types: i) co-programmed European Partnerships, based on memoranda of understanding or contractual arrangements; ii) co-funded European Partnerships, based on a single, flexible co-fund action; iii) institutionalised European Partnerships (based on Article 185 or 187 of the Treaty on the Functioning of the European Union). Following a life-cycle approach, the Framework Programme will set out the criteria for selecting, implementing, monitoring, evaluation and phasing out all European Partnerships.

The changes to the Programme's structure and the improvements to it will facilitate the achievement of the Programme's objectives, making it more effective and helping it generate even more economic benefits and value for money. These effects will be amplified by strengthened synergies and complementarities with other EU programmes, for example through the Seal of Excellence.

Efficient delivery is essential for meeting all the objectives. It is also key to achieving higher impact and further simplification. Building on the achievements of Horizon 2020, simplification remains a continuing endeavour also in the new Programme. Several improvements have been made to streamline delivery for impact. The Programme will aim at further simplification within the present real cost reimbursement system with its simplified funding model. Increased use will be made of project funding against fulfilment of activities (i.e. lump sum) and other simplified forms of funding allowed by the new Financial Regulation. Cross-reliance on audits across EU programmes and acceptance of usual cost

accounting practices will be developed. To increase flexibility, the Programme will support the intersection of disciplines and sectors and allow allocation of funds between and within pillars to react swiftly to emerging issues or challenges. Further improvements to the proposal submission and evaluation process will be envisaged by continuously trying to reduce the 'time to grant' and by improving feedback to applicants. The evaluation criteria, process and involvement of independent experts will underscore the Programme's excellence and impact. Innovation support schemes will be streamlined under the European Innovation Council, while the complementarity between grants and financial instruments could be reinforced through blended finance.

Impact depends ultimately on the dissemination and exploitation of research and innovation data and results, and it needs to be effectively captured and communicated. An ambitious and comprehensive strategy will increase the availability of such data and results and accelerate their uptake to boost the overall impact of the Programme. Portfolios of mature results will be exploited in synergy with other EU programmes to ensure their uptake at national and regional level, maximising European innovation potential. This will be complemented by effective communication and outreach campaigns that build trust and engage citizens.

Progress towards the Programme's objectives will be tracked along 'impact pathways' (on scientific, societal, and economic impact). The impact pathways will be time-sensitive, distinguishing between the short, medium and long term. The impact pathway indicators will contain both qualitative and quantitative information, the availability of which will depend on the Programme's stage of implementation. Individual programme parts will contribute to these indicators to varying degrees and through various mechanisms. The data behind the key impact pathway indicators will be collected in a centrally managed and harmonised way that imposes minimum reporting burden on beneficiaries, including using unique identifiers for applicants and sourcing data automatically from existing external public and private databases. Baselines, targets and benchmarks will be established before the Programme's launch. Management and implementation data from the Programme will continue to be collected in near real-time. An analysis of progress on key dimensions of management and implementation will be carried out every year. Interim and ex-post evaluations will ensure that methodologies are consistent and coverage is comprehensive.

1 INTRODUCTION: POLITICAL AND LEGAL CONTEXT

1.1 Scope

This impact assessment accompanies the Commission proposals for Horizon Europe, the 2021-2027 Framework Programme for EU Research and Innovation (R&I), which will succeed Horizon 2020 (2014-2020): proposals for the Framework Programme and Rules for Participation[1], the Specific Programme[2], as well as the 2021-2025 Research and Training Programme of the European Atomic Energy Community (Euratom Programme)[3]. An impact assessment for the defence research has been carried out separately and is accompanying the proposal for the European Defence Fund Regulation.

R&I are crucial for providing solutions to the challenges of our time. They deliver on citizens' priorities, as embodied in the Sustainable Development Goals and in the Paris Agreement on fighting climate change[4], on growth and jobs, and to solve the global challenges we face today and will face tomorrow[5]. In areas like health, digital technologies, industrial transformation, resilient societies, natural resources, energy, mobility, environment, food, low-carbon economy and security, R&I are critical to the success of EU priorities, in particular jobs and growth, Digital Single Market, Energy Union and climate action. R&I are at the core of the productivity and competitiveness of our economy. About two-thirds of Europe's economic growth over the last decades has been driven by R&I. R&I support the creation of new and better jobs and the development of knowledge-intensive activities, which account for more than 33% of total employment in Europe. Moreover, to ensure sustainable growth and the capacity to address the societal challenges ahead, Europe must reinforce and maintain its technology and industrial capacities in the key areas that underpin the transformation of our economy and society.

"Fostering R&I across the EU" is the most important policy challenge for 97% of respondents to the cluster-based public consultation on EU funds in the area of investment, research & innovation, SMEs and single market[6].

R&I determine the productivity and competitiveness of our economy: about two-thirds of Europe's economic growth over the last decades was driven by innovation. They support the creation of new and better jobs, and the development of knowledge-intensive activities, which account for more than 33% of total employment in Europe[7]. Europe must maintain and

[1] The Treaty requires that rules for participation and dissemination are adopted by the European Parliament and the Council in accordance with the ordinary legislative procedure.
[2] The Treaty on the Functioning of the European Union (TFEU) requires that a multiannual Framework Programme is adopted by the European Parliament and Council in accordance with the ordinary legislative procedure, and implemented through Specific Programmes adopted in accordance with the special legislative procedure.
[3] The Euratom Treaty provides the legal basis for promoting and facilitating nuclear research.
[4] European Commission (2017), 2017 Special Eurobarometer on Climate change. According to the 2017 Special Eurobarometer on Climate change, 92% of EU citizens see climate change as a serious problem, and 79 % of Europeans believe fighting climate change can boost the economy and create jobs.
[5] This initiative contributes in particular to the following Commission priorities: Jobs, Growth and Investment; Digital Single Market; Energy Union; Deeper and Fairer Internal Market; An Area of Justice and Fundamental Rights; Towards a New Policy on Migration; EU as Stronger Global Actor; and EU of Democratic Change. It contributes as well to the implementation of the 2030 Agenda on sustainable development, the EU Global Strategy, and new EU priorities, notably security, defence and migration, in line with the Rome declaration.
[6] See Annex 2 on Stakeholder consultation.
[7] European Commission (2017), The economic rationale for public R&I funding and its impact, Policy Brief Series, p. 23.

even reinforce its technological, industrial and innovation capacities in a sustainable way, in the strategic areas that underpin our society, economy and international commitments.

Currently, Europe underinvests in R&I compared to its main trading partners. If this continues, Europe risks being outpaced irreversibly. The EU's overall R&I intensity is just above 2% of GDP (failing to meet the 3% target[8]). In particular, private investment in research and development in the EU has remained low in comparison to other advanced economies, and the gap has grown again since 2013. This poor EU performance signals a weak capacity to translate knowledge into market-creating innovations[9]. Europe has to anticipate and ride the new global wave of breakthrough innovation that is coming up, one that will be more "deep-tech"[10] and will affect sectors such as manufacturing, financial services, transport or energy.

EU-level R&I investments support public goods[11] with a high European added value[12]: through EU-wide competition for excellence, EU investments support the training and mobility of scientists, create transnational and multidisciplinary collaboration, leverage additional investment from the public and private sectors, build the scientific evidence necessary for effective EU policies, and structure national R&I systems[13].

To stimulate innovation in Europe, more is needed. EU investments in R&I must be enhanced and re-designed to better serve strategic areas for Europe and cover the full value chain development from early and advanced research to innovation and market deployment. They must be matched by national investments in R&I, and the market and regulatory framework must create the right conditions for innovation to flourish[14]. However, these issues are outside the scope of this impact assessment.

1.1.1 Political context

The common view of the EU Institutions is that the Framework Programmes for R&I have a high EU added value and that the implementation of the current Programme is largely a success. In addition to the Communication on the Interim Evaluation of Horizon 2020[15], the Commission's reflection paper on the future of EU finances highlights R&I as a key European priority[16], citing it as an example of a public good with clear EU added value. Opinions and reports from the European Parliament [17], the European Economic and Social Committee [18], the Committee of Regions [19], the European Research Area and Innovation Committee (ERAC, where Member States' public administrations are represented)[20], and

[8] In contrast, China's intensity is now higher, and South Korea's is more than double. The EU will need to train and employ at least one million new researchers, but the share of R&I personnel in the labour force increased marginally 2002-2015.
[9] LAB-FAB-APP, Investing in the European future we want, Lamy High Level Group Report (2017), p. 11
[10] "Deep tech" refers to companies founded around scientific discoveries or meaningful engineering innovations.
[11] European Commission (2017), Reflection paper on the future of EU finances.
[12] More evidence can be found in the Annex 4 on the EU added value of R&I.
[13] The EU has been investing in R&I since 1984. Over time, the share of the EU budget dedicated to R&I has increased.
[14] LAB-FAB-APP, Investing in the European future we want, Lamy High Level Group Report (2017), p. 11.
[15] European Commission (2018), Communication on the Horizon 2020 Interim Evaluation, COM(2018)2 final.
[16] European Commission (2017), Reflection paper on the future of EU finances.
[17] 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.
[18] European Economic and Social Committee (2016), EESC information report INT/807, Horizon 2020 (evaluation).
[19] 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.
[20] 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.

more recently, the Competitiveness Council (through Council Conclusions[21]) support the findings of the Interim Evaluation, in particular stressing that EU added value must be the major driver for the design and implementation of the next Framework Programme.

Box 1 Overall budget envelope

On 2 May 2018, the European Commission adopted its proposals for a new Multiannual Financial Framework (MFF) for 2021-2027[22]. **Under these proposals, the Horizon Europe and the Euratom programmes will have a combined budget of EUR 100 billion** over this period. This impact assessment report reflects the decisions of the MFF proposals and focuses on the changes and policy choices which are specific to these instruments.

In response to the Horizon 2020 interim evaluation, the European Parliament, supported by the Committee of Regions, similarly calls, among others, on the EU to avoid budget cuts to Horizon 2020 and to endow the successor programme with at least EUR 120 billion[23]. The ERAC calls for proportionality between budget and ambitions. Similarly, Council Conclusions emphasise the need to prioritise R&I across all relevant EU policies, and provide significant funds for the future programme.

1.1.2 Legal context

The Framework Programme for R&I is based on Articles 173, 182, 183 and 188 of the Treaty on the Functioning of the European Union[24]. This initiative is in an area of (shared) parallel competence and the subsidiarity and proportionality principles apply. This impact assessment satisfies the requirements of the Financial Regulation in respect of preparing an ex-ante evaluation.

The EU Framework Programme for R&I respects the subsidiarity and proportionality principles. Action at EU level is **necessary**: the underlying findings of a recent external study are that more than four out of five Horizon 2020 projects would not have gone ahead without Horizon 2020 funding[25]. They produce **undeniable added value** in terms of scale, speed and scope compared to national and regional-level support to R&I (without replacing it[26]) by boosting excellence through transnational competition, strengthening impact via collaborative R&I, and providing critical mass to tackle global challenges (see Annex 4). Moreover, it is **proportionate**, not going beyond what is required for Union objectives.

1.2 Lessons learnt from previous programmes

EU Framework Programmes have generated significant and long-lasting impacts[27], as shown by successive evaluations since the EU started investing in R&I in 1984. More details on the lessons learnt from evaluations of previous Programmes are in Annex 3.

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[21] Council of the European Union (2017), From the Interim Evaluation of Horizon 2020 towards the ninth Framework Programme - Council conclusions.

[22] European Commission (2018), A Modern Budget for a Union that Protects, Empowers and Defends, The Multiannual Financial Framework for 2021-2027, COM(2018) 321 final.

[23] 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.

[24] The Euratom proposal is based on Article 7 of the Treaty establishing the European Atomic and Energy Community.

[25] PPMI (2017), Assessment of the Union Added Value and the Economic Impact of the EU Framework Programmes (FP7, Horizon 2020).

[26] Lab – Fab – App, Investing in the European future we want, Lamy High Level Group report, Annex 5, p. 32. Indeed, the Lamy High Level Group report identified no direct evidence of overall crowding-out effect of national funding. While some countries present simultaneously a decrease in national budget for R&D and an increase in EU contribution from the Framework Programme, this result is not systematic for all countries.

[27] European Commission (2018), A new, modern Multiannual Financial Framework for a European Union that delivers efficiently on its priorities post-2020, COM(2018)98 final.

Box 2: Recommendations from the ex-post evaluation of the Seventh Framework Programme

The Ex Post Evaluation of the Seventh Framework Programme (FP7) made the following recommendations[28], which are also relevant for this impact assessment:

a. Ensure focus on critical challenges and opportunities in the global context.
b. Align research and innovation instruments and agendas in Europe.
c. Integrate the key components of the Framework Programmes more effectively.
d. Bring science closer to the citizens.
e. Establish strategic programme monitoring and evaluation.

The Communication on the interim evaluation of Horizon 2020[29] identified several areas for improvement. In addition to in-depth analysis, this was based on extensive stakeholder feedback[30] and the strategic recommendations of the independent High Level Group on maximising the impact of EU R&I Programmes (Lamy High Level Group):

- **Continue simplification**. Horizon 2020 has made great progress in terms of simplification compared to FP7, but simplification is an ever continuing undertaking, requiring constant improvements. Further simplification should be pursued to support faster innovation cycles and lower administrative burden.
- **Support breakthrough innovation.** While some potential for supporting breakthrough, market-creating innovation was identified in Horizon 2020, such support should be considerably strengthened in order to identify, develop and deploy breakthrough and market-creating innovations and support the scale-up of young and quickly growing innovative companies to international and European levels.
- **Create more impact through mission-orientation and citizen involvement.** The Framework Programme needs greater impact and more outreach to citizens. A mission-oriented approach would increase the focus on impact, while involving citizens, customers and end-users in agenda-setting (co-design) and implementation (co-creation) leads to more innovation by stimulating user-driven innovation and the demand for innovative solutions.
- **Increase synergies with other EU funding programmes and EU Policies**. While synergies already exist between Horizon 2020 and other EU programmes, they should be further strengthened. In particular, building on synergies with the European Structural and Investment Funds (ESIF) and smart specialisation strategies, R&I capacities built over the past decade in lower performing regions could be better used for Framework Programme-supported projects.
- **Strengthen international cooperation**. While Horizon 2020 has a broad international outreach and openness to the world, third-country participations declined when compared to FP7[31]. International cooperation in R&I is vital for ensuring access to talent, knowledge, know-how, facilities and markets worldwide, for effectively tackling global challenges, and for implementing global commitments. It needs to be further intensified in order to strengthen Europe's R&I excellence and competitiveness.

[28] European Commission (2016) Response to the Report of the High Level Expert Group on the Ex Post Evaluation of the Seventh Framework Programme, COM(2016) 5 final.
[29] European Commission (2018), Horizon 2020 interim evaluation: maximising the impact of EU research and innovation, COM(2018)2.
[30] The open public stakeholder consultation on the Interim Evaluation received 3500 replies and 300 position papers.
[31] 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.

- **Reinforce openness**. There is a need to build on the great progress made in terms of making the scientific publications and data generated by Horizon 2020 openly accessible to the wider scientific community and public. The next Framework Programme should fully embrace Open Science policy as a way of strengthening scientific excellence, benefiting from citizen participation, achieving better reproducibility of results, and increasing the re-use of research data.
- **Rationalise the funding landscape**. A key area for improvement is the rationalisation of the funding landscape, in particular with respect to partnership instruments and initiatives. Reforming the current policy approach to European Partnerships should make it possible to use the full potential of the new or renewed European Partnerships in achieving ambitious policy objectives that cannot be achieved by the Union or national action alone.

Following the Interim Evaluation of Horizon 2020, the Lamy High Level Group report (presented at the conference "Research & innovation – shaping our future" on 3 July 2017)[32] and the open public stakeholder consultations for the preparation of the sectorial legislation accompanying the proposal for the post-2020 MFF, more than 300 position papers were received. Fostering R&I across the EU resulted as the most important policy challenge according to the respondents to the public stakeholder consultation. Key messages and a detailed analysis of this stakeholder input can be found in an Annex 2.

2 CHALLENGES AND OBJECTIVES

2.1 Key features of Horizon 2020 and expected impacts of its continuation

Having excellence as the core underlying principle, Horizon 2020 attracts participants from the best institutions and companies in and outside Europe, covering a wide range of disciplines. Stakeholders express strong satisfaction with the programme, as shown by the sustained interest in its highly competitive calls and high oversubscription rates (which is commonly quoted by stakeholders as being the biggest problem). The programme offers unique collaboration and networking opportunities. Scientific publications of Horizon 2020 are cited already at twice the world average rate. Patents produced through the programme are of higher quality and likely commercial value than similar patents produced elsewhere. Horizon 2020 has shown flexibility in responding to evolving political priorities, such as migration, and emergencies such as the Ebola and Zika outbreaks. Horizon 2020 is on track to contribute significantly to the creation of jobs and growth. Moreover, it supports EU policy objectives through its focus on excellent science, industrial leadership and societal challenges

Key features of Horizon 2020:
- significant budget (close to EUR 77 billion) for 7 years (2014-2020), with a target of 35% related to climate action and 60% related to Sustainable Development;
- seamless integration of R&I into a single framework, from 'blue-sky', frontier research to close-to-market innovation activities;
- direct R&I investments through an EU-wide competition based on excellence as guiding principle (and main evaluation and selection criterion);
- central management by the European Commission, its executive agencies or other implementing bodies;
- a three-pillar structure focusing on excellent science, industrial leadership and societal challenges.
- major simplification measures implemented through the Common Support Centre, such as a single set of rules, an easy to use cost reimbursement model, a single point of access for participants, fewer audits.

[32] Conference proceedings available at https://publications.europa.eu/s/fC5N

The continuation of the ongoing Programme is expected to generate even more:

- **new knowledge and technologies, promoting scientific excellence and significant scientific impact.** The Programme will continue to facilitate cross-border collaboration between top scientists and innovators, allowing for trans-national and cross-sector coordination between public and private R&I investment. Horizon 2020 has already attracted the world's best research institutions and researchers, supported ~340,000 researchers, and developed Europe's human capital. The first scientific publications from Horizon 2020 are world-class (cited more than twice the world average) and contributed to major discoveries like exoplanets, the Higgs boson, and gravitational waves.[33].
- **positive effects on growth, trade and investment flows**[34], quality jobs and international mobility for researchers in the European Research Area. The continuation scenario is expected to bring an estimated average GDP increase of 0.08% to 0.19% over 25 years, which means that each euro invested can potentially generate a return up to 11 euros of GDP gains over the same period[35][36] (see Annex 5). EU investments in R&I are expected to directly generate an estimated gain[37] of up to 100,000 jobs in R&I activities in the "Investment phase" (2021-2027) and to foster an indirect gain of up to 200,000 jobs over 2027-2036, of which 40% are high-skilled jobs, through the economic activity generated by the Programme.
- **significant social and environmental impact**. This will happen directly through the dissemination, exploitation and uptake of scientific results translated into new products, services and processes, which in turn contribute indirectly to the successful delivery on political priorities.

These impacts mean that the potential cost of discontinuing the EU R&I Programme (i.e. cost of non-Europe) is substantial. Discontinuation would result in a decline of competitiveness and growth (up to EUR 720 billion of GDP loss over 25 years[38]), sharp reductions in the private and national investments that are currently leveraged by EU-level co-investments, creating significant losses of social, environmental and economic impacts.

Box 3: Three phases of the economic impact of the Framework Programme

The expected economic impact of continuation is decomposed in three phases in the NEMESIS model[39]:

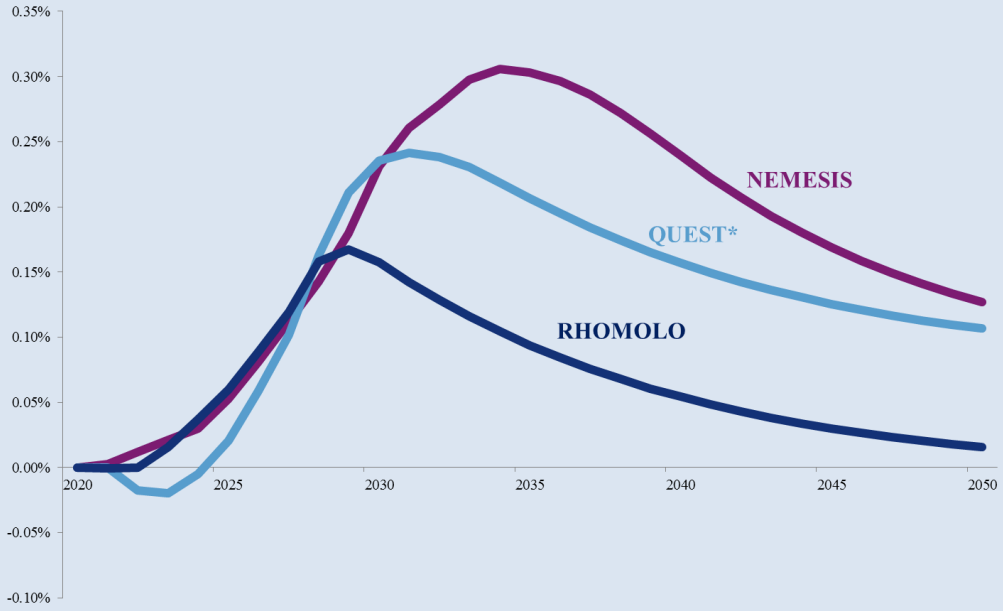
- **The investment phase**. From the beginning to the end of the Programme (2021-2027). Assuming a "maturation" lag of innovation between 3 and 5 years, economic impact is driven by the spending, with comparatively moderate impact from the production of innovations at this stage.
- **The innovation phase**. During and after the investment phase, R&I investments produce economic effects through the creation of new process and product innovations. Process innovation increases efficiency, which leads to lower cost. Product innovation increases the quality of, and raises the

[33] European Commission (2017), Key findings of the Interim Evaluation.
[34] The economic impact of the Programme comes from the transformation of scientific excellence into innovations that generate economic outcomes: employment, exports, competitiveness, value-added and higher GDP.
[35] This multiplier is based on simulations done using the NEMESIS model and is consistent with figures provided in the Interim evaluation of Horizon 2020 (calculated over a period of 17 years) and in the ex-post evaluation of the 7th Framework Programme.
[36] The average GDP gain in RHOMOLO is 0.08%, the average gain in QUEST is up to 0.14% and the average gain in NEMESIS is 0.19%. NEMESIS results are based on Seureco (forthcoming), Support for assessment of socio-economic and environmental impacts (SEEI) of European R&I programme. QUEST and RHOMOLO results were produced, respectively, by DG ECFIN and DG JRC.
[37] ibid.
[38] This figure is calculated for the EU-27 only and it is based on the NEMESIS model.
[39] Seureco (forthcoming), Support for assessment of socio-economic and environmental impacts (SEEI) of European R&I programmes.

demand for, products. The lower cost and enhanced quality increase competitiveness.

- **The obsolescence phase**. After the innovation phase, knowledge depreciation decreases gains.

Figure 1: GDP gains from the continuation of Horizon 2020 (percentage change compared to a situation without Framework Programme)



*Note: Figures calculated for EU-27; different sets of results from QUEST are presented in Annex 5 based on different funding assumptions. This graph presents the scenario with higher benefits.

2.2 Main R&I challenges and problems to be addressed

Based on the key findings and lessons learnt from the Horizon 2020 Interim Evaluation (see section 1.2 above), the following key challenges in the area of R&I to be addressed by the future Programme have been identified:

1) The creation and diffusion of high-quality new knowledge and innovation in Europe should be improved. Europe is overall a global scientific powerhouse, but it is essentially a "*mass producer* [of knowledge] *with, relative to its size, comparatively few centres of excellence that standout at the world level and with large differences between European countries*"[40]. Moreover, the gap between high productivity firms and the rest has grown, illustrating a serious issue in the circulation of knowledge and technologies. This corresponds to the following findings of the Horizon 2020 Interim Evaluation:

- Sub-optimal creation[41] of high-quality knowledge and lack of diffusion[42] of knowledge across borders, sectors, disciplines[43] and along the value chain;
- Insufficient open science[44];

[40] European Commission (2017), Interim Evaluation of Horizon 2020, SWD(2017) 220, book, p. 46.
[41] More than 14% of publications from the United States are in the top 10% most cited publications compared to 11% for EU publications (see Research and Innovation Observatory). When looking at the top 1% most cited publications, the difference is even larger (50% more in the US than in the EU) (see S. Thomson, V. Kanesarajah (2017), The European Research Council – The first 10 years, Clarivate Analytics).
[42] Knowledge diffusion between business and academia remains lower in the EU than in the US (public-private co-publications per million-population stand at 50, over 35 points lower than in the US (see European Commission (2016), Science, Research and Innovation Performance of the EU).
[43] J. Allmendinger (2015), Quests for interdisciplinarity: a challenge for the ERA and Horizon 2020, RISE policy brief.
[44] RISE Group (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, p. 65.

- Scattered pockets of scientific excellence and R&I infrastructures[45];
- Rapid increase of global competition for talent[46];
- Hampered global R&I cooperation[47].

2) There is a need to reinforce the impact of R&I in policy-making. R&I have to take a more prominent place in shaping EU policy priorities and for delivering on policy commitments and priorities of the Union. R&I are expected to make a crucial contribution to achieving EU policy priorities, including the Sustainable Development Goals. The impact is stronger when investments are prioritised in areas where the EU added value is greatest[48] and aligned with policy needs; when support provides incentives in a highly performing and dynamic system with supportive framework conditions; and where R&I results have a strong potential to feedback into the policy-making cycle. Investments in R&I have to better fit into the full innovation cycle, from societal needs to market deployment, supporting the implementation of EU, national and regional strategic policy priorities. Uptake of innovative solutions has been low so far, and more needs to be done to increase end-user involvement, for demonstrating and scaling up promising solutions and create favourable market and framework conditions for innovation, including social innovation, while ensuring that competition in the internal market which drives the innovative efforts of companies and unlocks their innovative potential is not distorted. This corresponds to the following findings of the Horizon 2020 Interim Evaluation:

- Variable focus on EU strategic challenges[49];
- Sub-optimal link between R&I and EU policy-making[50];
- Low awareness of innovative solutions and insufficient end-user/citizen involvement in the R&I process[51].

3) EU is lacking rapid uptake of innovative solutions. Around two thirds of EU manufacturing companies have not recently used any advanced technologies[52], and competition from the USA and Asia has intensified. The EU's substantial knowledge assets, notably in the field of key enabling technologies, need to be more effectively and quickly turned into innovations, particularly as innovative solutions for global challenges are increasingly research-intensive. Apart from aiming at high industrial participation in the programme, a stronger focus is needed on innovators working on breakthrough market-creating innovations - these are rare in Europe (fast-growing start-ups, so-called *unicorns*, are

[45] Scientific quality is concentrated in a group of leading countries, predominantly in North-West Europe, but there are a number of small universities with a small number of excellent fields in less developed regions (source: Interim Evaluation of Horizon 2020).

[46] Increasingly, expertise and resources are abroad: 75% of knowledge (see European Commission (2016), Science, Research and Innovation performance of the EU) and 90% of market growth (see European Commission (2015), Trade for all, Towards a more responsible trade and investment policy) will be outside the EU over the next decade (see also European Commission (2017), Strengthening European Identity through Education and Culture, The European Commission's contribution to the Leaders' meeting in Gothenburg, p.4).

[47] European Commission (2017), Interim Evaluation of Horizon 2020, SWD(2017) 220, book, p.100.

[48] Lab – Fab – App, Investing in the European future we want, Lamy High Level Group report, p.8.

[49] European Commission (2017), Interim Evaluation of Horizon 2020, SWD(2017) 220, book, p. 59.

[50] Ibid.

[51] Social awareness is a constraining factor for the full-scale deployment of R&I-driven solutions required for societal transformation, but new and rapidly evolving technologies like robots and artificial intelligence raise concerns amongst citizens. In Europe, absence or uncertainty of demand for innovative goods and services are among the most cited obstacles to innovation, see also JRC Science for Policy Report (2016), Modes of Innovation.

[52] Flash Eurobarometer 433, Innobarometer 2016 – EU business innovation trends. This figure has increased by 14 percentage points between the last two releases of the Innobarometer (i.e. 2015 and 2016).

five times fewer than in the USA[53]). This corresponds to the following findings of the Horizon 2020 Interim Evaluation:

- Slow industrial transformation[54];
- Limited scale-up of innovative SMEs at EU level and lack of venture capital[55];
- Lack of entrepreneurial skills to translate ideas into innovations[56].

4) There is a need to strengthen the European Research Area (ERA). While strong progress was made over the last years[57], knowledge flows, good working conditions, effective career development of researchers and other ERA priorities, need to be more widely spread. Within the EU, scientific excellence is rather concentrated, and EU funding from Horizon 2020 to low performing R&I countries remains low[58]. The delivery of the Programme can only be optimised by unlocking the potential of all partners - this means there is a need for strengthening the EU scientific and technological base and spreading the benefits of excellence[59].

2.3 Objectives of the future Programme

The Framework Programme's general objective is based on Article 179.1 TFEU:

> to strengthen the scientific and technological bases of the Union and foster its competitiveness, including for its industry, deliver on the EU's strategic policy priorities and contribute to tackling global challenges, including the Sustainable Development Goals.

As a lesson learnt from the Interim Evaluation of Horizon 2020 supported by strong stakeholder feedback, specific objectives are identified for the Programme as a whole (i.e. not per part or instrument) to improve coherence and linkages among Programme parts. Based on the challenges identified in section 2.1, the specific objectives are:

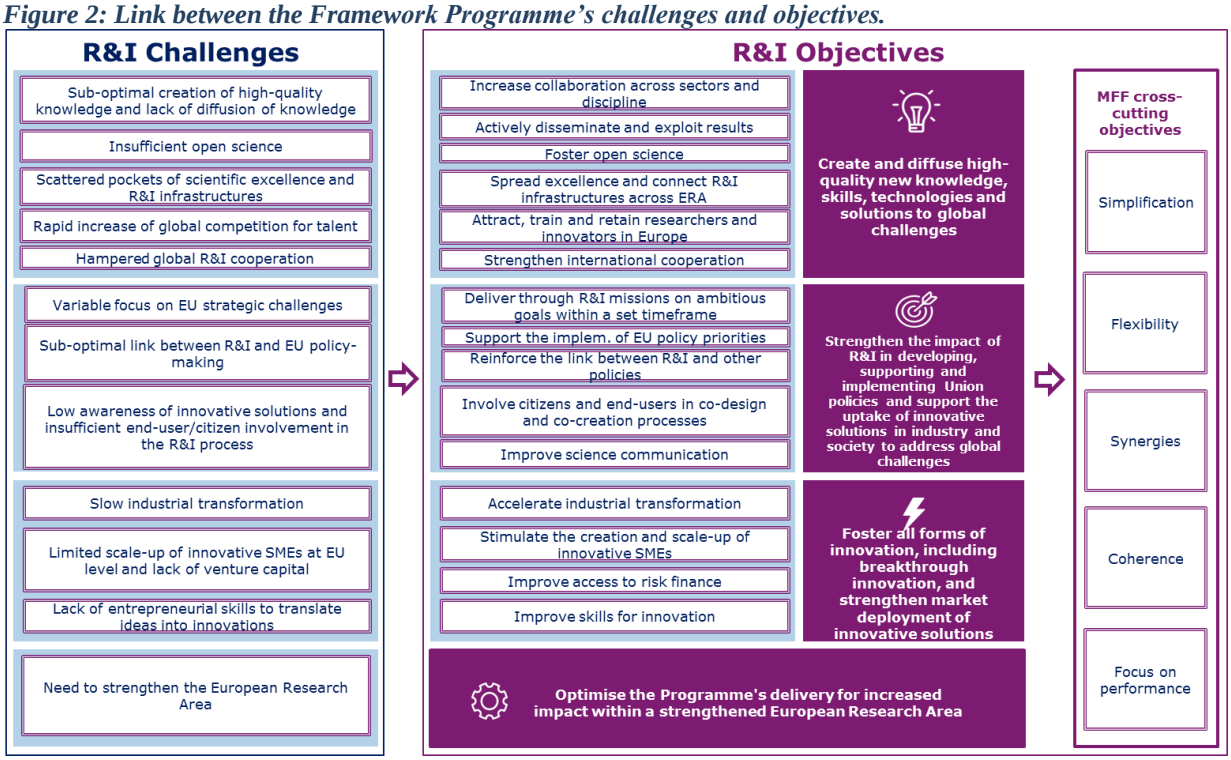
1) to support the creation and diffusion of high-quality new knowledge, skills, technologies and solutions to global challenges;
2) to strengthen the impact of research and innovation in developing, supporting and implementing Union policies, and support the uptake of innovative solutions in industry and society to address global challenges;
3) to foster all forms of innovation, including breakthrough innovation, and strengthen market deployment of innovative solutions;
4) to optimise the Programme's delivery for increased impact within a strengthened European Research Area.

General and specific objectives will be pursued through an improved Programme structure (Section 3). The implementation of the Programme will be optimised in terms of delivery (Section 4) in line with the cross-cutting objectives of the MFF, notably simplification, flexibility, coherence, synergies and focus on performance. The specific objectives are

[53] Lab – Fab – App, Investing in the European future we want, Lamy High Level Group report, p.7.
[54] High-Level Strategy Group on Industrial Technologies (2018), Conference Document.
[55] Very few European start-ups survive beyond the critical phase of 2-3 years, and even fewer grow into larger mermaids. Less than 5% of European SMEs grow internationally. Venture capital in the EU is one-fifth the level of the USA.
[56] Less than half Europeans believe they have the skills to pursue entrepreneurial opportunities World Economic Forum, Enhancing Europe's Competitiveness Fostering Innovation-driven Entrepreneurship in Europe, p16.
[57] European Commission (2017), ERA Progress Report 2016, Report from the Commission to the Council and the European Parliament, COM(2017) 35.
[58] European Commission (2017), Interim Evaluation of Horizon 2020, SWD(2017) 220, book, p. 119.
[59] Ibidem, p. 46.

operationalised in the Specific Programme implementing the Framework Programme. All objectives articulate with each other coherently, so that all actions in each pillar can deliver on the objectives without risking any inconsistencies or exclusions.

Figure 2: Link between the Framework Programme's challenges and objectives.



3 PROGRAMME STRUCTURE AND PRIORITIES

3.1 Scope and structure of the new Framework Programme

"An evolution, not a revolution"[60] - building on the positive findings of the Horizon 2020 Interim Evaluation, stakeholder feedback[61] and the Lamy High Level Group report, only a further refinement of the current Programme is necessary[62]. Therefore, the vast majority of the parts and features of Horizon 2020 will be continued, albeit with several optimisations and minor redesigns. As all components of the Framework Programme are necessary to achieve its objectives, a different level of ambition (including budgetary) would result in an adjusted level of support across all areas. Moreover, compared to Horizon 2020, Horizon Europe will invest less in sector-specific projects and partnerships, and focus instead on systemic transformations.

The Programme's scope will continue to cover research[63] and innovation[64] in an integrated manner. Scientific knowledge, societal challenges and industrial technologies

[60] LAB-FAB-APP, Investing in the European future we want, Lamy High Level Group Report (2017), p.14.
[61] 80-90% of stakeholders' position papers echo the Lamy High Level Group, recognise that Horizon 2020 is a success and do not call for changes to the basic structure of the programme.
[62] European Commission (2018), Communication on the Horizon 2020 Interim Evaluation, COM(2018)2 final, p.11.
[63] Research and experimental development (R&D) comprise creative and systematic work undertaken in order to increase the stock of knowledge – including knowledge of humankind, culture and society – and to devise new applications of available knowledge. The activity must be: novel, creative, uncertain, systematic, transferable and/or reproducible. (Frascati Manual, http://www.oecd.org/innovation/inno/frascati-manual.htm)
[64] Innovation is the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations. Innovation activities are all scientific, technological, organisational, financial and commercial steps which actually, or are

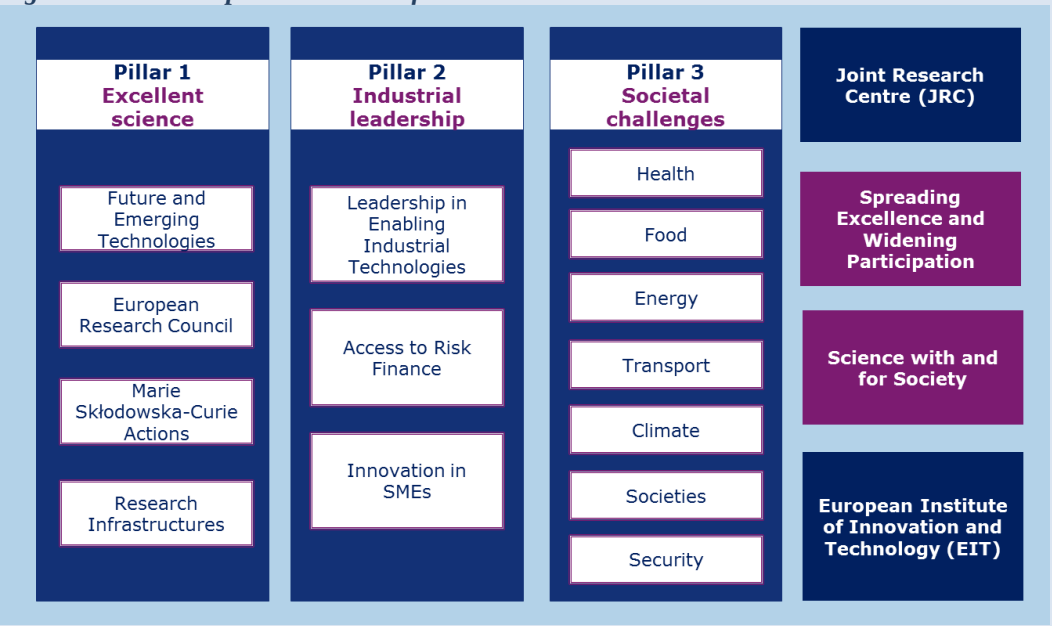
should complement each other and be mutually reinforcing, bringing industry, academia, public stakeholders, and citizens closer together, and thereby aligning the processes and the outcomes of R&I with societal needs, expectations and values, including gender balance. In close synergies with other EU Programmes, the Framework Programme will continue to support the whole innovation ecosystem with seamless support from the lab to the market uptake for high-risk activities that would not be performed without public support.

Box 4: The three-pillar structure of Horizon 2020

Pillar 1 - Excellent Science aims to raise the level of excellence in Europe's science base and ensure a steady stream of world-class research to secure Europe's long-term competitiveness. **Pillar 2 - Industrial Leadership** aims to speed up the development of the technologies and innovations that will underpin tomorrow's business and help innovative European SMEs to grow into world-leading companies. **Pillar 3 - Societal Challenges** responds directly to the policy priorities of the Europe 2020 strategy and aims to and addresses major concerns shared by citizens in Europe and elsewhere.

In addition to the three pillars, Horizon 2020 has two specific objectives: (i) "**Spreading Excellence and Widening Participation**" and (ii) "**Science With and for Society**". It also includes support for the **European Institute of Innovation and Technology** (EIT) – with the objective of promoting the knowledge triangle – and for the **Joint Research Centre** (JRC) – with the objective of providing robust evidence for EU policy making. Furthermore, a number of **cross-cutting issues** are promoted, e.g. the realisation of the European Research Area (ERA), Responsible Research and Innovation, SMEs and private sector participation, Social Sciences and Humanities, gender, international cooperation, sustainable development and climate-related expenditure.

Figure 3: The three-pillar structure of Horizon 2020



The three-pillar structure will be continued and optimised. It will be redesigned to better address the challenges described in Section 2.2. With clearly defined and complementary rationales for intervention, each part will contribute to all the specific objectives. The design of the three pillars will ensure interconnections leading to mutual reinforcement of activities, helping meet the Programme's objectives and ultimately boosting the overall impact (see Figure 4). Support to basic research will remain a cornerstone of the Programme, pursued primarily under the first pillar (but also in the other two pillars); applied research and incremental innovation will be the centre of gravity in the second pillar, addressing both

intended to, lead to the implementation of innovations. Innovation activities also include R&D that is not directly related to the development of a specific innovation. (*Oslo manual*, http://www.oecd.org/science/inno/2367580.pdf)

industrial and societal needs (Global Challenges and Industrial Competitiveness); innovation is the focus of the third pillar (Open Innovation). The largest share of resources is needed for Global Challenges and Industrial Competitiveness pillar, followed by Open Science and Open Innovation, whereas Strengthening the European Research Area entails only limited budget.

The majority of stakeholders commenting on the pillar structure are satisfied with the current three-pillar structure of Horizon 2020 and wish to see either a complete replication or some modifications to the exsisting architecture. The main suggestions for improvements over the Horizon 2020 structure relate to increasing the links between pillars to improve the coverage of the entire knowledge and innovation chain. Several position papers outline the increasing importance of the 'Societal Challenges' and call for a more prominent pillar that takes into account the current socio-economic issues[65].

The revised pillar structure reflects the nature of the R&I challenges, which has evolved compared to Horizon 2020. As highlighted in previous sections, the Programme needs to be equipped with an innovation-focussed pillar to support breakthrough market-creating innovations that bring transformational changes. In addition, given the crucial role of Key Enabling Technologies in the economy and society[66], the R&I agenda-setting has to integrate industry's contribution to societal needs with efforts to tackle global challenges and other EU political priorities in order to improve the coherence and impact of the Programme.

The overarching mission-orientated approach will provide a sense of direction to all activities supported by the Programme. For instance, future missions under pillar 2 (see section 3.2.2) will be planned in the context of ongoing frontier research under the ERC. While fully respecting the bottom-up nature of those programme parts, relevant ERC and MSCA projects might be linked to ongoing missions. The scale and scope of missions can also inspire new research and innovation proposals elsewhere in the Programme. Promising projects from either of the first two pillars might produce spin-offs and be scaled-up with support under the EIC Accelerator under pillar 3 (see section 3.2.1). Similarly, activities supported through the EIT KICs may be picked up under the EIC Accelerator, or feed into ongoing missions (see Annex 8).

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

[66] Rüttgers J., and al. (2018), Re-defining industry, Defining innovation, Report of the independent High Level Group on industrial technologies. On industry's contribution and value to society, see also https://industry-changemakers.ert.eu/

Figure 4 Main structure of the Framework Programme: "evolution, not revolution"

- ***Pillar 1 - Open Science****:* Building on its current successes, the first pillar will continue to focus on excellent science and high-quality knowledge to strengthen EU's science base through the European Research Council (ERC), Marie-Skłodowska Curie Actions (MSCA) and Research Infrastructures. A greater emphasis will be placed on Open Science policy (open access to publications, accessibility and reuse of scientific data), including in the Research Infrastructures part in support for the European Open Science Cloud. In view of the largely "bottom-up", investigator-driven nature of this pillar, the European scientific community will continue to play a strong role. The Future and Emerging Technologies (FET) part (Pro-active, Open and Flagships) has, and continues to have, a relevant impact on knowledge production, the economy and society[67]. The lessons learnt[68] from these essential instruments will be taken forward and streamlined with other instruments in the Framework Programme

[67] 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.
[68] European Commission (2017), Annex 2 of the Interim Evaluation of Horizon 2020, SWD(2017) 221 final.

(see section 3.2.1). However, the "FET" label will be discontinued for increased coherence and user-friendliness, in the interest of rationalising the support landscape.

- ***Pillar 2 - Global Challenges and Industrial Competitiveness***: The second pillar will integrate the Horizon 2020 parts *Societal Challenges* and *Leadership in Enabling Industrial Technologies* to better address EU policy priorities and support industrial competitiveness. Due to its policy focus, the pillar will be implemented "top-down" through a strategic planning process ensuring societal and stakeholder involvement, and alignment with Member States' R&I activities. The pillar will provide robust, evidence-based support to Union policies, in particular through the Joint Research Centre (JRC). While maintaining a strong degree of continuity with Horizon 2020, the main changes will be:
  - Societal Challenges and Leadership in Enabling Industrial Technologies of Horizon 2020 integrated in five clusters to enable more flexibility and interdisciplinarity, with a specific digital and industry cluster (see Box 5);
  - reinforced mission-orientation, with a limited set of highly visible R&I missions that engage citizens and civil society organisations to help reach ambitious goals[69] (see Annex 8 on missions);
  - higher visibility for industry's role in solving global challenges (see Box 6), including through Key Enabling Technologies.
  - simplified forms of partnership initiatives that are open to all (e.g. private sector, Member States, philanthropic foundations; see Annex 8).

Box 5: Clusters in the Global Challenges and Industrial Competitiveness pillar

The Global Challenges and Industrial Competitiveness pillar has five clusters that cover the activities of the LEIT part of pillar 2 and the seven societal challenges of pillar 3 of Horizon 2020. The clusters are Health; Inclusive and Secure Society; Digital and Industry; Climate, Energy and Mobility; and Food and Natural resources. The clusters are derived from specifically commissioned foresight input, including from stakeholders, and have the Sustainable Development Goals as main reference point. The clusters and their intervention areas are expected to have more impact since they cut across classical boundaries between disciplines and address different types of challenge. The integrated clusters of activities will form the basis for support to collaborative research and innovation projects under the Global Challenges and Industrial Competitiveness pillar in the implementation of the Framework Programme.

Table 1: Clusters and intervention areas

Health	Inclusive and Secure Society	Digital and Industry	Climate, Energy and Mobility	Food and Natural Resources
– Health throughout the life course – Environmental and social health determinants – Non-communicable and rare diseases – Infectious diseases – Tools, technologies and digital solutions for health – Health care systems	– Democracy – Cultural heritage – Social and economic transformations – Disaster-resilient societies – Protection and Security – Cybersecurity	– Manufacturing technologies – Key digital technologies – Advanced materials – Artificial intelligence and robotics – Next generation internet – Advanced computing and Big Data – Circular industries – Low-carbon and clean industries – Space	– Climate science and solutions – Energy supply – Energy systems and grids – Buildings and industrial facilities in energy transition – Communities and cities – Industrial competitiveness in transport – Clean transport and mobility – Smart mobility – Energy storage	– Environmental observation – Biodiversity and natural capital – Agriculture, forestry and rural areas – Sea and oceans – Food systems – Bio-based innovation systems – Circular systems

[69] Three examples of missions for pedagogical use are described in Mazzucato M. (2018), Mission-Oriented Research & Innovation in the European Union.

- ***Pillar 3 – Open Innovation***: Whilst innovation will be supported throughout the whole Programme, an innovation-focussed pillar will offer a one-stop shop for high potential innovators with the European Innovation Council (EIC). The EIC will offer a coherent, streamlined and simple set of support actions dedicated to the emergence of breakthrough ideas, the development and deployment of market-creating innovations and scaling-up of innovative enterprises. These activities will be largely defined "bottom-up", being open to innovations from all fields of science, technology and applications in any sector, while also enabling focused approaches on emerging breakthrough or disruptive technologies of potential strategic significance. Additional measures under this Pillar will boost support to the European innovation ecosystem, notably through co-funding various joint national initiatives that boost innovation (e.g. joint programme between agencies implementing national/local innovation policies, joint public procurement actions). In addition to the EIC, financial instruments implemented under the InvestEU programme will help bridge the "valley of death" between research and commercialisation, and will support the scaling-up of companies. The European Institute for Innovation and Technology (EIT) and its Knowledge and Innovation Communities (KICs) will have an important role in the Open Innovation pillar, supporting the development of the European innovation ecosystem through the integration of education, research and entrepreneurship. Through their focus on key strategic priorities in line with the strategic programming of the Framework Programme (see section 4.1), KICs will also contribute to the wider programme objectives, including to deliver on global challenges and missions.

In addition to the three main pillars, the Horizon Europe will strengthen the European Research Area through successful elements of Horizon 2020 that will be integrated: (i) **Sharing excellence** (extending the Horizon 2020 Spreading Excellence and Widening Participation actions Teaming, Twinning, ERA chairs, and COST) to continue supporting low performing R&I Member States to increase their excellence; (ii) **Reforming and enhancing the European Research Area,** covering the Policy Support Facility; foresight activities; Framework Programme's monitoring, evaluation, dissemination and exploitation of results; the modernisation of European universities; and Science, society and citizens (building on the Horizon 2020 Science with and for Society).

The redesigned pillar structure will improve internal coherence, in particular through:

- the integration of industrial technologies in Pillar 2, enhancing the contribution of industry to tackling global challenges, and matching supply with demand for new solutions[70];
- the rationalisation of the current Societal Challenges into five cross-theme clusters that will cover the whole innovation chain and that will encourage transdisciplinary activities, including social sciences and humanities (SSH);
- the streamlining of different innovation support instruments through the EIC;
- the link of the EIC to the other activities of Horizon Europe, in particular ERC, MSCA and the EIT-KICs, to help researchers and innovators to deploy their innovation to the market and scale up.
- emphasis on a strong horizontal role of education and training.

[70] Key Enabling Technologies and digital technologies are instrumental in modernising Europe's industrial base, to ensure that industry reduces its carbon footprint and embrace a circular economy approach. Moreover, industry could mobilise important industrial players and ensure participation of SMEs on social and political priorities.

Box 6: The reinforced role of industry in Horizon Europe – Industrial Competitiveness

Strengthening the Union's scientific and technological bases and encouraging it to become more competitive, including in its industry, is an objective enshrined in Article 179 of the Treaty on the Functioning of the European Union. The Union and its Member States support industrial competitiveness by speeding up the adjustment of industry to structural changes, encouraging a favourable regulatory environment, encouraging an environment favourable to cooperation and fostering better exploitation of the industrial potential of policies of research and innovation (Article 173 of the Treaty on the Functioning of the European Union).

Horizon 2020 supports industrial competitiveness, as highlighted by the following facts:

- A 20% target exists for the total combined budget to be awarded to SMEs under the "Leadership in Enabling and Industrial Technologies" and "Societal Challenges" parts of Horizon 2020. By the end of 2017, this has been exceeded with almost 25% of the EU contribution awarded to SMEs[71].
- Private for-profit companies have been awarded 27% of the overall Horizon 2020 budget, amounting to EUR 6.7 billion.

Building on the strong support to stimulating industrial leadership and competitiveness currently provided, which will continue (e.g. the single funding rate for industry participants, partnerships with industry), the following changes in the new Framework Programme will reinforce it:

- **The whole Programme will contribute to industrial competitiveness.** This reflects the overriding aims of the Programme, in which industrial technologies reinforce scientific knowledge and tackle global challenges; in which industry, academia, public stakeholders, citizens and their associations (CSOs) are brought closer together; and which seamlessly supports the whole innovation ecosystem from research to innovation and market deployment.
- **Industry is a core enabler to solve Global Challenges.** Integration of the Leadership in Enabling Industrial Technologies programme parts, previously under the second pillar in Horizon 2020 ('Industrial Leadership'), within the Global Challenges and Industrial Competitiveness pillar would provide a higher visibility to the role of industry in solving Europe's major societal challenges, for instance through Key Enabling Technologies.
- **The "Digital and industry" cluster** will be dedicated to support innovative, sustainable and digital industries, including through Key Enabling Technologies for the future. This cluster is expected to address directly the issue of slow industrial transformation and promote adjustment of industry to structural changes.**Partnerships with industry will continue.** EU policy-driven R&I partnerships with industry are important for pooling resources in order to tackle big policy and societal challenges, to support competitiveness and jobs and to encourage greater private investment in research and innovation, amongst other things. Public-private collaboration with industry will continue as part of a simplified and more impact-focussed approach to European Partnerships (see section 3.2.5 below).

As a result, the expected implications for industry are:

- Europe's global leadership in various industries, especially in high value added and technology-intensive products and services, will hinge on its capacity to master the Key Enabling Technologies, in which the Framework Programme will continue to invest.
- Investing in new technologies through the Programme will enhance EU's industrial competitiveness in the global transition to circular and low-carbon economy, create new business opportunities including in export markets, and protect businesses against scarcity of resources or volatile prices.
- A broader perspective involving users and society at large (and more generally the demand side) in the design and development of innovative solutions to address global challenges will ensure ownership and commitment from industry and other stakeholders, as well as the buy-in from civil society.
- Bringing together activities on digital, key enabling, clean and space technologies, the Programme will allow for a more systemic approach, and a faster and more profound digital and industrial transformation.

In terms of design structure, some stakeholders[72] have identified the risk that merging the stand-alone "industrial leadership" pillar would discourage industry participation. On the other hand, a higher participation of industry in the Global Challenges and Industrial

[71] European Commission (2018), Annual Report on Research and Technological Development Activities of the European Union and Monitoring of Horizon 2020 in 2017.

[72] See Annex 2 on the Stakeholder Consultation.

Competitiveness pillar could be seen as giving the private sector a disproportionate role in setting the R&I agenda at the expense of other stakeholder groups. As a mitigation measure, the strategic planning process (see section 4.1), building on the lessons learnt from the inclusive programming process of Horizon 2020, will ensure a balanced approach by involving all stakeholders, including citizens, customers and end-users in agenda-setting. The Programme will also gain flexibility by a less prescriptive approach to defining R&I activities. This brings about a higher capacity to adapt to evolving political priorities and to respond to emerging, unforeseen challenges.

Box 7: Climate mainstreaming

Horizon 2020 legal basis provides a target of investing at least 35% of its budget for climate-related activities. The EP has asked for a thorough climate mainstreaming and underlined that the EU should not finance projects and investments that are contrary to the achievement of EU climate goals[73]. The European Court of Auditors recommends aligning EU spending and investment more closely with the Union's strategic priorities[74]. 14 Member States have signed a joint letter to the Commission on 5 March 2018 asking for a climate-friendly EU-budget.[75]

Horizon 2020 is a major contributor to the EU's target to mainstream climate action and sustainable development. While the expenditure target for climate action has not been met, the overall success of the mainstreaming approach has been confirmed by the Commission in the MFF Mid-Term Review[76], in the European Court of Auditors Special report 31/2016[77], in the related council conclusions[78], and by a targeted external report[79].

The EU has signed up to the Paris Agreement on fighting climate change, and has already set itself a target to reduce greenhouse gas emissions by at least 40% by 2030. It also made wider energy transition commitments as captured in the Energy Union and its implementation packages, such as the the European Strategy for Low-Emission Mobility[80] and the Clean Energy For All Europeans package[81].

In continuation with the provision set out in Horizon 2020 and line with the EU's international commitments, an ambitious goal for climate mainstreaming across all EU programmes has been set, with a target of 25% of EU expenditure contributing to climate objectives. To ensure its essential contribution to these objectives, Horizon Europe will continue contributing to climate action, including to clean energy transition in the EU. The programme is expected to contribute with 35% of its budget spent to climate objectives.

3.2 Improvements and their expected implications

In addition to the structure optimisations described in section 3.1, the key areas for improvement identified by the Horizon 2020 Interim Evaluation (see section 1.2) have been translated into novel features and enhancements of existing features. These improvements build on the foundations of the interim evaluations[82], findings of High Level Groups[83] and the work of scientific experts[84]. They were developed on the basis of analysis detailed in the

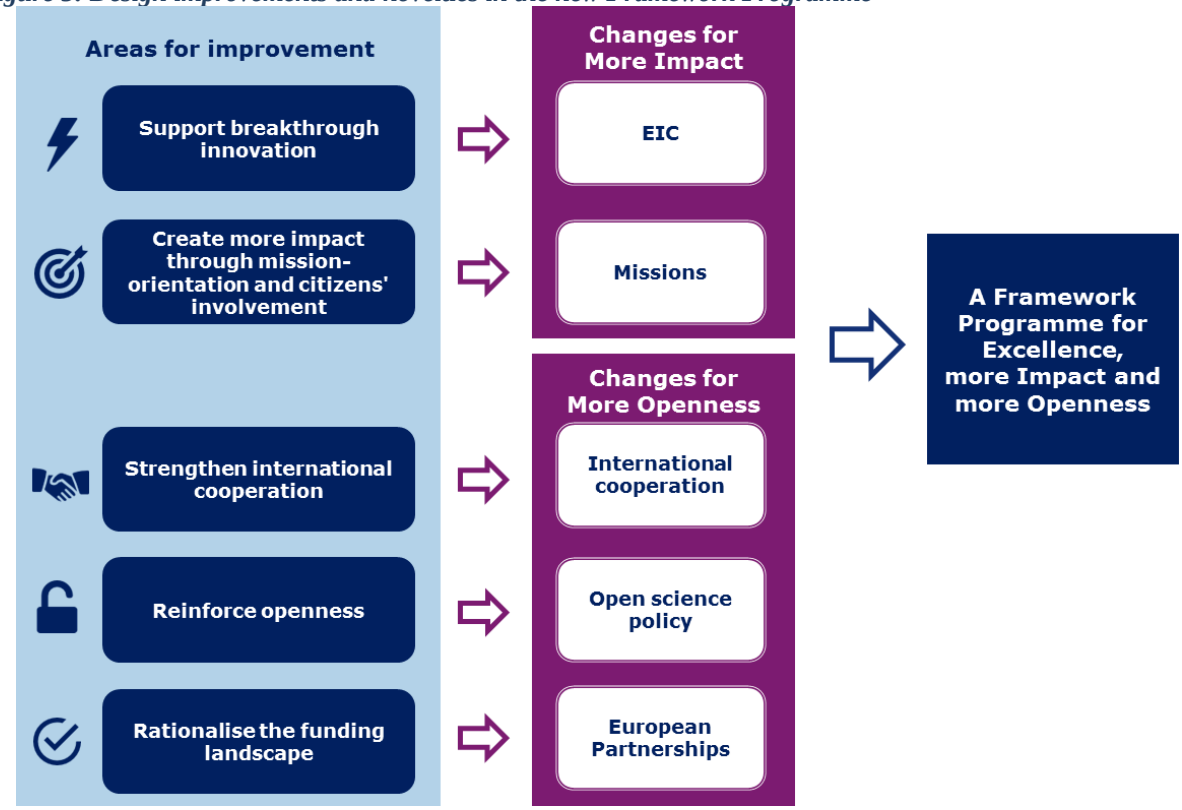
[73] European Parliament (2017), Resolution of 14 March 2018 on the next MFF: Preparing the Parliament's position on the MFF post-2020, ref. 2017/2052(INI).
[74] European Court of Auditors (2018), Future of EU finances: reforming how the EU budget operates, Briefing Paper.
[75] http://www.bmub.bund.de/en/service/details-europe-and-environment/artikel/statement-of-green-growth-group-2/
[76] http://ec.europa.eu/budget/mff/lib/COM-2016-603/SWD-2016-299_en.pdf
[77] https://www.eca.europa.eu/en/Pages/DocItem.aspx?did=39853
[78] Council conclusions 7495/17, adopted by ECOFIN on 21 March 2017, http://data.consilium.europa.eu/doc/document/ST-7495-2017-INIT/en/pdf
[79] https://publications.europa.eu/en/publication-detail/-/publication/1df19257-aef9-11e7-837e-01aa75ed71a1
[80] European Commission (2016), A European strategy for low-emission mobility, COM(2016)0501 final.
[81] European Commission (2016), Clean Energy for all Europeans, COM(2016)0860 final.
[82] Among others, the Interim Evaluation of the Joint Undertakings,Interim evaluation of the European Institute of Innovation and Technology, FET Flagships – Interim evaluation.
[83] In particular, the High Level Group on maximising the impact of EU R&I programmes and the Research, Innovation and Science Policy Experts (RISE) group.
[84] For the evidence used in this impact assessment, please refer also to Annex 1.

Annex 8, from among identified alternative ways to address the key challenges identified in section 2.2.

The significant improvements linked to the design of the programme (see Figure 5) will be covered in this section, along with their expected implications. While Horizon 2020 is already excellent, impactful and open, these changes will make the Framework Programme achieve even more impact (EIC and missions) and more openness (through strengthened international cooperation, reinforced Open Science policy, and a new policy approach to European Partnerships). Neither of these changes goes beyond what is necessary at EU level (proportionality test), and each one aims to increase the overall effectiveness, efficiency and coherence of the Programme (see Section 3.3 for an overview of how this is achieved). More details can be found in Annex 8, which also covers more gradual changes, e.g. linked to Sharing excellence.

Moreover, the lessons learnt linked to simplification have been taken up in the section on delivery for impact (Section 4 and Annex 9), while those related to synergies with other EU programmes were included in the upstream design of those programmes (see Annex 7).

Figure 5: Design improvements and novelties in the new Framework Programme



3.2.1 The European Innovation Council (EIC)

Why do we need it? There is a growing lack of equity funding for risky companies dealing especially with deep-tech products, in particular young, innovative firms and scale-ups in Europe. According to a recent study[85], the total equity funding gap in Europe is estimated at EUR 70 billion, of which 85% is represented by the so-called "first valley of death"[86]. The

[85] Deloitte (2016) Equity funding in the EU.

[86] The "Valley of Death" is commonly known as a market failure. "First valley of death" is associated to pre-commercial development of a product, with still high technical risks and unproven ability to generate revenue. Companies facing the "second valley of death" are in a more advanced stage of their lifecycle, and they are mainly looking for growth finance.

European Investment Bank estimates[87] that it would require around EUR 35 billion a year in additional venture capital for financing start-ups and growth-stage firms in the EU to match comparable US levels. Private investors are deterred by the lack of certainty, no cash flow generation, and unproven ability to scale-up rapidly. Such ventures need a sophisticated support ancillary to a grant, such as equity, guarantee, or other type of financing (tailor made blended finance, see section 4.5) to better de-risk them and bring them to a stage where they can be financed on usual commercial terms by investors.

What do we have now? Horizon 2020 provides some measures of targeted support to disruptive technologies and to innovative companies for bringing discoveries close to the market, with a quarter of Innovation Actions having breakthrough potential[88]. On the one hand, the FET instrument supports high-risk cutting-edge research projects aiming to bring about transformational change by opposition to incremental innovation. However it lacks an instrument to bring these disruptive innovations to the market. On the other hand, the SME Instrument focusses especially on product, performance, business model innovations and market uptake, but much less on service, network, and customer engagement innovations and does not provide for market deployment and scale-up. In Horizon 2020, the SME Instrument has provided EUR 1,332 million in grants to 3,239 SMEs supporting the technical and commercial feasibility of a business idea and the development of innovation with demonstration and scale-up purposes. Majority of the projects emerging from receiving SME Instrument grants are however still exposed to the "first valley of death" for their subsequent development, which is not covered by the SME Instrument. These projects still have investment requirements to fully develop and commercialise their products[89]. Overall, Horizon 2020 does not provide enough support to innovators, and in particular SMEs, to develop breakthrough technologies cutting across sectors to access market and scale up rapidly at EU level.

What did the other EU institutions say? The European Parliament stresses the importance of innovation support in general, and of disruptive innovation and scaling up in particular. Council Conclusions emphasise 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[90].

The majority of stakeholders commenting on the EIC are supportive and provide suggestions on its possible role, objectives and implementation. In general stakeholders expect the EIC to simplify the current support to innovation and act as an European accelerator. They note that the support to innovative SMEs and start-ups is essential to maximise Europe's potential for growth and socioeconomic transformation[91].

What changes? The Framework Programme will introduce the EIC under the Open Innovation Pillar to place the EU in the lead for breakthrough market-creating innovation[92].

However, private investors are deterred by unproven ability to scale-up rapidly and generate cash flow. In both cases technologies are seen too risky by private investors, and are, therefore, often not funded.

[87] European Investment Bank (2016) Restoring EU competitiveness p.36.

[88] European Commission (2017). Interim Evaluation of Horizon 2020, SWD(2017) 220, p.34.

[89] European Investment Bank (2018) Improving Access to Finance for Beneficiaries of the SME Instrument,.

[90] Ibid.

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

The EIC will support innovators with breakthrough ideas and market creating innovations that currently face high risks due to the fragmentation of the innovation eco-system, lack of risk finance and risk aversion[93]. The EIC will integrate, reorganise and expand activities previously carried out in Horizon 2020, such as in Access to Risk Finance (in synergy with the InvestEU programme), Innovation in SMEs (notably the SME instrument), Fast-track to Innovation as well as Future and Emerging Technologies (FET-Open).

The EIC will mainly implement two complementary instruments, offering a seamless support from research and innovation activities to market deployment and scaling-up of innovative companies. The Pathfinder for advanced research will be a grant-based instrument for early stage research on technological ideas that can bring about transformational change, to nurture spin-offs and potential market creating innovations. The Accelerator will be a financial instrument operating through tailor made blended finance (advances, reimbursable or not, equity, guarantees; see also section 4.5) in support of the development and the deployment of market-creating innovation and the scale-up of innovative companies, until they can obtain support from the InvestEU programme or be financed on usual commercial terms by private/commercial investors. The Accelerator will place a particular emphasis on innovations / spin-offs / start-ups generated within the Pathfinder, as well as from any other parts of the Programme such as the ERC, the EIT KICs and R&I missions. In de-risking the operations it supports, the Accelerator will also stimulate private investments in R&I while preserving competition in the internal market.

EIC business advisory services will complement these instruments in order to connect innovators with industrial partners and investors and provide them with other support services. A High-Level Advisory Board composed of entrepreneurs, corporate leaders, investors and researchers, will assist the Commission in the governance and have an outreach function with an ambassadorial role. For its launch, the EIC could be implemented with the support of an executive agency for some tasks. Subsequent development may however lead to establishment of a fully externalised solution, as one of the possible implementation scenarios (see Annex 8).

What is the EU added value? As for the Horizon 2020 Future Emerging Technologies and the SME Instrument, the continent-wide competition for ideas will ensure excellence and EU-gains. Moreover, only EU-level action has the capacity to tackle the persistent lack of large-scale venture capital. EU support will be more effective and more comprehensive (e.g. common regulation, fostering synergies with other EU programmes) compared to national or regional support. The EIC will focus on breakthrough innovations at European level, pooling resources and unleashing the potential of European and global markets for EU innovators[94]. The EIC will not replace national and private initiatives fostering breakthrough innovation, but instead it will increase the coherence of the overall innovation ecosystem by establishing a one-stop shop for high potential innovators and partnerships with national, regional and local innovation actors.

[92] Breakthrough market-creating innovations are defined in Horizon 2020 as radically new, breakthrough products, services, processes or business models that open up new markets with the potential for rapid growth at European (and global) levels, in contrast to incremental innovation (improvements to existing products for existing markets).
[93] Additional evidence provided in Annex 8 on the European Innovation Council.
[94] To this end, a level playing field among competitors is key to unleashing the innovative potential of companies (especially SMEs) for breakthrough or disruptive innovation to happen.

Figure 6 EU support to innovation (bottom-up and top-down)

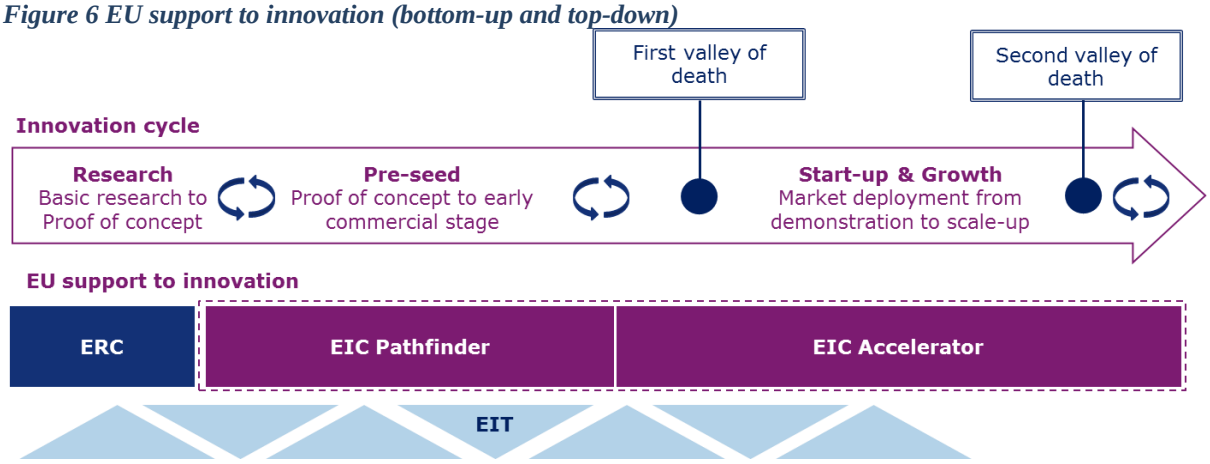


Table 2 Comparing the EIC with the ERC, EIT, and InvestEU

	European Innovation Council (EIC)	European Research Council (ERC)	European Institute for Innovation and Technology (EIT)	InvestEU
Key principles	Focus on excellence (attract best innovators) based largely on bottom-up approach, but also high-risk, breakthrough R&I activities that create markets and provide solutions to global challenges.	Focus on excellence (attract best researchers), based on bottom-up approach	Focus on knowledge triangle integration (education, research and innovation) that empowers innovators and entrepreneurs to solve global challenges through KICs	Focus on bankable projects, and expected return on investment. Implemented, through financial intermediaries (Banks, Venture Capital Funds, and other private investors)
Target group	Focus on the individual (the innovator), with high-growth potential (researchers, entrepreneurs, start-ups, SMEs and mid-caps), from single beneficiaries to multi-disciplinary consortia, but promote their incorporation and growth under late stage activities	Focus on the individual (the researcher)	Focus both on individual entities and on cooperation of businesses, education institutions & research organisations within KICs	Focus on entities that can borrow money or can sell shares.
Rationale	Remove constraints (field of innovation) for growth and scale-up	Remove constraints (field of science, collaboration partners)	Reinforce R&I ecosystems in specific areas (knowledge exchange and networks, entrepreneurship, skills); support innovators to start and accelerate new businesses; provide talent through entrepreneurial	Leveraging private sources of finance. Address market gaps and sub-optimal investment situations.

			education	
Evaluation and Selection	Selection by peers (scientists and innovators) and investors based on excellence, the impact (marketability), and the level of risk	Selection by scientific peer review	Selection of KICs by EIT Governing Board; KICs business plans (i.e., innovation and education activities, projects) assessed by panel of experts appointed by EIT	Selection by financial intermediaries through due-diligence process.
Types of Action	Grants (Pathfinder) and combination of grant-type advances and equity or financial guarantees (Accelerator). Projects may be amended or terminated if milestones are not met, seeking alignment with private investors	Long-term grants with guaranteed funding	Grants to KICs partnerships + complementary activities (incl. education & entrepreneurial programmes)	Equity finance, mainly focusing on risk-capital funds and debt finance in the form of loans and guarantees.

What are the risks? Firstly, in giving priority to potential impact rather than return on investment, the EIC will promote long-term operations too risky to attract private investors. In recent years, these risks have increased due to the more multi-disciplinary nature of R&I and the intrinsic complexity and systems nature of many emerging technologies. If the risk of failure of projects under the EIC is more pronounced, even higher is the potential benefit of generating new markets that are essential for the future of the Union and its citizens, e.g. deep-tech based areas of future growth and jobs such as clean and efficient new energy sources, block-chain, artificial intelligence, genomics and robotics. Secondly, there is a potential risk of conflict of interest linked to the involvement of experts, which will also be innovators and/or investors themselves. Safeguards will be put in place, for example by preventing them to invest into EIC supported companies, or similar provisions.

Box 8: EU Added Value of mono-beneficiary instruments

The Horizon 2020 interim evaluation showed that the quality of R&I improves through EU-wide competition. This is an important element of EU added value, notably in areas where mono-beneficiaries are the norm, like the SME Instrument and the ERC. The EU added value of the ERC from its exclusive focus on excellence through competition helped it become a global beacon of excellence. Similarly, an in-depth evaluation study of the SME Instrument[95] positively assessed its EU Added Value: it is unique compared to similar support schemes at national/regional level (which are only focusing on certain priority domains; do not have rolling submissions; have significantly smaller project volumes; require project collaboration with other SMEs or universities).

What are the expected implications?

- **More innovations that create the new markets of the future**. Giving more prominence and visibility to breakthrough innovation, the EIC will attract the Europe's best innovators. The selection process by peer-

[95] Technopolis (2017), Evaluation of the SME instrument and the activities under Horizon 2020 Work Programme "Innovation in SMEs".

scientists and innovators and investors will enable risk-taking, hence providing support to radically new initiatives in uncharted territories. The EU could become the home of up to a third of leading innovators in major areas for breakthrough deep tech innovation[96] such as Artificial Intelligence, biotech, and augmented/virtual reality and to leading innovators addressing global challenges.

- **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. The EIC will also target innovative companies with a great potential for scaling up, offering them co-investment to become larger and increase their markets. The support to innovative companies and in particular SMEs will increase their market valuation, employment, and turnover.

- **Increased complementarities between grant-type funding, financial instruments, and leverage from private investment.** Under the Accelerator, blended finance will 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. Combined with activities undertaken by the (InvestEU Programme) this alignment of interests with private investors will provide improved access to venture capital and risk finance, hence leveraging the overall volume of finance available for innovation..

- **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 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.

3.2.2 Research and Innovation Missions

Why do we need it? As underlined by the Interim Evaluation of Horizon 2020[97], the current EU research and innovation programme does not fully prioritise investments with the highest overall impact and added value for Europe, as expected impact is defined only at the level of individual call topics. This leads to fragmentation and a dilution of impact. The consequent lack of focus on societal impact also results in a low level of public awareness and engagement in EU-funded R&I. This implies that current EU investments in R&I are not sufficiently responsive to, or connected with, the needs of citizens.

[96] Ibid.
[97] European Commission (2018), Communication on the Horizon 2020 Interim Evaluation, COM(2018)2 final, p. 7. See also the specific recommendation in the Lamy High Level Group report on "adopting an impact-focused, mission-oriented approach" in future EU research and innovation programmes (LAB-FAB-APP, Investing in the European future we want, Lamy High Level Group Report (2017), p. 15-16.

What do we have now? Horizon 2020 featured over 20 Focus Areas in key domains, where priorities cut across different parts of the programme (e.g. blue growth, circular economy, digital security), to concentrate resources and efforts. While focus areas reinforced the programme's coherence and its capacity to provide interdisciplinary solutions to multiple societal challenges, their multiplication also resulted in some confusion. Moreover, citizens were not involved in the process, and limited coordination of the focus areas undermined their impact. Nor did they set achievable and time-bound goals.

What did the other EU institutions say? All EU Institutions stress the importance of involving citizens more profoundly in the co-design and co-creation of R&I contents to maximise the impact generated by the Framework Programme[98]. The European Parliament recognises the importance of society playing a more active part in defining and addressing the problems, and in jointly putting forward the solutions. The Committee of the Regions is calling for the adoption of a new, complementary approach based on missions and for greater importance of science-society actions. The European Economic and Social Committee calls for increased involvement of Civil Society Organisations in the Framework Programme. The Council Conclusions and the European Research Area and Innovation Committee (ERAC) point to the need to deliver better and continued outreach to society, and call for exploring a mission-oriented approach[99].

Almost all stakeholders referencing R&I missions clearly supported mission-orientation of Horizon Europe or acknolwedged it as a possible future scenario. In general, stakeholders consider that tangible missions that underpin the overall political objectives could enhance visibility and create a more engaging narrative of the Framework Programme. There is also a widespread acknowledgement on the need to engage wider society in identifying the most relevant missions within broader societal challenges. [100]

What changes? Horizon Europe will introduce a limited number of highly visible R&I missions. Missions will replace and build on the Horizon 2020 Focus Areas. They will be well-defined[101] and self-standing programme parts, as opposed to the Focus Areas. This will more clearly and directly incentivise cross-sectoral and cross-disciplinary cooperation. Clear objectives and rationale will be established at the mission's inception (addressing a specific weakness identified in the focus areas approach) in order to define targets, clear time-bound goals and expected impact. Finally, missions will be more closely co-designed with end-users and citizens, thus prioritising public engagement and involvement and "building upon existing work and prior commitments to bring societal actors together to prioritise R&I activity"[102].

Different types of missions can be envisaged, for example missions to accelerate progress towards a set technical or societal solution, focusing large investments on a specific target (e.g. accelerate market uptake of post Li-ion energy storage solutions) or missions for transforming an entire social or industrial system within an established timeframe (e.g. transformation of the entire energy system or mobility system in cities). Evidence indicates

[98] Democratic Society (2018), "Citizen Participation in FP9: A model for mission and work programme engagement". See p.18-19 for a more detailed overview.
[99] Ibid.
[100] Griniece, E. (2018), Synthesis of stakeholder input for Horizon Europe and European Commission analysis.
[101] 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).
[102] Democratic Society (2018), p.18.

that a combination of approaches would be most suited to the scale of EU-level missions and the complex challenges which they will address[103].

Missions will be selected (after the launch of Horizon Europe) according to the following selection criteria[104]:

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

At the implementation stage, Mission Boards for each mission will ensure proper involvement of stakeholders and end-users. 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[105] while also ensuring societal ownership of the missions [106].

What is the EU added value? Setting R&I missions at EU level gives them the critical mass necessary to address global challenges. They will help the EU to better deliver on Sustainable Development Goals and its strategic policy priorities. Setting R&I missions at EU level would also facilitate ensuring that the EU regulatory framework fully supports the achievement of such an EU mission, for instance through applying the innovation principle, setting standards at EU level, or through joint public procurement at EU level. Missions can involve end-users and citizens much more closely in EU R&I activities.

What are the risks? The success of missions hinges on the timely and due dialogue with stakeholders, to avoid disengagement or weak interest. Moreover, in the implementation phase, the evaluation and monitoring mechanisms will need to be sophisticated enough to capture the long-term impacts of missions. Finally, the ultimate uptake and roll-out of innovative solutions arising from missions will depend on wider framework conditions – this kind of wider support to uptake can be supported through policy actions in the spirit of the Inovation Principle, or through Innovation Deals[107].

What are the expected implications?

[103] "There is much evidence that EU scale R&I missions would be best serves in a hybrid model (including or combining accelerator and transformer elements), that is flexible in addressing different types of challenges and different levels of complexity, while at the same coordinating and concentrating the effort and resources towards the commonly agreed objectives". Joint Institute for Innovation Policy (2018), Mission-Oriented Research and Innovation: assessing the impact of a mission-oriented research and innovation approach.

[104] Mazzucato M. (2018), Mission-Oriented Research and Innovation in the European Union: A problem-solving approach to fuel innovation-led growth.

[105] This is identified as a key characteristic of the most successful mission-like initiatives across the world. See: Joint Institute for Innovation Policy study.

[106] "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". Joint Institute for Innovation Policy study.

[107] https://ec.europa.eu/research/innovation-deals/index.cfm

- **Improved cross-sectoral and cross-disciplinary cooperation**. Missions will require expertise from different sectors and disciplines to come together. For example, climate action requires meaningful collaboration across sectors such as urban planning, construction, energy efficiency in buildings, mobility, behavioural aspects, food, environmental capacity, and in many other areas. The mission-oriented approach will work across clusters to promote system-wide transformation.

- **Increased impact on global challenges and EU policy priorities**. Missions will increase effectiveness in delivering societal impact for end-users and citizens, by prioritising investments and set directions to achieve objectives with societal relevance. Missions will set the direction for the EU regulatory framework, and leverage further public and private sector R&I investments in Europe.

- **Reduced gap between science/innovation and society.** R&I missions will be easy to communicate, in order to mobilise citizens and end-users in their co-design and co-creation (e.g. through citizen science and user-led innovation). In turn, this increases the relevance of science and innovation for the society and it would stimulate the societal uptake of innovative solutions and leverage business investment.

3.2.3 International cooperation

Why do we need it? International cooperation in R&I is vital for ensuring access to talent, knowledge, know-how, facilities and markets worldwide, for effectively tackling global challenges and for implementing global commitments[108].

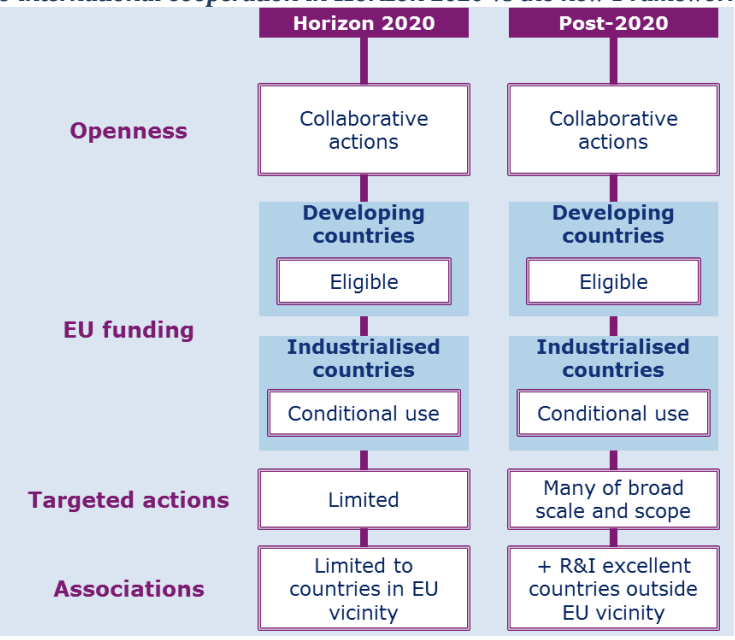
What do we have now? Association to the programme is limited to countries geographically close to Europe. Organisations from non-associated third countries can participate in projects in all parts of the programme, except for mono-beneficiary grants, specific close-to-market innovation activities and actions for access to risk finance. 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 third-country entities whose participation is deemed essential for carrying out an action.

What did the other EU institutions say? The Council and the European Parliament have called for strengthening international R&I cooperation in the Framework Programme, including with associated countriesand emerging countries, as soon as possible through concrete actions. The Parliament, in addition, has highlighted the value of science diplomacy. Council Conclusions have also reaffirmed the importance of reciprocity.

A predominant view among stakeholders is that cooperation should be strengthened to counter the drop in internationalisation activities and participation rates from third countries that was experienced in Horizon 2020. Some stakeholders also advocate science as a platform for international diplomacy. A few stakeholders noted that EU could adopt legislation to encourage exploitation of research and innovation results in Europe first[109].

[108] European Commission (2018), Communication on the Horizon 2020 Interim Evaluation, COM(2018)2 final, p. 8.
[109] Griniece, E. (forthcoming) Synthesis of stakeholder input for Horizon Europe and European Commission analysis .

Figure 7: Approach to international cooperation in Horizon 2020 vs the new Framework Programme



What changes? The Framework Programme will intensify cooperation in line with the strategy for EU international R&I cooperation and the "Open to the World" R&I priority[110]. The programme will 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. The programme should increasingly invite partners from the rest of the world to join EU efforts as an integral part of initiatives in support of EU actions for sustainable development; it should provide more support for activities that facilitate the collaboration of European researchers with their counterparts worldwide, enable international mobility of researchers and ensure access to research infrastructures globally; and it should extend support to joint and coordinated funding of global industrial research and innovation 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. The programme will intensify support to international flagships, partnerships, bilateral and multilateral initiatives and joint programmes and calls, to increase access to researchers, knowledge and resources worldwide and optimise benefits from cooperation.

Box 9: Third Countries associated to the Framework Programme

- The Framework Programme will define which countries will be able to apply for association, what criteria should be used to assess their applications, and what principles should apply for the terms and conditions regarding their participation.
- Each Association Agreement to the Framework Programme should define the scope, specific terms and conditions of participation, as well as the rules governing the financial contribution of the associated country. These rules should ensure a close approximation between payments and returns.

What is the EU added value? Openness of the Framework Programme to third countries enhances the EU added value of the Programme itself, allowing EU participants to

[110] See Annex 10 on the Implementation of the strategy for international cooperation in R&I.

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. Increasing international cooperation does not go beyond what is necessary to achieve the objectives of the programme.

What are the risks? The main risk is that the proposed specific objective, priorities for actions and instruments to be used will not be sufficient for strengthening international cooperation in the Programme compared to the current situation. Regarding the process, there is also the risk that European objectives both in terms of global challenges and competitiveness take less of a driving role in priority-setting when more international partners are involved. International S&T cooperation policy dialogues and broad consultations should ensure that international joint actions are strategically designed in line with EU interests and agreed with international partners based on mutual interest and common benefit.

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[111].

- **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 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 proven 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.

[111] 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.

3.2.4 Open Science policy

Why do we need it? The next Framework Programme should fully embrace Open Science as a way of strengthening scientific excellence, benefiting from citizen participation, achieving better reproducibility of results and increasing knowledge circulation and the re-use of research data[112], hence accelerating the take-up of R&I knowledge and solutions and increasing the EU policy and societal impact of the Framework Programme.

What do we have now? There is a shift towards a more open, collaborative, data-intensive and networked way of doing research and sharing research results, enabled by developments in ICT and related infrastructures and the increasing proliferation of data. Open access to publications is mandatory, while 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. Participation in the Open Research Data Pilot is the default for Horizon 2020 projects, and it requires a Data Management Plan and open access to research data, but there are solid conditions to opt-out from the Pilot at any stage.

What did the other EU institutions say? The European Parliament opinion is in favour of the general principle of Open Access, while the European Research Area and Innovation Committee (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[113].

The majority of stakeholders who referred to Open Science note that data and knowledge produced from EU funded projects should be shared openly. However, some business representatives underlined the need for the opt-out option to be maintained to secure confidentiality of market-oriented innovation outputs. Stakeholders also highlight that open science, open data and open access calls for new principles in citation and academic reward system and requires attention to the development of skills in research data management[114].

What changes? The Framework Programme will fully embrace and support Open Science policy as the new research *modus operandi* through various requirements in the Work Programmes. It will go beyond the open access policy of Horizon 2020, requiring immediate open access for publications and data (with robust opt-outs for the latter), and research data management plans to support sound data management; it will foster the proliferation of FAIR data (findable, accessible, interoperable and re-usable). It will support activities that promote a sustainable and innovative scholarly communications ecosystem; it will foster activities for the enhancement of researcher skills in open science and support reward systems that promote open science; it will integrate research integrity in the open science activities and support citizen science. Lastly, it will also support the introduction of next generation indicators for the assessment of research.

[112] European Commission (2018), Communication on the Horizon 2020 Interim Evaluation, COM(2018)2 final, p.9.
[113] Ibid.
[114] Griniece, E. (forthcoming) Synthesis of stakeholder input for Horizon Europe and European Commission analysis .

What is the EU added value? Even while Member States are developing their own policies for Open Science, the positive effect of EU action is substantial[115]. Horizon Europe will contribute towards policy alignment across the Member States and thus towards the development of a better and more unified environment for research collaboration in ERA and beyond it. Requirements of the Programme have structuring effects that accelerate the propagation of Open Science policy via collaborative projects in the research community. Horizon Europe will accelerate the transition towards Open Science by building a European Open Science Cloud supported by world-class infrastructure that will gradually also benefit industry and the public sector.

What are the risks? The main concern on Open Science in Horizon Europe relates primarily to the requirement for open access to data from research projects. Without clearly explained safeguards, this policy could be perceived as deterrent for industry and businesses to participate. This is why, while open access to research data will be the standard, Horizon Europe will be fortified with robust exceptions to this rule, where access to data needs to be protected and Intellectual Property Rights protected. The principle that research data has to be 'as open as possible, as closed as necessary' will be emphasised every time it is necessary. A concern shared also at the time of Horizon 2020 is that the development of open access in Europe may offer content paid by European taxpayers for exploitation to the entire world, and therefore advantages other countries for more severe competition in research and innovation. The Commission is not the only funder with such open access and open science policy requirements. Funders across the globe are aligned in mandating open access to publications and data and relevant open science policies. It is not expected that Europe will set itself into a comparative disadvantage in this way, vis-à-vis other countries across the world.

What are the expected implications?

- **Increased 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 circulation and the reuse of results, improves science communication and enables interdisciplinary research.

- **Increased accessibility to high quality digital content**. Data are increasingly becoming the starting point for innovation, with high returns[116]. 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.

[115] The effect of emulating or aligning Member States funding policies to match these of Horizon 2020 with respect to open access is clearly reported by Member States in the National Point of Reference (NPR) report of 2015) and can be seen in many instances, for example in aligning embargo periods (p. 16). Similar trends can be observed in the 2017 NPR report, where 2/3 of Member States report that the 2012 Recommendation for Open Access to and Preservation of Scientific Information has had significant impact on national policies.

[116] https://ufm.dk/en/publications/2018/preliminary-analysis-introduction-of-fair-data-in-denmark

- **Higher societal and policy impact**. Open science policy 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. Accessible R&I data and results can be used for evidence-based policy-making, therefore they contribute to strengthening the policy role of R&I.

3.2.5 European Partnerships

Why do we need it? The European R&I partnership landscape grew significantly in size and complexity over the last decade with an increasing risk of overlap and non-coherence with the EU framework programme and between the partnerships themselves. In particular, there is a large number of Public-Public Partnership initiatives (currently close to 100). Still, Partnerships are key to achieving policy objectives that the Framework Programme alone cannot achieve. Reforming the current partnership landscape and improving the design and implementation of future European Partnerships, renewed or newly set-up, should make it possible to use their full potential in achieving ambitious policy objectives.[117]

What do we have now? Horizon 2020 supports two broad categories of partnerships: those mainly involving industry, i.e. Article 187 initiatives or Public-Private-Partnerships (PPPs) and contractual PPPs (cPPPs); and those involving mainly Member States, i.e. Article 185 initiatives or Public-Public-Partnerships (P2Ps), ERA-NET Cofund, European Joint Programming-Cofund and Joint Programming Initiatives. Moreover, there are other types of mixed partnerships such as the Knowledge and Innovation Communities (KICs) of the European Institute of Innovation and Technology (EIT) (integrating the knowledge triangle) and the Future and Emerging Technologies Flagships.

What did the other EU institutions say? The Competitiveness Council Conclusions stressed 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 Research Area and Innovation Committee (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 European Parliament advocates 'decomplexifying' the EU funding landscape[118].

A large share of stakeholders submiting position papers is concerned by the complexity of the EU R&I funding landscape. A dozen stakeholders explicitly emphasise the fact that exsisting support schemes should be carefully evaluated, and the discontinuation of funding should be an option (i.e. sunset clauses).[119]

What changes? An overall European Partnerships strategy based on an objective- and impact-driven intervention logic will be developed and implemented in order to ensure that partnerships are established or renewed[120] only in cases where impacts need to be created that cannot be achieved by other Framework Programme's actions or national action alone. All future European Partnerships will be designed based on the principles of Union added value,

[117] European Commission (2018), Communication on the Horizon 2020 Interim Evaluation, COM(2018)2 final, p. 9.
[118] Ibid.
[119] Griniece, E. (forthcoming) Synthesis of stakeholder input for Horizon Europe and European Commission analysis .
[120] Specific partnerships, whether new or renewed, are not included in the legal proposal of the Framework Programme.

transparency, openness, impact, leverage effect, long-term financial commitment of all the involved parties, flexibility, coherence and complementarity with Union, local, regional national and international initiatives.

The strategic planning process of the Framework Programme (see section 4.1) 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.

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 criteria set out in the Framework Programme. They 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-programmed European Partnerships between the EU, Member States, and/or other stakeholders, based on Memoranda of Understanding or contractual arrangements with partners; ii) co-funded European Partnerships, based on a single, flexible programme co-fund action for R&I activities; iii) institutionalised European Partnerships (based on Art. 185 or 187 TFEU, and EIT regulation for KICs). Following a life-cycle approach[121] the legal act will set out the criteria for the selection, implementation, monitoring, evaluation and phasing out of all European Partnerships.

What is the EU added value? The main added value derives from the additional private and public R&I investments on EU priorities (additionality and leverage), the alignment of these investments towards common objectives (directionality) and the achievement of impacts that cannot be created by other Framework Programme actions or national action alone. In addition, the revised policy approach will substantially improve the coherence between European Partnerships and the Framework Programme in general, based on clear criteria identified together with Member States and other stakeholders. EU investments in R&I will be simpler to communicate and understand for stakeholders. The approach will build on, and bring together, all the on-going and future partnerships.

What are the risks? The major risk for the new policy approach is considered to be the expectations from the current partnerships to continue on a business as usual approach and expect more or less automatic renewal without being in line with the criteria set. It is crucial to ensure early involvement of Member States and stakeholders, including currently active initiatives, in the strategic programming process to build trust and ownership on the agreed future priorities.

What are the expected implications?

[121] As proposed by the ERAC ad-hoc working group on partnerships (2018)

- **Improved coherence and simplification.** The 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 will guide the establishment of the next generation of partnerships. This will lead to a smaller number of more coherent partnerships and improve the overall coherence of the European R&I ecosystem.

- **More openness and flexibility.** Partnerships will be open to all types of stakeholders (Member States, civil society/foundations, industry, including small and medium sized enterprises) with no entrance barriers for newcomers and smaller R&I players. Flexibility will be encouraged with a simplified toolbox, and a lifecycle-based planning and implementation approach.

- **Enhanced impact of EU R&I funding.** The new approach to partnerships will ensure that partnerships will only be established in cases where desired impacts cannot be created by other Framework Programme's actions. As EU co-funding will be limited to agreed EU strategic priorities, including EU R&I missions, the overall impact of EU R&I funding will be increased by leveraging additional investments on EU policy priorities, by providing 'directionality' to these investments, and by reaching out to a broader set of stakeholders.

3.3 Overall impact on the new Framework Programme

Impact is expected to be even higher than for the current Programme, because of improved programme-design novelties, increased internal coherence between Programme pillars, with more focus on cross-disciplinary, cross-sectoral and cross-policy activities, increased synergies with the MFF programmes, rationalisation, more user-friendly modalities, increased openness to all stakeholders, more flexibility and efficient delivery mechanisms, including a more effective dissemination and exploitation of R&I results.

The EIC which aims to capitalize on EU science strengths and improve transition from science to breakthrough innovation, (i.e. innovation with highest impact) is expected to be particularly effective in assisting companies along their innovation journey by offering innovators seamless support (from grants to blended finance, from early stage research to market uptake). Missions which aim to set ambitious goals and channel EU R&I investment to areas with highest added value (i.e. highest impact) would allow the Programme to deliver better on EU strategic challenges; support the implementation of EU policy priorities; improve the contribution to EU policy-making; increase cross-sector and cross-disciplinary cooperation; and improve the societal uptake of innovative solutions based on better communication with, and involvement of, citizens. Strengthening international cooperation would foster R&I by attracting even more of the world's top innovators, knowledge-intensive companies, scientific organisations and researchers. Strengthening open science policy should create and diffuse better high-quality knowledge, while better involving and informing citizens. The integrated approach for partnerships would improve leverage of, and alignment to, Member State and private investments.

Table 3: Effectiveness of the changes to the Programme

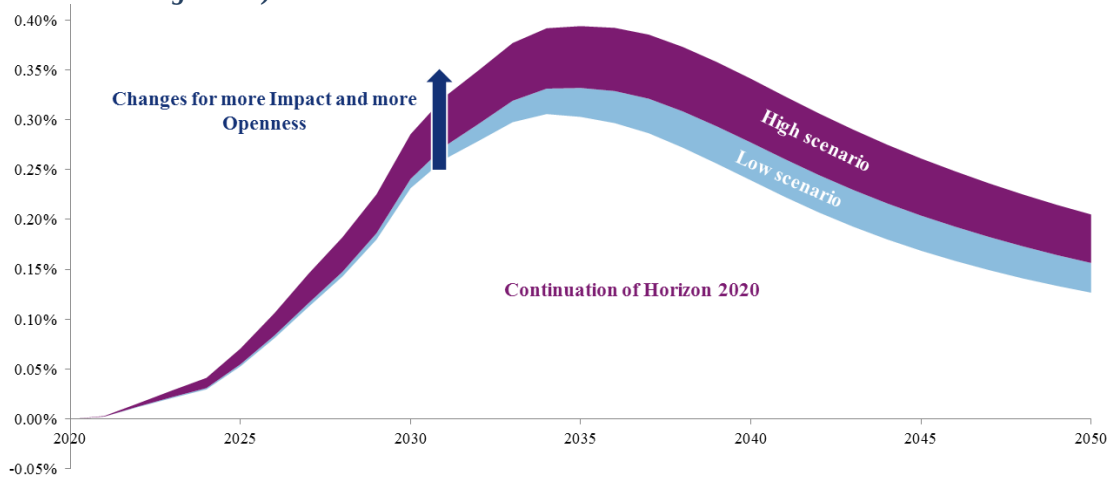
Changes	Objectives of the Framework Programme				MFF cross-cutting objectives				
	Support the creation and diffusion of high-quality knowledge	Strengthen the impact of R&I in developing, supporting and implementation EU policies	Foster innovation	Optimise the Programme's delivery for impact within a strengthened ERA	Simplification	Flexibility	Coherence	Synergies	Focus on performance
Structure	0	0	0	+	+	+	+	0	0
EIC	+	+	+++	++	+	++	+	+	++
Missions	+	+++	+	++	+/-	+	++	++	++
International cooperation	++	+	+	+	0	0	0	0	+
Open Science policy	++	+	+	+	0	0	+	0	0
Partnerships	+	++	+	++	++	+	+	+	+

Note: +, ++, +++ correspond respectively to slight, moderate and significant improvement compared to a no-policy change scenario. +/- correspond to a coexistence of positive and negative impacts. 0 means no significant change.

Horizon Europe is expected to generate more substantial economic benefits. Compared to the baseline (Section 2.1), the improvements will increase the overall impact, with different possible scenarios depending on how R&I leverage, diffusion and economic performance will react to these changes. Illustrative results from the NEMESIS model[122] (see Annex 5) show that the estimated GDP gains for the EU compared to the baseline can range from +0.04% in a low scenario to +0.1% in a more optimistic scenario (direct and indirect effect). The total impact of the Programme on EU GDP could range from EUR 30 billion to EUR 40 billion per year over 25 years (EUR 800 billion to EUR 975 billion in total)[123].

[122] The impacts of the changes were quantified based on the NEMESIS model only. As shown in Annex, 5, the QUEST and RHOMOLO models provide lower results in terms of GDP gain for the baseline scenario.
[123] Seureco (forthcoming) Support for assessment of socio-economic and environmental impacts (SEEI) of European R&I programme,.

Figure 8: Impact of the changes compared to the baseline (GDP gain, compared to a situation without Framework Programme)



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

Horizon Europe will deliver more value for money. Figure 8 shows that the future Programme is expected to generate even more economic benefits due to the improvements in the programme structure and design, which together with more delivery for impact (see section 4) will ensure that the Programme will be cost-effective.

Table 4 Economic costs and benefits of Horizon Europe

Economic Benefits[124]		Costs[125]	
Leverage of R&I investment	EUR 6-7 billion over 2021-2027	Submitting proposals	Cost for beneficiaries: About EUR 650 million per year[126]
GDP gain	720 to 975 billion over 25 years	Administrative burden (reporting obligations)	Cost for beneficiaries: EUR 0.9-2.3 million per year[127]
Employment	Direct benefit: Over 100 thousand jobs in R&I activities around 2027 Indirect benefit: Over 200 thousand jobs around 2035	Management of projects and proposal evaluation	Cost for administrations: EUR 500-600 million per year[128]

[124] These benefits are estimated after 2021 based on the NEMESIS model. Source: Seureco (forthcoming) Support for assessment of socio-economic and environmental impacts (SEEI) of European R&I programme,.
[125] Costs are based on Horizon 2020 figures.
[126] The Interim Evaluation of Horizon 2020 shows that the estimated cost for applicants to write proposals is EUR 1908.9 million or EUR 636 million annually. Of these costs, it is estimated that EUR 1.7 billion would be spent on writing proposals that do not get funded, including EUR 643.0 million for non-funded high quality proposals alone.
[127] The administrative burden of reporting obligations were estimated based on the standard cost model. The total burden is obtained by multiplying: (1) Average personnel cost per hour: based on data from the R&D surveys (Eurostat), the average cost of R&D personnel per FTE R&D staff is EUR 4927 per month in the EU. Based on this, a gross salary range of EUR 4000-6000 per month is assumed for the calculations (20% around the EU average). This corresponds to an hourly wage of EUR 25 to 37.5 per hour. In line with the better regulation guidelines, the hourly pay to be used in the standard cost model corresponds to this gross salary plus overhead costs (25%). This gives a range of EUR 31.25 to 46.88 per hour. (2) Time required per reporting obligation: the duration of the tasks required to fulfil a reporting obligation is estimated to range between 4 and 8 hours. (3) Number of projects: about 11,100 projects were launched during the first three years of Horizon 2020. This corresponds to 25,900 over 7 years. (4) Number of reporting obligations: based on data from Horizon 2020 projects, an average of two reporting obligations per project is assumed.
[128] The administrative expenditure related to the evaluation of proposals and the management of projects is below 5% of the budget. More extensive use of executive agencies since 2014 (REA, ERCEA, INEA and EASME) promoted economies of scale and increased synergies. As a result, administrative expenditure was drastically reduced (compared to 6% in FP7). At the same time, the level of client satisfaction is very high. Therefore, a rate of 5% is a reasonable assumption for the next Framework Programme. This corresponds to an estimated cost of EUR 500 to 600 million per year.

Lastly, these effects will be amplified by strengthened synergies and complementarities with other EU Programmes (see Annex 7). This will entail for example stronger alignment of priorities; clearer complementarities; more flexible co-funding schemes to pool resources at EU level; common strategic planning processes to allocate funding; greater alignment between applicable rules; and eligibility of R&I high-quality proposals for funding by other EU programmes (e.g. Seal of Excellence, co-funded European Partnerships), stronger involvement of existing networks at EU level (e.g., the Enterprise Europe Network). Portfolios of R&I results will be made available for EU regions for potential uptake based on their specific needs, thus maximising the benefits coming from synergies with EU initiatives, for increasing regional competitiveness and innovation. This will maximise the impact of investments, speed up market uptake and the development of a comprehensive R&I ecosystem. Moreover, the Framework Programme will deepen links with EU policy priorities by bringing R&I results into policy-making, with full involvement of sectoral policy-makers.

Box 10: Market uptake

Improving market uptake of innovative solutions is a broad concept encompassing various activities, which help R&I-driven innovation to succeed on the market and create new value for market players and consumers/citizens alike. However, market uptake goes beyond R&I. Therefore, activities under the Framework Programme alone cannot suffice to incentivise broad market uptake and dissemination of innovative solutions. Other EU programmes need to also play a key role (see Annex 7 on Synergies).

What does Horizon 2020 currently do for market uptake?

- Supports the development of innovative solutions until demonstrators and pilots (introduction of a first-of-its-kind innovation in the EU).
- Speeds up the introduction of innovations on the market and supports coaching and mentoring of companies.
- Provides support to closer-to-market activities, including the launch and scale-up of innovative companies, without distorting competition within the EU.
- Supports public demand for innovative solutions, through Public Procurement for Innovation and Pre-Commercial Procurement. This support is limited to the coordination costs between procurers.
- Develop standards for innovative products and services, but with limited progress so far.

What can the Framework Programme do more for market uptake?

- Ensure market uptake is considered at the phase of proposal development, fostering applicants to co-create/experiment their research and solutions with users from the outset, to ensure improved fit to the final needs, including within the KICs co-location centres;
- Support innovation actions and the demonstration of technological and non-technological innovative solutions of a first-of-a-kind nature in Europe with potential for replication;
- Establish pipelines of innovative solutions (originated from R&I projects) targeted to public and private investors, including the EIC's Accelerator and other EU programmes;
- Support to roll out and replication of innovative solutions with cross-border and transnational dimension;
- Support to pre-commercial procurement and public procurement of innovation is maintained;
- Support with the EIC the deployment of market-creating innovations and the scale-up of start-ups, innovative SMEs and mid-capital firms with breakthrough potential to create new markets by blended finance of grants and financial instruments under the EIC;
- 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 EU programmes for further implementation
- Support non-technological innovations (social innovation, business model innovation, public sector innovation etc.) including innovative delivery mechanisms.
- 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.
- Provide holistic support throughout the dissemination and exploitation lifecycle to ensure a constant stream of innovations stemming from the Framework Programme.
- Put in place an ambitious and comprehensive dissemination and exploitation strategy for increasing the availability of R&I results and accelerating their uptake to boost the overall impact of the Framework Programme and the European innovation potential.

3.4 Critical mass

Achieving critical mass is key for the efficiency and effectiveness of the Programme[129]. Horizon Europe cannot work effectively if it is not able to fund a sufficiently broad portfolio of relevant technologies and a sufficiently large range of complementary R&I projects that can build on each other and contribute to the objectives of the Programme. Reaching critical mass means that the Programme should be able to fund projects large enough to bring together across countries, sectors and disciplines, all partners and resources required to achieve the targeted objectives. Critical mass is also needed to support large-scale initiatives, preparing full market deployment of solutions in areas like batteries, infectious diseases, smart and clean buildings and vehicles, low-emission technologies, circular economy, solutions for plastic waste, and connected/automated cars. Ambitions will have to be scaled back equally across the Programme if critical mass would not be available.

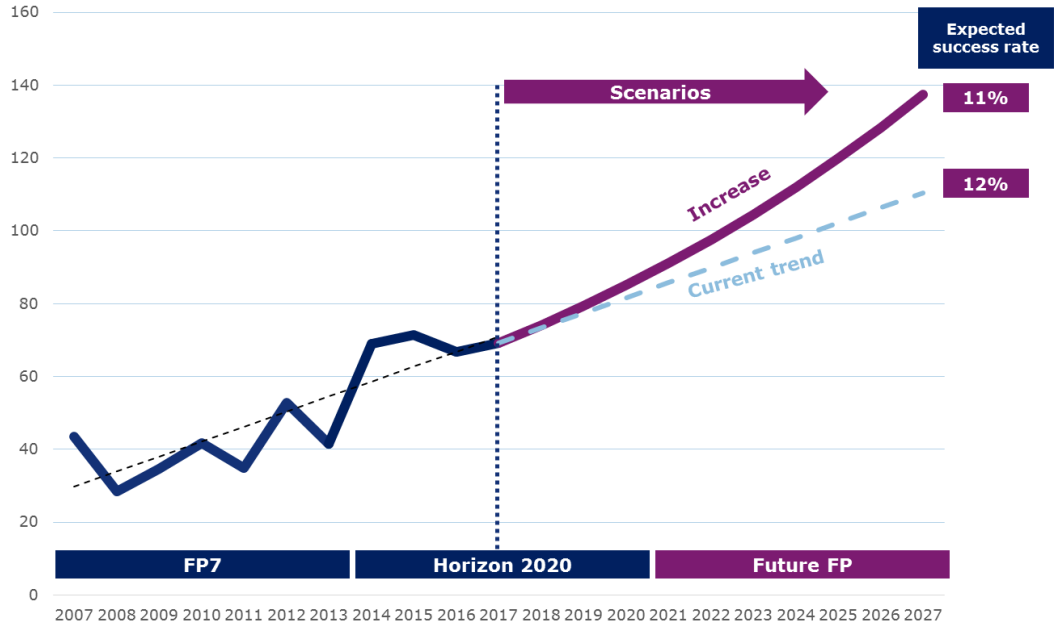
Over the first three years of Horizon 2020, only 11.6% of the proposals could be funded. This low success rate can be explained by the high attractiveness of the Programme, which has led to a sharp increase in the number of eligible proposals compared to FP7[130]. Moreover, in the first years of Horizon, only 1 in 4 high quality proposals could be funded - an additional EUR 62 billion would have been needed to fund all proposals independently evaluated above the stringent quality threshold.[131]. This underfunding represents an opportunity cost for Europe's promising R&I potential, since it undermines the critical mass needed to tackle global challenge; constitutes a waste of resources for the applicants (who spent an estimated EUR 636 million a year preparing proposals[132]), deters excellent R&I players from applying, and deprives the EU of the full potential of the Programme. Based on the steady trend observed over the last decade, the number of proposals should be larger than in Horizon 2020. If the resources allocated to the Programme would remain similar to those of Horizon 2020 (in constant prices), the success rate would likely decline, or at best be maintained at ~12%, with only 20% -25% of high-quality proposals funded. This success rate is too low for the Programme to be efficient - a success rate of 15-20% (comparable to FP7), and funding for at least 30% of high quality proposals would be ideal[133].

Alternative measures to increase the success rate are not expected to be fully effective. Using financial instruments through the InvestEU programme and enhancing complementarities with other MFF programmes, including the European Regional Development Fund, would allow funding more R&I projects. More use of two-stage calls would filter proposals at an early stage[134]. However, financial instruments are not appropriate for all projects[135], and two-stage calls will not solve the problem for unfunded high quality proposals. Likewise, decreasing the size of projects would imply abandoning larger scale projects, mainly affecting collaborative projects, which are an intrinsic part of the EU added value of the Programme. More strict eligibility criteria can improve overall success rate[136], however will not address the issue of low success rate for high-quality proposals. Lastly,

[129] European Commission (2017), The Grand Challenge. The design and societal impact of Horizon 2020.
[130] The success rate in Horizon 2020 is 11.6%, compared to 18.5% under the previous framework programme (FP7).
[131] Proposals that passed all thresholds in the independent evaluation process (from Horizon 2020 Interim Evaluation).
[132] European Commission (2017), Interim Evaluation of Horizon 2020, SWD(2017) 220, book, p. 83.
[133] LAB-FAB-APP, Investing in the European future we want, Lamy High Level Group Report (2017), p.10.
[134] European Commission (2017), Interim Evaluation of Horizon 2020, SWD(2017) 220, book, p. 87-88.
[135] European Commission (2017), Reflection paper on the future of finance, p. 26.
[136] In calls under the Horizon 2020 Societal Challenge 7 "Secure Societies", the success rate reached 20% by imposing strict eligibility criteria.

decreasing the funding rate would lower effectiveness because applicants, including those with high-quality proposals, would need to find complementary funding, and could be discouraged from applying or taking risks.

Figure 9 EC contribution requested in proposals (EUR billion)



Source: DG Research and Innovation. NB: the "increase" scenario assumes an increase in proposals' requested contribution from Horizon 2020 to the new Framework Programme that is similar to the increase experienced from FP7 to Horizon 2020.

4 DELIVERY FOR IMPACT

Efficient delivery is essential for reaching all the Programme's objectives. This section will describe the improvements made in order to better reach the cross-cutting objectives of the MFF: simplification, flexibility, coherence, synergies and focus on performance. These improvements are based on recommendations for optimising delivery from the Horizon 2020 Interim Evaluation [137] and the Lamy High Level Group report[138]. The changes are presented in a structured way along the typical lifecycle of EU R&I support. When changes represent a significant departure from Horizon 2020 (see Table 6 for lessons learnt from Horizon 2020), they will be assessed qualitatively and, where possible, quantitatively. More details can be found in the Annex 9 on the Rules for Participation.

[137] European Commission (2018), Communication on the Horizon 2020 Interim Evaluation, COM(2018)2 final, p.5.
[138] LAB-FAB-APP, Investing in the European future we want, Lamy High Level Group Report (2017), p.18.

Table 5: Mapping of continued, discontinued and new features 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 and the EIT, which was a separate specific objective	Industrial Leadership as a separate pillar	• Open Innovation pillar • Strengthening the European Research Area : covers Science With and for Society, and Spreading Excellence and Widening Participation, which are Horizon 2020 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 (covered under 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 mission concept) • Support to Joint Programming Initiative, ERA-NET, Contractual Public Private Partnerships, Institutionalised public-private partnerships (Art. 187) and Institutionalised public-public partnerships (Art. 185): incorporated within European Partnerships, with strong criteria		• Missions • EIC pathfinder • EIC accelerator
Implementation – concepts			
• Key Enabling Technologies • Gender Equality • Ethics standards	• International cooperation (new criteria) • Strategic planning – widened to include R&I activities from other funding programmes • Governance		

Optimising delivery is also key to achieve higher impact and further simplification[139]. When properly designed, the Rules for Participation ensure legal certainty for participants and contribute to overall coherence in terms of implementation. Simplification remains a continuing endeavour in Horizon Europe, building on the achievements of Horizon 2020, which reduced the administrative burden and costs for applicants, and made it more attractive for newcomers and SMEs through new elements like its funding model (single reimbursement rate and a flat rate for indirect costs), the Participant Portal, and e-signatures. Beneficiaries and stakeholders have reacted very positively[140].

Impact depends ultimately on the dissemination and exploitation of R&I data and results, and it needs to be effectively captured and communicated[141]. An ambitious and comprehensive dissemination and exploitation strategy will increase the availability of R&I data and results and accelerate their uptake to boost the overall impact of the Programme. The strategy will move from a focus on individual projects to analyses of portfolio of R&I results in key policy areas and will further endorse Open Access policy to incentivise the exploitation of R&I results. In particular, clusters of mature R&I results will be exploited in synergy with other EU programmes to foster their uptake at national and regional level, maximising the European innovation potential. This will be complemented by effective R&I communication and outreach campaigns that build trust and engage citizens.

Table 6 Lessons learnt from the Interim Evaluation of Horizon 2020 and from the Stakeholder Consultation

	What do we have now?	What did we learn?
Strategic planning	The priority-setting process is defined in multiannual Work Programmes[142] (WP). The WPs identify the priorities in calls for proposals. They allow some flexibility to respond to new developments[143]. The strategic planning process builds on: Scoping Papers developed by the Commission; foresight; targeted consultations of industry, academia and civil society; and input from experts (Advisory Groups). The WPs are adopted by Commission Decision, in consultation with Member State representatives in the 14 configurations of the Programme Committee.	The strategic planning process improved the intelligence base underpinning priority-setting, and made the focus of the programme more in line with stakeholders needs. Nonetheless, the translation of high-level challenges and objectives into specific calls and topics is not always clear, while the transparency in the WP formulation process and the participation of stakeholders/and citizens/CSOs in agenda-setting were identified as areas for improvement.

[139] See also Annex 11 on the simplification checklist.
[140] European Commission (2016), Report on the Horizon 2020 Simplification Survey.
[141] LAB-FAB-APP, Investing in the European future we want, Lamy High Level Group Report (2017), p.22.
[142] This is complemented by separate Work Programmes for the European Research Council, the Euratom, the Joint Research Centre, and the Strategic Innovation Agenda for the European Institute of Innovation and Technology (EIT).
[143] For instance, an emergency procedure to swiftly allocate funds to a particular purpose can be activated through WP updates, as happened in Horizon 2020 to tackle the outbreaks of Ebola and Zika.

	What do we have now?	What did we learn?
The single set of rules	The single set of rules (i.e. the Rules for Participation and dissemination of results) implies that the same rules are applied in all parts of the programme, regardless of the implementing body (Commission, Executive Agencies, Joint Undertakings). Only a very limited number of derogations from the Rules for Participation exist, when duly justified, e.g. for specific operating needs of public-to-public partnerships (Art. 185 TFEU) and public-private partnerships (Art. 187 TFEU)[144]. The Common Support Centre (CSC) harmonises implementation of the rules across all implementing actors.	The single set of rules and its harmonised implementation via the CSC are widely seen by beneficiaries as advantageous, contributing to increased legal certainty, coherence and simplification of the rules, though some partners perceived it as a loss of flexibility compared to FP7[145]. Moreover, Member States have repeatedly expressed their wish to include Art. 185 TFEU initiatives under the the Participant Guarantee Fund[146], which does not currently cover them.
The funding model	The rules concerning the contribution of the EU to eligible costs do not differentiate between organisation categories or types of activities (in contrast to the FP7 funding model, which used a complex matrix of organisation categories and activity types). Its main features are a single reimbursement rate for direct costs (up to 100% of eligible costs for Research and Innovation Actions, and up to 70% for Innovation Actions[147]) and a single flat rate for indirect costs (25% is applied to the direct eligible costs[148]).	The funding model has not led to a significant change in funding intensity[149]. The funding model is a simplification measure that allows for flexibility and that has mobilised and largely satisfied stakeholders[150]. The overall funding rate is on average 70% of total project eligible costs (both direct and indirect). In a simplification survey[151], 78% of respondents appreciated the single reimbursement rate.
Simplified forms of grants	Horizon 2020 features a simplified cost reimbursement system with enhanced use of unit costs[152], flat-rates and lump sums, while actual cost reimbursement (i.e. costs actually incurred by beneficiaries) is used still for the majority of the budget. Unit costs are used for specific types of personnel costs (i.e. for average personnel costs and SME owners without a salary) and other direct costs (i.e. internal invoices), while indirect costs are covered by a single flat-rate. Lump sums, at the start of Horizon 2020, were used for small-sized projects (e.g. Phase 1 of the SME Instrument). In the 2018-20 Work Programme, pilot actions were launched for testing lump sum project funding for "mainstream" collaborative R&I projects.	While beneficiaries express preference for actually incurred costs, a number of financial complexities are inherent to this model (e.g. calculation of the monthly hourly rate, additional remuneration). Moreover, reimbursement of actual costs focuses attention on justification of costs, and not on the expected impact as in the case of lump-sum funding. Further simplification of the actual cost reimbursement system is necessary, in particular for personnel costs. The European Court of Auditors[153] also proposed that the post 2020 Framework Programme assesses the need for further use of simplified cost options such as lump sum project funding and prizes.

[144] At the request of the European Parliament during inter-institutional negotiations, the scope of derogations were set out in the RfP for Art. 187 TFEU initiatives while for Art. 185 TFEU initiatives, these are laid down in the respective basic acts.
[145] Interim Evaluation of the SESAR Joint Undertaking (2014-2016) operating under Horizon 2020, p. 53.
[146] Since 2007, two Participant Guarantee Funds were created (EU and Euratom) to protect from non-recovery of sums due to the Union and to allow ongoing projects to continue in case of default of one of the beneficiaries.
[147] Non-profit organisations are reimbursed 100% also in Innovation Actions.
[148] Except subcontracting financial support to third parties, and in-kind contributions not used on the beneficiary's premises.
[149] The following types of actual costs can be declared as eligible: personnel costs, sub-contracting, purchase of goods, services or works (incl. travel costs), financial support to third parties and costs incurred by third parties.
[150] European Commission (2017), Interim Evaluation of Horizon 2020, SWD(2017)
[151] European Commission (2016), Report on Horizon 2020 simplification survey.
[152] The Marie Skłodowska Curie Actions are fully funded by a set of unit costs.
[153] The European Court of Auditors (2018) "A contribution to simplification of EU research programme beyond Horizon 2020"

	What do we have now?	What did we learn?
Grants and financial instruments	More than 90% of the Horizon 2020 support is grant based, while the rest is provided with financial instruments (i.e. debt or equity) through the European Investment Bank (InnovFin)[154]. Pre-commercial public procurement (PCP), public procurement for innovation (PPI) and inducement prizes represent only a limited share of the Horizon 2020 budget.	Only a small number of firms receiving Horizon 2020 grants benefitted from Horizon 2020 financial instruments. Extremely few companies taking part in Horizon 2020 obtained investments for scaling up from InnovFin. This points to a potential lack of integration between the grant and non-grant based instruments at different stages of the innovation cycle but also to limitations of intermediated risk-sharing mechanism where the initial risk is to be fully borne by the Union due to market risk-aversion[155].
Proposal evaluation and selection	Major investment decisions are taken at the stage of evaluation and selection of proposals. The system, based on independent expert judgement ensures that the selected projects are the best. The approach ensures maximum coherence across the different implementing bodies, based on three award criteria against which proposals are evaluated: Excellence; Impact; and Quality and efficiency of the implementation[156].	The Horizon 2020 proposal evaluation and selection process is generally highly regarded. Still, some stakeholders asked for more transparency, found the quality of evaluation feedback received uneven, and considered that the evaluation experts sometimes appeared to lack the appropriate expertise[157]. To increase efficiency in relation to over-subscription, two-stage calls for proposals were identified as good practice.
Ex-ante and ex-post audits	The general rules related to the management and implementation of projects are detailed in the Model Grant Agreement. Beneficiaries are bound by the grant agreement they sign with the Commission. The audit and control system seeks an appropriate balance between trust and control, taking into account administrative burden for participants. The Horizon 2020 audit strategy is based on the financial audit of a representative sample of expenditure, and is complemented by a selection based on risk assessment	The Common Support Centre strengthened the corporate approach in implementing the programme and in auditing projects. However, some Joint Undertakings expressed the need of additional direct audit coverage and considered the common representative sample as not sufficient enough for their needs, leading to a potential increase of audit burden towards the Horizon 2020 beneficiaries.
Dissemination and exploitation	Throughout Horizon 2020, specific calls for proposals, coordination and support actions and public procurement provide targeted assistance to projects in order to optimise the dissemination and exploitation of their research results. To further assist project consortia, the Commission provides tailor-made support services, e.g. the Common Exploitation Booster, the Common Dissemination Booster and the Innovation Radar.	Beneficiaries develop activities for better dissemination and exploitation but results are still not fully accessible to all relevant stakeholders and this represents a barrier to knowledge circulation and to innovation uptake. The uneven exploitation capacity among beneficiaries hinders market uptake. Moreover, feedback from R&I projects into policy-making must be strengthened[158].

[154] European Commission (2017), Interim Evaluation of Horizon 2020, SWD(2017) 220, book, p. 140.
[155] Ibid. p. 84.
[156] For the ERC, only the Excellence criterion applies. Under Innovation Actions in Horizon 2020, Impact has a higher weight.
[157] European Commission (2017), Interim Evaluation of Horizon 2020, SWD(2017) 220, book, p. 236.
[158] Ibid., p.200

	What do we have now?	What did we learn?
Delegation	To ensure a more modern, effective and dynamic implementation, while reducing staffing by 5% over 5 years[159], 75% of Horizon 2020 budget is delegated to other EU bodies: Executive Agencies (55%), Public Private Partnerships (Art. 187 TFEU initiatives, 10%), the European Investment Bank (4%), the European Institute of Technology (EIT, 4%) and Public-Public Partnerships (Art. 185 TFEU initiatives, 2%). The remaining 25% is managed "in house" by the Commission.	The delegation to implementing bodies allows Commission services to focus on policy-making and strategic planning, while maximizing the effective and efficient use of EU funding. Executive Agency evaluations confirmed their effectiveness and high value for money, with administrative costs well below 5%[160].

4.1 The strategic planning process

Towards a strategic, impact-oriented and collegial planning process. The strategic planning process will provide multi-annual strategic orientations for the Framework Programme. It will be co-created in synergy with other EU programmes and policies, with the intention of giving coherence to the entire portfolio of actions supported by the EU under the MFF. The process will be streamlined into a single Commission document[161], applying to all Programme components[162], including missions[163], European Partnerships, and the EIT Strategic Innovation Agenda[164]. This draft Strategic R&I Plan will be open for public consultation, providing more involvement of EU Institutions and citizens than previously. The Work Programmes will then be developed on the basis of the finalised Strategic Plan.

In addition, a simpler governance structure with ad-hoc and flexible advisory mechanisms and Programme Committee configurations will improve the rationalisation and simplification of the planning process, hence delivering results more efficiently and transparently.

What are the expected implications?

- **Increased co-creation with other EU Institutions and citizens.** While in Horizon 2020 the priority setting was defined mostly with targeted consultations, the new Strategic R&I Plan will be more open for general public consultation, involving citizens, customers and end-users in agenda-setting (co-design) for the Programme. In particular, the public will have a say in the definition of R&I missions.

- **Higher coherence within the Programme and enhanced synergies with other EU Programmes**. By bringing together all Commission services and implementing bodies, the Strategic R&I Plan will ensure a

[159] Commission's proposals for the 2014-2020 Multiannual Financial Framework (MFF).
[160] PPMI (2016), Evaluation of the operation of ERCEA (2012-2015), final report; and PPMI (2016), Evaluation of the operation of REA (2012-2015), final report.
[161] This could also become a formal Commission document such as a Communication or Staff Working Document.
[162] While the focus would be on the programmable Global Challenges and Industrial Competitiveness pillar, the relationship between this and the bottom-up parts such as the EIC, including the results from these, would feed into the planning process.
[163] This will reflect the expected impact of missions of up to 15 years, as appropriate.
[164] In the case of the ERC, the Scientific Council will continue to establish the overall strategy, the Work Programme and the proposal evaluation and selection. The JRC will also continue to establish its own Work Programme and strategy and receive opinions from Member States through its Board of Governors. The EIC will also develop its own Work Programme. As regards the EIT, the specific priority fields, financial needs, time schedule, selection process and implementation of KICs will be defined in the EIT Strategic Innovation Agenda (SIA) as a separate legal base arising from the EIT founding regulation. Proposals for future EIT KICs indicated in the EIT Strategic Innovation Agenda (SIA) should take into account the outcomes of the strategic planning process.

stronger and more inclusive agenda-setting process, whereby the linkages between EU Programmes would be strengthened, promoting faster dissemination and uptake of R&I results.

- **Better alignment of national and EU policies**. Involvement of Member States at early stage in the discussion on the strategic planning and in consequences in the work programme preparation will help to build better alignment between national and EU R&I activities.

4.2 The single set of rules

The principle of a single set of rules will continue with further improvements. In line with the corporate approach towards a *single-rule book* and the preparation of the MFF, the new EU Financial Regulation[165] will be used as a common reference under which the rules applicable to all EU funding programmes will be aligned. Derogations to the Financial Regulation are kept to the minimum, but maintained in order to strike the right balance between full harmonisation and specific needs of individual initiatives. The new Rules for Participation allow other funding bodies, in particular bodies implementing Article 185 or 187 TFEU initiatives, to establish limited derogations in their basic acts in cases duly justified by their specific needs. Furthermore, the Participant Guarantee Fund (renamed Mutual Insurance Mechanism) will be extended to article 185 TFEU institutionalised European Partnerships.

What alternatives were considered? Keeping Horizon 2020 status quo was considered for predictability, but this would have been a missed opportunity to streamline the approach taken on derogations (e.g. by maintaining the scope of the derogations for Art. 187 TFEU initiatives separate from other institutionalised European Partnership Initiatives) and for further simplification. Returning to FP7 Rules would provide more flexibility (e.g. by allowing different funding bodies to adopt rules as they see fit), but this would result in diverging rules, undermining simplification, legal certainty and hampering participation.

What are the expected implications?

- **More simplification and reduced costs**. The single set of rules contributes to the rationalisation of the new Framework Programme. It further harmonises and streamlines implementation methods, hence simplifying the burden e.g. for preparing and submitting proposals. It increases the accessibility and attractiveness of the programme, in particular for applicants with limited resources, such as SMEs.

- **Improved synergies with other EU programmes.** As the number of derogations to the Financial Regulation is reduced, EU programmes are more likely to share common rules. This increases the possibility for more targeted multi-faceted EU support, for instance through missions.

- **Increased flexibility while maintaining legal certainty.** The Framework Programme will further improve the balance between flexibility and legal certainty e.g. by allowing funding bodies to establish rules that depart from those laid down in the Financial Regulation or in

[165] European Commission (2017), Financial Regulation applicable to the general budget of the Union and its rules of application, available at: http://ec.europa.eu/budget/library/biblio/documents/regulations/financial_regulation_2017_en.pdf

the Rules for Participation, in order to accommodate their specific operating needs of individual initiatives in duly justified cases.

4.3 The funding model

Rules on funding rates will be maintained. Given the largely positive assessment of the Horizon 2020 funding model, Horizon Europe will maintain the single reimbursement rate for direct costs (up to 100% of the total eligible costs for Research and Innovation Actions and up to 70% for Innovation Actions) and the single flat rate for indirect costs (25% is applied to the total direct eligible costs)[166]. Similarly, the funding rate will be a maximum - this ceiling can be reduced for implementing specific actions, where duly justified (e.g. for Euratom, or specific close-to-market calls).

What alternatives were considered? Alternatives to the continuation were considered, mainly to reduce oversubscription[167], but maintaining attractiveness (i.e. broad involvement from all sectors and disciplines) is more important. A lower funding rate for all projects (e.g. 75%) would allow a larger number of beneficiaries to benefit from EU support. However, such an approach would decrease the overall attractiveness of the programme, especially for non-profit entities and SMEs, hence affecting the principle of excellence. Different levels of funding for industry compared to other types of beneficiaries were also considered, but this approach would have a negative impact on industry participation, on simplification and on time-to-grant. Alternative ways to address oversubscription are also identified in section 3.4 on critical mass.

What are the expected implications?

- **Maintained programme attractiveness.** Continuity in the funding model enhances predictability, legal certainty, attractiveness and ease of access to the Programme. Administrative burden would not increase. On the contrary, a significant departure from the Horizon 2020 model would force beneficiaries to adapt once again to a new system.

- **Further simplification and more flexibility.** The benefits of the current funding model have already largely materialised[168]: simple financial management of projects; reduced complexity of the financial rules; reduced financial error rate; acceleration of the granting processes.

- **Reduced oversubscription**. Extending the use of flexibility to establish lower funding rates in the Work Programme can contribute to reducing oversubscription for targeted calls or topics. The level of co-investment will increase or at least remain the same as in Horizon 2020.

[166] Except for subcontracting, financial support to third parties and unit costs for internally invoiced goods and service are calculated in accordance with the usual cost accounting practices of the beneficiaries. Such unit costs shall be determined on the basis of actual eligible direct and indirect costs.
[167] As shown in the Interim Evaluation of Horizon 2020, too much oversubscription could cause disillusionment and dissatisfaction, leaving good proposals unfunded and to be resubmitted.
[168] European Commission (2017), Interim Evaluation of Horizon 2020, SWD(2017) 220, book, p. 79.

4.4 Forms of funding, including simplified cost options

The cost reimbursement scheme will be further simplified. The two current unit costs (average personnel costs and internally invoiced goods and services) calculated in accordance with the beneficiary's practices[169] will be maintained. In addition, in view of simplification, the unit cost for internally invoiced goods and services will allow for a higher acceptance of the usual cost accounting practices. Beneficiaries will be able, under certain conditions[170], to calculate such unit cost based on 'actual direct and indirect costs', provided those costs are recorded in their accounts. The need to further align programme provisions with beneficiaries' accounting practices was also a recommendation from the European Court of Auditors[171]. In order to lower administrative burden, 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 – as well as other simplified forms of funding provided by the new Financial Regulation, including other incentives based on contributions not linked to costs, where appropriate.

As regards actual costs, the calculation of personnel costs will be further simplified and aligned to the Financial Regulation. The distinction between basic and additional remuneration will be removed and the Horizon 2020 capping on the additional remuneration abolished. For beneficiaries with project-based remuneration[172], 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.

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 under other budget categories according to the eligibility criteria for actual costs. In addition, the calculation of in-kind contribution free-of-charge will be further simplified: no distinction will be made if these resources are used on the premises of beneficiaries or third parties and beneficiaries will no longer need to declare them, under specific conditions, as receipts.

What alternatives were considered? Alternative simplified costs options were assessed regarding rules for personnel costs, such as optional unit cost (hourly rate) or contributions not linked to costs but were not found feasible. Fully relying on the Financial Regulation was also considered, but such an approach would imply a significant departure from current practices (lack of continuity) and would be negatively perceived by beneficiaries.

What are the expected implications?

- **Lower administrative burden.** The broader acceptance of beneficiaries' usual cost accounting practices, the abolition of the additional remuneration scheme, and the extended use of lump sum and output-based funding significantly contributes to simplification, as they improve and simplify reimbursement of actual costs, while providing flexibility. In particular, the use of lump sums reduces substantially the reporting requirements from beneficiaries during the lifetime of the project,

[169] The acceptance of other cost items will be further defined in the model grant agreement, as in the current system.
[170] These conditions (e.g. beneficiaries must be able to identify their actual eligible indirect costs) will be further developed in the model grant agreement.
[171] The European Court of Auditors (2018) "A contribution to simplification of EU research programme beyond Horizon 2020"
[172] Project-based remuneration means remuneration that is linked to the participation of a person in projects, is part of the beneficiary's usual remuneration practices and is paid in a consistent manner.

shifting the focus of project monitoring from financial checks to performance and content.

- **Lower error rate.** The further acceptance of the beneficiaries' usual cost accounting practices will reduce the error rate on issues that have generated recurrent and repetitive errors under FP7 and Horizon 2020. For example, the abolition of the additional remuneration scheme will allow the beneficiaries to report their personnel cost with respect to their usual accounting practices, whilst the current experience on auditing lump sums has confirmed the low error rate on such transactions.

- **More coherence with the Financial Regulation.** An alignment of the rules with other EU funding programmes will also allow the beneficiaries to apply even more widely their usual accounting practices, as this reduces the need to amend reporting models to the various (and sometimes diverging) needs of each EU programme. This harmonisation and further acceptance of the beneficiaries' usual accounting practices will reduce the administrative burden of the beneficiaries.

4.5 Grants, financial instruments and blended finance

Blended finance will help companies to scale up. The supply of flexible and agile funding schemes is essential for innovators. Grants will continue for projects that are far from the market, for example for basic research[173]. Yet, projects that are closer to market may still present a too high-risk profile, preventing them access to risk finance. Through the European Innovation Council (EIC), the new Framework Programme will offer large-scale blended funding (grants or reimbursable advance with equity or guarantees) to companies undertaking such projects, for late stage innovation activities, but also for market deployment activities such as pilot manufacturing, large trials or ensuring regulatory compliance[174], tailored to their risk level and technological maturity. The overall purpose of blended finance shall be to support high-risk innovations beyond the usual limits of grant-based research, where the risks – whether technological, market or regulatory – cannot be borne by the market alone. By combining grant-type funding with equity or guarantees under the EIC, the Programme will hence bridge the financing gap between late stages of R&I and market uptake and deployment, and will encourage investors and lenders to support innovative high-risk projects, with a greater propensity to co-invest or to offer lower interest-rates and less onerous requirements for collateral.

What alternatives were considered? While innovation at large will 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 - financial intermediaries (banks and investors) may remain averse to the residual risk they bear when investing in high-risk innovative projects. To date, available private and corporate financing remains small[175] for late stage of innovation activities and market take-up for high-risk breakthrough innovations, as financial institutions must limit their risks to maintain their

[173] European Commission (2017), Reflection paper on the future of EU finances, p.26.
[174] High-Level Group of Innovators (2018), Europe is back: accelerating breakthrough innovation.
[175] Europe's innovators struggle to access risk finance above the €10 million range. PwC/CB Insights, Money Tree Report Q4 2017, p. 93. Funding rounds of companies above $100 million are five times higher in the US and Asia than Europe (p. 92).

market rating. There is hence a necessity for direct Union intervention. Providing only for grant allows to start de-risk operations and attract private or corporate finance, but partially, as some activities too close to market, including deployment and scale-up, may not be covered by grants. Furthermore, the classical 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.

Box : Examples of blended finance

National innovation agencies such as Vinnova, BPI France, Innovate UK and CDTI operate blended finance in the form of grants in combination with soft loans and venture investments:

- A loan combined with a grant: the proportion of grant to loan depends on an assessment of the riskiness of the innovation whose development the funding will support: the higher the risk, the greater the grant component. This approach can be combined with the whole or partial write-off of the loan if the development of the innovation fails for technical or commercial reasons; or the reimbursement of part of the grant if the innovation succeeds.
- A conditional grant combined with a loan or equity: the payment of all or part of the grant is conditional on the grantee obtaining at least a matching amount as a loan or an equity investment (such as venture capital) from a lender or investor.

What are the expected implications?

- **Raise availability of large-scale risk finance in Europe** by providing large tailor-made investments that combine EU support through grants and blended finance, in addition to investment through support to equity or guarantees.

- **Increase leverage through active measures put in place for EU R&I funding to stimulate private finance**. For instance, proposals may also be submitted by investors including public innovation agencies looking for co-investment. A set of actions to improve 'investment-readiness' and 'bankability' will continue from the Horizon 2020 EIC Pilot in term of coaching (InvestHorizon), and the EIC events aimed at matching investor/investee and awareness raising.

- **Increase risk taking for breakthrough innovation** by de-risking technical or financial failure.

4.6 Proposal evaluation and selection

The key elements of the proposal evaluation and selection system will be maintained, including the use of independent experts, and the use of three award criteria (based on excellence, impact and quality and efficiency of the implementation) across the board, with differentiation for the proposals for ERC frontier research actions, which will continue to apply only the excellence criterion and for the EIC's Accelerator whose evaluation will include valuation of risk. Small improvements in order to address lessons learnt from the Horizon 2020 Interim Evaluation (e.g. to improve quality of feedback to applicants, differentiated expert panels, and multi-stage and multi-step procedures, gender balance in evaluation panels and the integration of the gender dimension in R&I content) can be ensured throughout the implementation of the Work Programmes. To increase the societal relevance

and applicability of proposals, greater use of civil society expertise should be encouraged in appropriate evaluation panels[176]. In particular for missions and the EIC, the Commission may select proposals based not only on the merit of individual proposals, but also in relation to the overall coherence of the portfolio of projects and other Union policy objectives. While the main principles would be spelled out in advance in the Rules, the Work Programmes will provide further details on the application of the award criteria depending on the objectives of the calls and instruments (e.g. the aspects to be taken into account under the evaluation procedures).

Box 11 Access conditions to the Framework Programme

For collaborative projects, the consortium must include at least three independent legal entities established in a different Member State or associated country, and with at least one of them established in a Member State, unless otherwise provided for in the work programme. For other specific activities (i.e. EIC, ERC, co-fund, or MSCA training and mobility actions), different minimum conditions apply. Additional eligibility criteria may be laid down in the work programme. In case of actions carried out outside the Union using and/or generating classified information, a security agreement have to be concluded between the Union and the third country in which the activity is conducted.

What alternatives were considered? A possible alternative was the exclusion from the Rules for Participation of these provisions, relying instead on the full flexibility offered by the Financial Regulation (leaving the criteria and other provisions for the Work Programmes). Although this would maximise flexibility, it risks a divergence of rules in practice, jeopardise smooth business processes, and lead to unpredictability for applicants. Specifying in full detail the criteria for evaluation and selection of proposals in the Rules would ensure a high degree of coherence across the programme and a measure of stability for applicants but would represent a significant loss of flexibility.

What are the expected implications?

- **Achieve a balance between flexibility and coherence.** The current system has been shown to work well, and there is no evidence for the need for a fundamental change. However, missions and the EIC require a proactive portfolio management to reach their objectives, calling for flexibility to ensure overall consistence. Providing the main ground rules in the legislation, while permitting adaptability via the Work Programme, has proven in the current and previous programmes to ensure coherence across the board, predictability for applicants, and smooth business processes, while maintaining a strong degree of flexibility and the possibility for experimentation.

- **Maintain a strong focus on excellence and performance.** Streamlined but adaptable rules will help applicants design well-focussed proposals, and will lead to processes in which the best proposals are identified and selected as quickly as possible.

4.7 Ex-ante and ex-post audits

A wider cross-reliance on audits and assessments – including with other EU programmes – is envisaged. The increased alignment to the Financial Regulation provide an

[176] Martinuzzi, A. et al. (2016), Network Analysis of Civil Society Organisations' participation in the EU Framework Programmes, Vienna and Leicester.

opportunity for audit synergies via Systems and Processes Audit. Indeed Systems and Processes Audit avoid duplication of audits, since there will be a common audit approach on common financial rules and hence a more harmonised and simple audit approach. By cross relying on audits of beneficiaries among the various EU programmes, the need for additional auditing will gradually be reduced. In addition, cross-reliance has been explicitly considered in other elements of assurance (e.g. Systems and Processes audits and audit on transactions) resulting into a reduced need for financial audits on beneficiaries with positive results in their Systems audits. Moreover, cross-reliance could be part of the conditions under which the obligation for the beneficiary to submit a certificate on the financial statement can be waived.

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 Commission. Integration of ex-post audit support into the Participant Portal will enable better view on the progress of the audits to the beneficiaries, allow completely electronic exchange of documents and notifications, all that can anticipate additional reduction of burden and costs to beneficiaries.

What alternatives were considered? The concept of cross-reliance on other audits or assessments with other EU programmes was considered, however its effectiveness depend on the homogeneity of the 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 in view of moving a step forward from a 'rule-based' approach towards a 'principle-based' one. However, it should be noted that such a challenging alternative would be possible only once having taken into account the eligibility criteria of the different programmes, in the particular context of the absence of any international standard in that matter.

What are the expected implications?

- **Reduce administrative burden**. Compared to Horizon 2020, the Systems and Processes Audit (SPA) will lead to a reduction of the audit burden of the beneficiary that has been positively assessed. A beneficiary which is positively assessed via a Systems and Processes Audit, receives a long term assurance that their usual accounting practices are compatible with the Horizon Europe's eligibility requirements, whilst the need for further auditing ceases to exist. The introduction of Systems and Processes Audit is a holistic audit approach, resulting into an overall assurance which when achieved, results into a significant reduction of the audit burden.

- **Increase simplification for beneficiaries of EU funds.** The Systems and Processes Audit (SPA) allows for more synergies with the Audits carried out under the shared management mode (e.g. especially those performed under the European Regional Development Fund). With this cross-reliance between audits, the Commission increases efficiency and effectiveness, avoids duplication of audit efforts and initiates a process where auditors within the Commission can exchange data and reviews.

4.8 Policy and rules regarding Dissemination and Exploitation

Horizon Europe will provide dedicated support to dissemination (including through open access to scientific publications), exploitation and knowledge diffusion actions. Strong emphasis will be placed on portfolios of research results for targeted diffusion to end-users, citizens, public administrations, academia, civil society organisations, industry and policy-makers, including through the use of data intelligence tools for harvesting knowledge and providing innovative data uses and visualisation.

More emphasis is put on to promoting the exploitation of R&I results, in particular in the EU. Horizon 2020 provides for a "best effort" to exploit results and, if indicated in the Work Programme, for additional exploitation obligations. In Horizon Europe, the "best effort" approach to exploit must have a particular focus on the EU. As in Horizon 2020, the Work Programme can specify additional obligations if justified. The beneficiaries must include in their proposals a dissemination and exploitation plan that must be updated during and after the end of the project, to ensure a continued focus on the exploitation of results.

What alternatives were considered? Alternatives for better exploitation of R&I results that were considered range from not having specific rules at all, to having more stringent rules across the board. Having a more stringent general rule was considered unjustified, as there may be valid reasons why exploitation occurs elsewhere (the EU often still benefits from such exploitation). Moreover, such a broad approach would deter industrial and international participants. Having no rules at all, and leaving the full choice of exploitation location to market forces was considered insufficent to safeguard the appropriate exploitation of results for the benefit of the Union.

What are the expected implications?

- **More economic and societal impact.** By fostering better exploitation of R&I results, a more EU-focussed exploitation increases the accessibility of high quality content, while ensuring that the benefits serve the EU. They aim at better ensuring the right balance between the pursuit of EU strategic interests in terms of competitiveness and job creation on one hand, and attractiveness for industry and openness to international participation on the other. This will assist market uptake, boost impact, and increase the innovation potential of results supported by EU funding.

- **Some additional reporting requirements.** The possibility of additional reporting specifically on exploitation or impact demonstration and related administrative burden will be weighed against the need to have accurate information regarding the exploitation of results beyond the lifetime of the projects.

- **Higher market uptake, impact and innovation potential.** Union support will ensure a constant stream of knowledge and innovations towards the scientific community, industry, policy-makers, and the public. Dedicated support services developed by the Commission, combined with the strengthened exploitation plans of the beneficiaries, will satisfy both the legitimate interest of beneficiaries and the interest of the public.

4.9 Delegation to Executive Agencies

The Commission will increase the share of the budget delegated to Executive Agencies, subject to positive outcome of the mandatory Cost Benefit Analysis. Given the new elements in the scope of the new Framework Programme (e.g. missions and the EIC) and the increased budget to be delegated, the reshaping of the portfolios of the existing Executive Agencies will be needed along with exploring the possibility of establishing additional ones. Activities with substantial policy content will be excluded from delegation to Executive Agencies while, in parallel, the effective feedback of R&I data and results from Executive Agencies to the Commission will be reinforced, in line with the dissemination and exploitation strategy, to strengthen the inputs for policy-making.

What alternatives were considered? For the implementation of the new Framework Programme, the following alternative options were considered: an 'in-house' scenario (reintegration of part of the programme management in the Commission); maintaining the current status as in Horizon 2020; and full delegation of all programme's activities. The in-house scenario would imply returning to previous management modes that entailed comparably higher administrative costs[177]. Specific scenarios for the implementation of the EIC activities through a dedicated Executive Agency are described in the Annex 8 on the EIC.

What are the expected implications?

- **Reduce administrative costs.** Independent evaluations[178] show that delegation to Executive Agencies brings substantial savings in administrative expenditure. The administrative costs of the programme implementation by Executive Agencies in Horizon 2020 are around 2-3% of the operational budget, which is well below the target of 5%.

- **Improve synergies with other programmes.** Executive agencies manage parts of different programmes that complement each other[179]: rationalising their portfolio can help aligning and integrating objectives of different programmes, for instance better linking R&I results to market deployment.

- **Enhance focus on performance.** Executive Agencies have reached and maintained very high levels of satisfaction among their beneficiaries[180], while at the same time successfully managing a larger number of projects than in FP7. This consistent high performance allows the Commission to focus on strategic priorities.

[177] The administrative expenditure in FP7 represented 5.16% of the total budget of the programme (indirect actions). The Interim Evaluation of Horizon 2020 shows that, over the first three years, its administrative expenditure is below the 5% target and is particularly low for the executive agencies.

[178] PPMI (2016), Evaluation of the operation of ERCEA (2012-2015), final report; and PPMI (2016), Evaluation of the operation of REA (2012-2015), final report.

[179] For example, INEA implements the Connecting Europe Facility Programme (large energy, transport, digital infrastructures projects) as well as Horizon 2020 Societal Challenges.

[180] Up to 82% for REA and up to 93% for ERCEA of the beneficiaries are satisfied with the performance of the agencies. See PPMI (2016), Evaluation of the operation of ERCEA (2012-2015), final report; and PPMI (2016), Evaluation of the operation of REA (2012-2015), final report.

4.10 Overall impact on the objectives of the MFF

The delivery tools of the Framework Programme will contribute to the cross-cutting objectives of the Multiannual Financial Framework (MFF), notably simplification, flexibility, coherence, synergies and focus on performance. Overall, the Framework Programme is expected to deliver large benefits that outweigh costs, in particular for the Programme's focus on performance, its flexibility, as well as its internal coherence and its synergy with other programmes (see Table 8).

Other MFF Programmes are closely linked to the new EU R&I Programme: synergies and complementarities between them should be enhanced (see Table 7 and Annex 7). Current Horizon 2020 beneficiaries also benefited from other EU programmes, e.g. the European Structural and Investment funds, EU Health Programme, and COSME[181].

Table 7 Synergies and complementarities with other MFF proposals

MFF Programmes	Links to new Framework Programme
Common Agricultural Policy (CAP)	A key priority for the 'second pillar' of the post-2020 CAP[182] is an increased focus on fostering innovation, in particular through wider diffusion of innovation, better access to new technologies and investment support. This will involve strengthening the links between agricultural and rural development policies and R&I in support to the development of knowledge and innovation systems. The development of an ambitious, integrated Strategic Research and Innovation Plan will define priorities of the Framework Programme in the area of food, nutrition security and sustainable management of natural resources with a view to develop synergies between the Framework Programme and the CAP. The latter will promote the use, implementation and deployment of innovative solutions, including those stemming from R&I projects funded by Horizon Europe.
European Maritime and Fisheries Fund	The post-2020 European Maritime and Fisheries Fund will provide important support to the implementation of the Common Fisheries Policy and the Maritime Policy. This programme will focus on creating the conditions for boosting competitiveness in the blue economy, especially through close-to-market innovation, access to marine knowledge and by ensuring a safe and secure maritime space. Strong and sustainable blue growth requires enhanced synergies with wider EU intervention. The Framework Programme is of particular relevance in this respect as it strengthens the knowledge base from which new, innovative products, processes and services can emerge in the maritime economy. The EMFF will support the rolling out of novel technologies and innovative products, processes and services, in particular those resulting from Horizon Europe in the fields of marine and maritime policy.
Connecting Europe Facility (CEF)	The post-2020 CEF will prioritise the large-scale roll-out and deployment of innovative new technologies and solutions which result from projects in transport, energy and telecommunications funded by the Framework Programmes. Horizon Europe will support all stages in the R&I chain, including non-technological and social innovation, and closer-to-market activities with innovative financial instruments. Through the Strategic Research and Innovation Plan, Horizon Europe will support R&I on transport, energy and mobility, in particular through the Climate, Energy and Mobility cluster, as well as digital technologies. The exchange of information and data between Horizon Europe and CEF projects will be facilitated, for example by highlighting technologies from the Framework Programme with a

[181] A total of 86% respondents to the cluster-based public consultation on EU funds in the area of investment, research & innovation, SMEs and single market reported having experience with the Horizon 2020 program. From this sample, the respondents reported having experience also with European Structural and Investment funds (22%), EU Health Programme (9%), COSME (8.%).

[182] The 'second pillar' of the CAP focuses on rural development and complements the system of direct payments to farmers and measures to manage agricultural markets (the so-called 'first pillar')

	high market readiness that could be further deployed through CEF.
Digital Europe Programme (DEP)	DEP focuses on large-scale digital capacity and infrastructure building in High Performance Computing, Artificial Intelligence, Cybersecurity and advanced digital skills aiming at wide uptake and deployment across Europe of critical existing or tested innovative digital solutions. While several thematic areas addressed by both programmes converge, DEP will mainly focus on roll-out and deployment activities outside research and innovation, whereas the Framework Programme will focus on investing in the entire spectrum from research to market. R&I needs related to digital aspects are identified and established in Horizon Europe strategic R&I plan, while DEP capacities and infrastructures are made available to the research and innovation community, including for activities supported through Horizon Europe such as testing, experimentation and demonstration across all sectors and disciplines.
Erasmus	The post-2020 Erasmus will continue to support mobility, cooperation and policy initiatives in the field of higher education. This includes support for integration of education, research and innovation, development of competences and inter-disciplinary, transferable, digital and entrepreneurial skills in forward-looking fields or disciplines and support to higher education institutions, research centres, businesses and civil society to contribute to innovation. The Framework Programme will continue to invest in the people behind research and innovation, strengthening their skills, training and career development and fostering the transfer of knowledge and cooperation between research-performing organisations and providing incentives for universities embracing open science policy. 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.
European Defence Fund	Complementarity and synergies with the European Defence Fund will be ensured, so that results under civil R&I also benefit defence R&I and vice-versa.
European Regional Development Fund (ERDF)	The post-2020 European Regional Development Fund (ERDF) will provide an important part of EU funds for R&I. The post-2020 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 Programme and Horizon Europe. It will continue to invest in actions that build R&I capacities of actors aimed at participating in the Framework Programme or other internationally competitive R&I programmes. Holders of Seal of Excellence[183] labels from the Framework Programme may be funded by Member States and regions, where relevant to the local context and smart specialisation strategies, including with resources from any Union shared-management programme. The same applies for national funding of joint programmes co-funded under the Framework Programme. In addition, budget from share management could be voluntary transferred for implementation to central managed programmes. Part of the Framework Programme will continue to support low-performing countries in R&I, in the context of strengthening the European Research Area. Smart specialisation strategies will continue to promote innovation based on the strengths of each region and be a basis for ESI Funds investments in R&I and the innovation eco-systems.
European Social Fund+ (ESF)	The post-2020 European Social Fund will continue to invest in human capital and skills development, as well as in social innovation. The ESF+ can mainstream and scale up new and innovative curricula for education and training programmes developed in R&I projects under the Framework Programme. Holders of the Seal of Excellence may be funded by the ESF+ to support activities promoting human capital development in research and innovation with the aim of strengthening the European Research Area. The Health strand of the ESF+ will mainstream innovative

[183]The Seal of Excellence scheme, launched in 2015, is a quality label recognising proposals submitted to Horizon 2020 calls which were evaluated as high-quality but were not funded due to lack of available budget. The holder of a Seal of Excellence can approach other sources of funding (regional, national, private, public) with this quality label.

	technologies and new business models and solutions, in particular those resulting from the Framework Programmes.
Neighbourhood, Development and International Cooperation Instrument	The future Neighbourhood, Development and International Cooperation Instrument will merge several EU external instruments existing in the 2014-2020 period[184]. The broad instrument will include a prominent neighbourhood window, strong focus on migration including a 20% unallocated envelope and provisioning for Macro-Financial Assistance. There are inherent complementarities between Horizon Europe and the future Instrument, for example in so far as they both contribute towards the EU's international commitments such as the 2030 Agenda for Sustainable Development[185], the Paris Agreement on Climate Change, or the renewed EU-Africa Partnership among others. The Neighbourhood, Development and International Cooperation Instrument will continue to complement the Framework Programme by building research and innovation capacity (at individual, organisational or institutional levels) including through research infrastructures in third countries and regions. It will support the diffusion and uptake of innovations, the development of human capital and market access for technological solutions developed through collaborative research and innovation.
Innovation Fund under the EU Emissions Trading System	The Innovation Fund under the EU ETS will support low-carbon technology demonstration projects in the EU. It has been established by the revised EU ETS Directive and it will use the proceeds from the auctioning of at least 450 million allowances under the EU ETS, as well as leftovers from the current NER 300 programme. It will specifically target innovative low-carbon technology demonstration projects in industry, renewable energy, energy storage, carbon capture and storage (CCS) or industrial carbon capture and use (CCU) to be developed via the R&I window of the (InvestEU Programme) in addition to resources deployed therein. Horizon Europe will fund the development and demonstration of technologies that can deliver on the EU decarbonisation, energy and industrial transformation objectives.
Internal Security Fund and Integrated Border Management Fund	The future Security and Border programmes will contribute to ensuring a high level of security in the Union, inter alia by tackling terrorism and radicalisation, organised crime and cybercrime, and by supporting the effective implementation of the European Integrated Border Management system. The programmes will support Member States' efforts in these areas, including by incentivising Member States to take up and apply R&I results from the Framework Programme. The Framework Programme will support R&I in the area of security, including border management, in particular though the cluster on Resilience and Security. Potential complementary actions can also be considered under Horizon Europe regarding research and innovation for customs control equipment in view of the Union instrument for financial support for customs control equipment (CCE).
InvestEU Fund	The InvestEU Fund will include financial instruments in four separate policy windows. An R&I thematic window will bundle financing activities that are closely linked to the objectives of the R&I Framework Programme, and dedicated products for innovative SMEs and mid-caps will be deployed through SME window. Blended finance in the Framework Programme will be provided by the EIC to high-risk market-creating innovations. Appropriate synergies with the new InvestEU programme shall be established, in particular regarding budgetary guarantees and leveraging Venture Capital funds supported by InvestEU.
Programme for Environment and	The post-2020 LIFE programme will continue to act as a catalyst for implementing EU environment and climate policy and legislation, including by taking up and

[184] The future External Instrument will merge the following instruments: European Development Fund, Development Cooperation Instrument; European Neighbourhood Instrument; Partnership Instrument for Cooperation with Third Countries; European Instrument for Democracy and Human Rights; Instrument contributing to Stability and Peace; Instrument for Nuclear Safety Cooperation, and the Common Implementing Rules post-2020.

[185] See https://sustainabledevelopment.un.org/post2015/transformingourworld

Climate Action (LIFE)	applying R&I results from the Framework Programmes and help deploying them at national and (inter-) regional scale. LIFE will continue to incentivise synergies with Horizon Europe through the award of a bonus point during evaluation for proposals which feature the uptake of Framework Programmes' results. Horizon Europe will contribute to tackling environmental challenges in particular through the clusters on Health, Climate, Energy and Mobility and Food and Natural Resources by defining relevant R&I activities in the Strategic Research and Innovation Plan.
Single Market Programme, including the Competitiveness of Enterprises and SMEs Programme (COSME)	The post-2020 COSME will address market failures that affect all SMEs and will promote entrepreneurship and the creation of growth of companies. Under the Framework Programme, the European Innovation Council (EIC) will directly support the activities and scale-up of high-risk profile innovative start-ups, SMEs and mid-cap firms, while the InvestEU programme will more broadly focus on R&I-driven innovative companies. The Enterprise Europe Network as a corporate tool with its Key Account Managers will continue to play a role in Business accelerator services of the EIC aiming at providing beneficiaries with access to partners, investors, and assistance (coaching, training, technical support).

Continued simplification will enhance user-friendliness. User-friendliness will mainly be enhanced by maintaining the single set of rules, continuity of funding rates and new simplifications such as the new simplified cost options, and the increased cross-reliance on certified accounting systems. Moreover, the European Innovation Council will also act as a one-stop-shop for innovators looking for funding, while also rationalising existing funding schemes for innovation, and will be clearly and visibly branded as such. European Partnerships will be opened up for all interested stakeholders. The Research Participant Portal is already highly appreciated by stakeholders (as well as other Commission services,) and we will further improve its design for the new Programme. Finally, a "toolbox" will be created to provide a comprehensive overview of all available funding tools in the legal proposal.

Synergies will be enhanced through the revamped strategic planning process, which will allow for identifying common objectives and common areas for activities (such a partnership areas or mission areas) across different Multi-Annual Financial Framework programmes. It will be open for public consultation, involving EU Institutions and citizens and end-users in agenda-setting (co-design) for the Work Programme.

Internal coherence will be strengthened through a redesigned pillar structure. The Framework Programme will not set objectives per pillar but at Programme-level. Each pillar and programme part is expected to contribute to those objectives albeit to different degrees. This will in turn ensure that each euro invested in one area will generate multiple impacts.

The Programme has the flexibility to easily adapt to emergencies or new priorities. The strategic flexibility in the programming process will allow the Commission to react to urgent needs and new priorities well beyond its start date in 2021. The Programme will be able to shift budget allocations within and between pillars. Similarly, the strong cross-disciplinary, cross-sector and cross-border nature of the Programme allow it to produce R&I results relevant to changing circumstances.

Table 8 Contribution of Horizon Europe to the MFF cross-cutting objectives (compared to Horizon 2020)

Delivery for impact	MFF cross-cutting objectives				
	Simplification	Flexibility	Coherence	Synergies	Focus on performance
Strategic planning	0	0	++	+	+
Single set of rules	0	+	+	+	0
Funding model	0	0	0	0	0
Forms of funding	++	+	0	0	0
Blended finance	-	++	0	+	+
Proposal evaluation	-	+	+	0	+
Ex-ante and ex-post audits	+	0	+	+	0
Dissemination & exploitation	-	0	0	+	++
Delegation	0	0	0	+	+

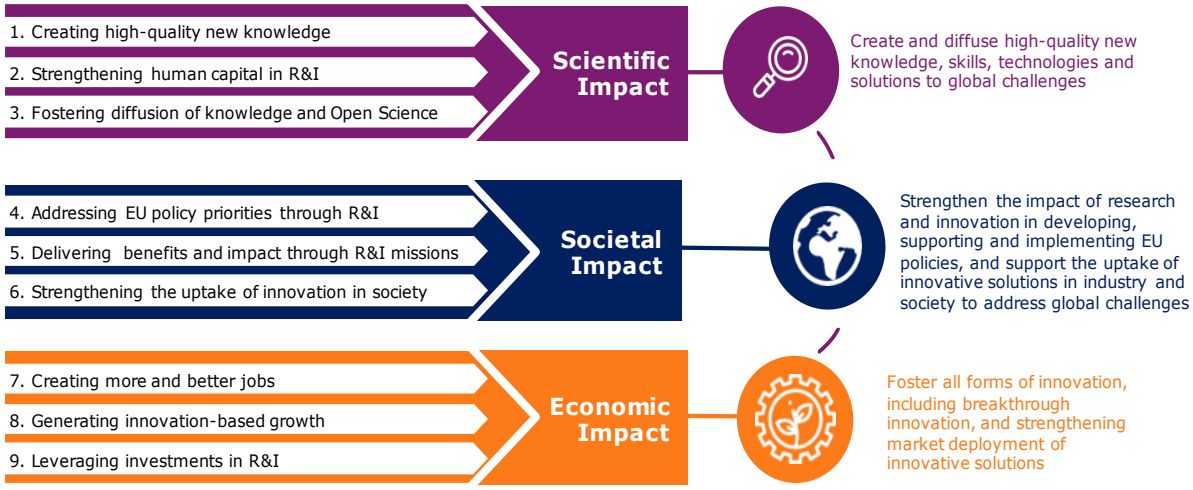
Note: +, ++, +++ correspond respectively to slight, moderate and significant improvement compared to a no-policy change scenario. +/- correspond to a coexistence of positive and negative impacts. – indicates a slight negative impact. 0 means no significant change.

5 HOW WILL PERFORMANCE BE MONITORED AND EVALUATED?

The monitoring and evaluation framework of the new Framework Programme[186] will have three main building blocks:

- **Annual monitoring of the programme performance**: tracking of performance indicators in the short, medium and longer-term according to key impact pathways towards Programme objectives, based on baselines and targets where possible;
- Continuous collection of programme management and implementation data;
- **Two fully-fledged (meta)-evaluations** of the programme at mid-term and ex-post (upon completion).

Figure 10 Tracking performance of the programme along key impact pathways towards impact categories translating the Programme's general objectives



Impact pathways, and related key impact pathway indicators, will structure the annual monitoring of the programme performance (see Annex 6) towards its objectives. The objectives translate into three complementary impact categories (each being tracked along several pathways), which reflect the non-linear nature of R&I investments:

1. **Scientific impact:** related to supporting the creation and diffusion of high-quality new knowledge, skills, technologies and solutions to global challenges;
2. **Societal impact:** related to strengthening the impact of research and innovation in developing, supporting and implementing EU policies, and support the uptake of innovative solutions in industry and society to address global challenges;
3. **Economic impact:** related to fostering all forms of innovation, including breakthrough innovation, and strengthening market deployment of innovative solutions

The impact pathways will be time-sensitive: they will distinguish between the short (typically as of one year, when the first projects are completed), medium (typically as of three years, and for the interim evaluation) and long term (typically as of five years, and for the ex-post evaluation). The impact pathway indicators will contain both qualitative and quantitative information, the availability of which will depend on the state of implementation of the Programme. These indicators serve as proxies to report on the progress made towards each type of impact at Programme level. Individual programme parts will contribute to these indicators to a different degree and through different mechanisms. Additional indicators

[186] Including Missions and European Partnership Initiatives

might be used to monitor individual programme parts when relevant and commensurate. These indicators proposed (see Annex 6) reflect the lessons learnt from the interim evaluation of Horizon 2020: all Horizon 2020 indicators related to outputs, results and impacts are maintained but streamlined and further specified to cover the whole programme. The management and implementation data is still collected but is separated from the key performance indicators, as illustrated in Table 9.

Table 9 Monitoring and Evaluation Frameworks

Horizon 2020	The new Framework Programme
3 headline indicators not directly attributable to the programme[187] 55 Horizon 2020 Key performance and Cross-Cutting issues indicators: ▪ 27 are related to management and implementation data (e.g. funding, participation) ▪ 28 are related to outputs, results or impacts, out of which: o none is related to the programme as a whole (covering only programme parts) o 9 relate to publications o 7 relate to intellectual property rights and innovations o 4 relate to leveraged funding o 4 relate to researchers' mobility and access to infrastructures	➢ All Horizon 2020 indicators related to outputs, results and impacts are maintained but streamlined and further specified to cover the whole Programme ➢ Management and implementation data are still collected and made available in close-to-real time through Dashboard but are not part of "performance indicators" ➢ Key indicators are set at Programme level according to the Programme objectives and are attributable to the Programme ➢ Key indicators are classified according to 9 key impact pathways, for tracking impact through short, medium and long term indicators – for more accurate reporting over time ➢ Higher reliance on external data sources, qualitative data and automated data tracking to minimise burden on beneficiaries ➢ Possibility for programme part or action specific indicators (but not in the legal base)

The micro-data behind the key impact pathway indicators will be collected in a centrally managed and harmonised way, with minimal reporting burden. This will be achieved, for example, by collecting at proposal stage the unique identifiers of applicants, by sourcing data automatically from existing external public and private databases also after project's end (e.g. data on publications, patents, employment and turnover), by adopting new ICT tools (e.g. text mining) and by using alternative primary data sources (e.g. expert reviews). Longer-term impact indicators may be estimated based on dedicated studies. The data collected will allow tracking disaggregated indicators and be analysed per type of action, type of organisation, type of collaboration, sectors, disciplines, calls, countries (including associated and third countries).

Baselines, targets, and benchmarks will be established prior to the Programme's launch. External experts will help establish accurate and timely baselines, and propose targets with appropriate benchmarks, where relevant. To the extent possible data will also be collected for control groups to allow counterfactual evaluation designs:

- Propensity score matching- based on pairing with similar researchers/companies and the development of panel data;
- Regression discontinuity design based on the comparison of the performance between successful and unsuccessful applicants (pending their approval on data use);
- Difference-in difference based on the comparison of the performance of beneficiaries before/after the Programme.

[187] Share of GDP invested in research and development; evolution of the Innovation Output Indicator, share of researchers as part of the active population.

Management and implementation data for all parts of the Programme and all delivery mechanisms[188] **will continue to be collected in close to real-time.** This data will be collected in a centrally managed and harmonised way through the Common Support Centre. It will also continue to be publicly available on a dedicated on-line portal in close to real-time allowing extraction per programme parts, types of actions and types of organisations (including specific data for SMEs). This will include inter alia proposals, applications, participations and projects (number, quality, EU contribution etc.); success rates; profiles of evaluators, applicants and participants (partly based on unique identifiers, and including country, gender, turnover, role in project etc.); implementation (including time-to-grant, error rate, satisfaction rate and the rate of risk taking etc.); and financial contribution to EU climate and environmental objectives and other mainstreaming targets. A yearly analysis of progress on key dimensions of the Framework Programme's management and implementation will be carried out.

The evaluations of the new Framework Programme will ensure coherence of methodologies and comprehensiveness of coverage (i.e covering all programme parts and all delivery mechanisms). Evaluation of individual programme parts can continue to make use of specific indicators that complement relevant the Programme-level indicators. The evaluation of the Framework Programme will build on the coordinated evaluations of each programme part, type of actions and delivery mechanism according to common evaluation criteria and standard methodologies (incl. counterfactual analysis and qualitative approaches such as case studies). The comprehensive interim evaluation of the entire Framework Programme is foreseen by 2024, to draw the first lessons from the changes introduced in the new Framework Programme. A full-scale ex-post evaluation is planned by 2030 to provide a full assessment of the new Programme and report on the longer-term impacts of previous ones.

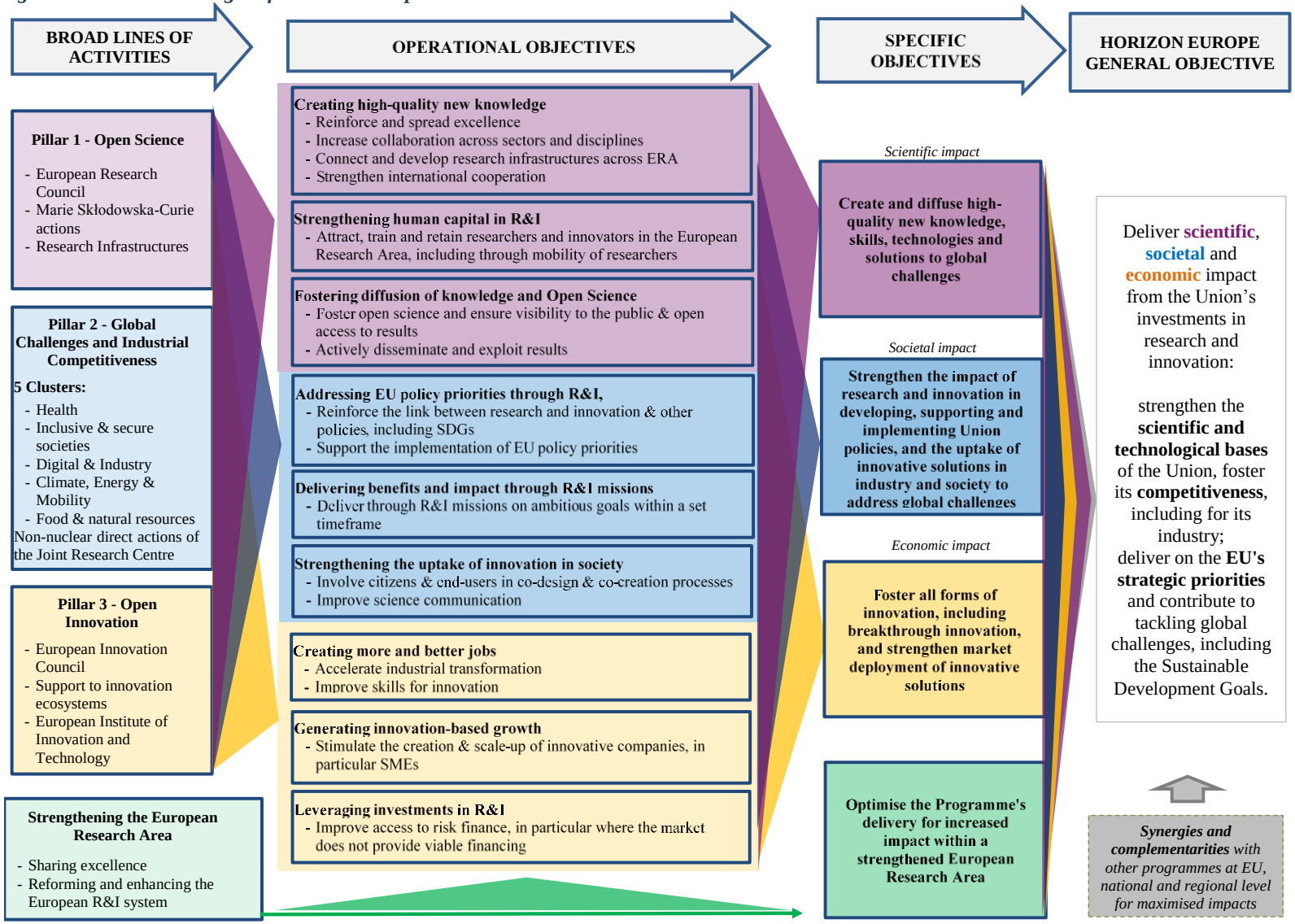
Lastly, evaluations will better account for the coordinated impact of R&I support at EU, national and regional level, building on existing work to better track the impact of EU R&I Programmes at national level[189]. The European RTD Evaluation Network[190]will provide the basis for a substantially increased cooperation with Member States and Associated States.

[188] Including European Partnerships.

[189] European Research Area and Innovation Committee (2017), Final Report of the ERAC Ad-hoc Working Group on Measuring the Impact of EU Framework Programmes for Research and Innovation at National Level. Available at: http://data.consilium.europa.eu/doc/document/ST-1206-2017-INIT/en/pdf.

[190] More information available at: https://ec.europa.eu/research/evaluations/index.cfm?pg=network.

Figure 11 Intervention logic of Horizon Europe



Source: European Commission, DG Research and Innovation