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EVALUATION

Accompanying the document

REPORT FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT AND THE COUNCIL

Ex-post evaluation of Horizon 2020, the EU Framework Programme for Research and Innovation

{COM(2024) 49 final} - {SEC(2024) 52 final} - {SWD(2024) 30 final}

ANNEX I. PROCEDURAL INFORMATION

The *ex post* evaluation of the Horizon 2020 programme (Decide reference: PLAN/2022/785) has been developed under the lead of DG RTD, under the guidance of the interservice steering group (ISSG) composed of 29 DGs (AGRI, BUDG, CLIMA, CNECT, COMM, COMP, DEFIS, EAC, ECFIN, ECHO, EMPL, ENER, ENV, GROW, HOME, HR, IAS, INTPA, JRC, MARE, MOVE, NEAR, OLAF, OP, REGIO, SANTE, SG, SJ, TRADE) and 4 Executive Agencies (CINEA, EISMEA, ERCEA, HADEA) established in April 2022.

The ISSG met in April 2022 to discuss the expectations of participating services, the draft call for evidence, the draft consultation strategy and the working methods of the ISSG. Following this ISSG the call for evidence was then published in July 2022 for four weeks and received 35 individual replies (presented in Annex 5). The ISSG met again in October 2022 to discuss the feedback received on the call for evidence and the draft questionnaire for stakeholder consultation.

Following this ISSG meeting, the stakeholders' consultation was launched on 1 December and closed on 19 February, having gathered 1 818 replies. The ISSG met for the third time in February: an update was provided about the late advancement of external evaluation studies, emerging findings were discussed and a draft evaluation (SWD) was presented and open for comments. Main messages from the upstream meeting with the Regulatory Scrutiny Board were shared with the member of the ISSG. A revised version of the evaluation (SWD) was open for comments in March by the Directorates General and agencies of the Horizon Europe governance and comments were integrated. The ISSG met on 3 May 2023 to discuss the draft final version of the evaluation SWD before submission to the Regulatory Scrutiny Board (RSB).

This evaluation has been selected for scrutiny by the RSB. The outcome of the scrutiny was the issuance of a negative opinion, following a dedicated meeting on 21 June 2023. In the first negative opinion the Regulatory Scrutiny Board pointed at areas for improvement relating to:

Strengthening the effectiveness and efficiency analysis	• Under Chapter 4.1.3 on economic impacts, a new section was added on 'Improving Europe's economic growth and competitiveness', while the section on 'Facilitating access to risk capital' has been expanded. Under Chapter 4.1.2 on societal impacts, it is recognized that societal impacts take a longer time to become visible and the shortcomings of the monitoring system are recognised, noting that the conclusion is based not only on KPI data but also on qualitative evidence from the enclosed case studies. The section on 'Promotion of gender equality in Horizon 2020' has been completely revised by recreating the missing point of comparaison (FP7) and explaining the data limitations. The assessment period for GDP gains (cumulative and average annual) was changed from 2014-2030 to 2014-2040, to allow enough time for impacts to emerge as the last projects will only end in December 2028. • Under Chapter 4.2 on efficiency, a Benefit Cost Ratio (BCR) of 5 to 1 is stated, referring to a newly created Section 5 in Annex 4 for calculations and further discussion of the BCR. It is clarified that the assessment considers actual, paid out amounts for the EU budget, with data frozen on 1 January 2023. The quantification of time saved from faster grant agreements was corrected. A new section has been added on 'What are potential areas for further simplification?', covering lump sum funding (including expanded data from the pilot exercise), Seal of Excellence (moved from the External Coherence chapter) and the two-stage application process. • Chapter 4.3.1 on internal coherence has been expanded.

	• In Chapter 4.4 on EU added value, the section of leverage now explains that, as different types of participants have different funding rates, even within the same type of action, it is not possible to determine a priori the 'expected' direct leverage factor per type of action. There was no target set for leverage in Horizon 2020 and benchmarking against FP7 is not appropriate, because the two programmes have different types of action with different funding rates. Instead, benchmarking against two other programmes is included, with some limitations. In addition, in the final revision of the FP-wide counterfactual analysis, causality links were explained in more detail – additional information was added on the approach used, including analysis of only comparable companies and ensuring a sufficient number of lead and lag years in the FP-wide counterfactual analysis.
Strengthening the cost benefit analysis	The benefit cost ratio of 5:1 has been added in the main SWD. The overview table and further explanations are available in a new dedicated section in Annex 4. Quantification of costs and benefits has been privileged but non quantified benefits are also presented in Annex 4. In the final revision, information on the benefit cost ratio in the main report was extended (based on information previously in Annex 4). The estimate of the total beneficiaries' administrative cost of Horizon 2020 was added to the main cost table in Annex 4.2 and given more visibility. The price base of the total benefit estimate used in the BCR calculation was changed to current prices. The BCR calculation table presents alternative values broken dwon by model used and assessment period. The central model output used for the calculation of the GDP gain (total benefits) was changed from Nemesis to Rhomolo, to present a more conservative estimate. Additional information on application costs found at Horizon 2020 interim evaluation was added in Annex 4 as a point of comparison.
Strengthening the conclusions	Conclusions have been re-organised and twice further elaborated by repeating some key statistical data from the evaluation findings. For Societal Challenges, conclusions explain the deficiencies of the monitoring system and longer timespan needed to contribute to societal challenges. Following improved analysis of gender aspects, this conclusion has been updated. New conclusions have been added on boosting Europe's economic growth and competitiveness and the cost-benefit ratio. The main areas for improvement are identified: research infrastructure, dissemination and exploitation of R&I results and measures aimed at widening participation in the programme. In the final revision, a new score was added for the programme's contribution to *Europe's* competitiveness. Also the following note was deleted because data was available only for IPR: 'It is expected that the programme will further improve its performance as ongoing projects come to an end, in line with IPR outputs from FP7, which more than doubled in 2023 after the final evaluation of FP7 (2015)'. Lastly, a new sentence was added to further acknowledge uncertainties caused by the ongoing implementation of 41% of the projects, while informing that the cumulative implementation rates at the time of the evaluation were 99.99% for Horizon 2020 commitments and 87.84% for payments. Similar statement also added in the section on 'How has the situation evolved in the reporting period'.
Strengthening lessons learned	The section on lessons learned has been expanded, reflecting all the elements from the previous analysis where any shortcomings were identified and coherent with the overall picture presented in the conclusions. An update has been provided on the main short-term and long-term suggestions for improvement made by the interim evaluation of Horizon 2020. In the final revisions, status was provided for three lessons learned from the interim evaluation, on the programme externalisation, feedback to policy and international cooperation. It was also clarified which lessons learned came from the interim evaluation and which ones from the final. Lastly, when response to a lesson learned was finalised, this was indicated, though most points will require continuous monitoring and follow up in future (Horizon Europe) evaluations.

Following the negative opinion, the ISSG had a written consultation on the revised SWD between 25 August and 5 September. Based on this, the revised evaluation was resubmitted to the RSB on 15 September 2023 – receiving a positive opinion on 12 October 2023.

In the second, positive opinion the Regulatory Scrutiny Board pointed at further areas for improvement relating to:

The report should better explain the underlying assumptions behind the derived Benefit-Cost-Ratio	Assumptions behind the Benefit Cost ratio expanded in the SWD
Given the report's finding that Europe's overall competitive position has not fundamentally changed over the duration of Horizon 2020, while indicating that this does not imply that Horizon 2020 did not contribute to competitiveness, the report should be more balanced in concluding and scoring Horizon 2020'scontribution to boosting EU's competitiveness.	Language nuanced regarding the direct contribution of Horizon 2020 in boosting EU competitiveness
The report should elaborate further on the data limitations related to having 59% of finalised projects. The fact that more projects have been finalised than under FP7 at the corresponding moment does not present a solid base for drawing firm conclusions. (past performance does not guarantee to be repeated). In general, the conclusions should be more nuanced for specific parts of the programme.	Data on finalised projects at the time of the evaluation could not be updated. 59% is higher percentage at the time of the final evaluation of FP7 (50%). Timing of the evaluation could not be postponed but 59% of finalised projects is deemed a solid base.
Several scores allocated in the conclusion section should be critically reviewed to better reflect the outcome of the impact analysis.	Scoring double checked
The report should critically review some of the assumed causality links, such as that Horizon 2020 beneficiaries invest more, recruit more and grow more than nonbeneficiaries.	Different analyses were run for this purpose covering different samples and using a diverse set of methods. An overview of those along with their caveats is provided in Annex 2. The results of the analyses agree in finding positive effect on firms' employment and revenues growth. One of those, which tracks firms up to 5 years before and after their application for funding, found that beneficiary firms increase on average their employment level by 20% compared to non-funded firms with high quality proposals, and their total revenues by about 30% in the years following the receipt of the first grant. These average effects are present even after 2.5 years (the average duration of a project in the sample).
The report should better distinguish between what has been learned from the final (or mid-term) Horizon 2020 evaluation, and be more explicit on which lessons have already been (partly) taken up and revised in the successor programme, and which remain relevant for future revisions in this policy area.	Language reinforced

No exception from the usual procedural requirements of the better regulation guidelines was requested for this evaluation.

This evaluation is based on evidence gathered via different channels and an overview is presented in Annexes 2 and 3. The main sources of evidence are internal analyses by the European Commission, analysis and reports by other European Institutions and by external evaluators who worked on twelve evaluation studies, carried out between 2021 and 2023, listed in Annex 2.

The external evaluation studies operated under the steer of interservice groups composed of relevant Commission services which at the end of the studies agreed on the adequacy of the resulting final reports, with particular respect to their relevance, appropriate design, reliable data, sound analysis and reliable findings.

ANNEX II. METHODOLOGY AND ANALYTICAL MODELS USED

The *ex post* evaluation of Horizon 2020 was coordinated by the Common Programme Analysis & Regulatory Reform Unit of the Commission's Directorate-General for Research & Innovation, with the support of: (i) a working group (the 'MEAVE' - Impact Monitoring, Evaluation and Analysis Virtual Entity) gathering together the R&I family DGs and Executive Agencies; (ii) and an interservice steering group comprising relevant Commission DGs. The *ex post* evaluation of Horizon 2020 started in 2022 and was guided by the Terms of Reference adopted by the Commission after a vote by the Member States' Programme Committee[1].

The evaluation builds on: (i) a large amount of quantitative and qualitative evidence collected through a variety of methods described below; and (ii) a thorough evaluation analysis, applying triangulation of evidence from different sources, ensuring an objective and robust assessment.

Main data sources

The scope of the Horizon 2020 *ex post* evaluation includes all calls with a closure deadline on 31 December 2020 and grants signed by June 2022. Section 3 provides data on how programme implementation evolved from its launch until 1 January 2023, when 41% of projects were still ongoing. Section 4 provides an analysis of the programme based on triangulation of evidence predating 1 January 2023 (most external evaluation studies were carried out during 2022, with programme data extracted at the end of 2021).

The analysis was based on the following data sources:

- The main source of data for the evaluation is the Common Research Data Warehouse (CORDA) Portal. The portal gathers data collected through different Commission tools, including policy monitoring at work programme level, data collected at proposal stage, grand agreement preparation and through continuous project reporting.
- Beyond CORDA, additional datasets were used. This was also to have comprehensive data on the whole framework programme, in particular for the different partnerships (such as European Institute of Innovation and Technology knowledge and innovation communities (EIT KICs) and joint undertakings (JUs)), for the Joint Research Centre (data and analysis provided by the JRC on its activities) and Innovation Radar data.
- Evidence and analysis conducted in the interim evaluation of Horizon 2020[2], the interim evaluation of the EIT[3], and the independent High-Level Group on maximising the impact of EU research & innovation programmes (the 'Lamy Group')[4].
- External datasets such as Scopus[5], Orbis[6], PATSTAT, Crunchbase, Dealroom, Pitchbook, Technote, and MAG/OpenAlex.

[1] C(2022) 7817.
[2] https://op.europa.eu/en/publication-detail/-/publication/bccdcce7-d8c9-11e8-afb3-01aa75ed71a1/
[3] https://op.europa.eu/en/publication-detail/-/publication/7415ff23-db2d-11e8-afb3-01aa75ed71a1
[4] https://ec.europa.eu/info/sites/default/files/conferences/sof/hlg_2017_report.pdf
[5] https://www.scopus.com/search/form.uri?display=basic#basic
[6] https://orbis.bvdinfo.com/version-202251/Orbis/Companies/Login?returnUrl=%2Fversion-202251%2FOrbis%2FCompanies

- Monitoring reports of Horizon 2020[7] and statistical data mainly from the Commission's internal IT Tools (Horizon Dashboard), as well as Eurostat/OECD data.
- Extensive quantitative and qualitative analyses on specific aspects and objectives of Horizon 2020, conducted through 12 external evaluation studies by independent evaluation experts, selected using a transparent process and overseen by relevant Commission departments.

Seven studies covered specific aspects of Horizon 2020. These were: • Evaluation study on the '**Opportunities and Challenges in Targeted Funding of Research and Innovation: Lessons learnt from the Horizon 2020 Focus Areas and implications for Horizon Europe Missions**', https://data.europa.eu/doi/10.2777/40351 • Evaluation study on the **Open access policy study**, https://data.europa.eu/doi/10.2777/268348 • Evaluation study on the **proposal evaluation system under Horizon 2020**, https://data.europa.eu/doi/10.2777/16211 • Evaluation study on the **European Innovation Council (EIC) Pilot**, https://data.europa.eu/doi/10.2777/261324 • Evaluation study on the **external coherence & synergies of Horizon 2020 within European R&I support system**, https://data.europa.eu/doi/10.2777/054469 • Evaluation study on the **relevance & internal coherence of Horizon 2020 and its policy mix**, https://data.europa.eu/doi/10.2777/058655 • Evaluation study on the implementation of **cross-cutting issues in Horizon 2020**, https://data.europa.eu/doi/10.2777/763665
Five other studies covered specific policy objectives of the programme: • Evaluation study on **Excellent Science** in the EU Framework Programmes for R&I, https://data.europa.eu/doi/10.2777/967813 • Evaluation study of the EU Framework Programmes for R&I for addressing Global Challenges and Industrial Competitiveness – Focus on activities for a more **Resilient Europe**, https://data.europa.eu/doi/10.2777/60819 • Evaluation study of the EU Framework Programmes for R&I for addressing Global Challenges and Industrial Competitiveness – Focus on activities for the **Digital and Industrial Transition**, https://data.europa.eu/doi/10.2777/99438 • Evaluation study of the EU Framework Programmes for R&I for addressing Global Challenges and Industrial Competitiveness – Focus on activities related to the **Green transition**, https://data.europa.eu/doi/10.2777/422725 • Evaluation study of the EU Framework Programmes for R&I for an **Innovative Europe**, https://data.europa.eu/doi/10.2777/144504

- Data from other EU institutions, such as the Conclusions on the Interim Evaluation of the Council, the work of the European Parliament's ITRE committee, relevant Court of Auditors' reports[8] and reports/evaluations of the European Economic and Social Committee.
- Input from the public consultation on the Horizon 2020 *ex post* evaluation. This consultation received input from 1 818 respondents and 21 position papers.

Detailed descriptions of the models and methods used in the different information sources mentioned above are available in each respective external study and internal analysis report. Below is a short overview.

[7] https://ec.europa.eu/info/publications/horizon-2020-monitoring-flash_en

[8] For the section on leverage of JUs, the ECA Annual report on EU Joint Undertakings for the financial year 2021 was used and its underlying data. For S2R, the EU contribution includes administrative contributions of EUR 13.5 million. If these are disregarded, the expected leverage factor becomes EUR 1.22, instead of the EUR 1.18 reported.

Main methods used

1. Macroeconomic modelling

Measuring the full impact of R&I, i.e. capturing indirect effects on top of direct ones, is an intricate question, compounded by the often relatively long time lags between policy initiatives and observed actual impacts. The European Commission uses complementary modelling platforms for both the *ex ante* and *ex post* evaluations of research and innovation policies.[9] In this annex, macroeconomic modelling is used to quantify the economic impact of Horizon 2020 in terms of GDP gain and job creation in the EU. While there is consensus that R&I is an important factor in increasing productivity, quantifying the impact of R&I policies at macroeconomic level requires modelling tools that accurately capture how R&I translates into economic gains.

There are several models available to assess the dynamic transmission channels of R&I, each with specific features. This *ex post* evaluation uses results produced by three macroeconomic models: NEMESIS, QUEST and RHOMOLO. This is an *ex post* assessment in the sense that the input data on the Horizon 2020 investments are up to date and reflect the actual disbursements during the programming period. However, the results should not be regarded as a way to exactly track and monitor the actual macroeconomic impact of the Horizon 2020 interventions. This is because they rely on assumptions both on the modelling setup and on the simulation strategy adopted to simulate the investments' impact (i.e. the economic channels activated by them).

Results from NEMESIS were produced by a team of external experts, while RHOMOLO and QUEST results were produced by European Commission departments (the Joint Research Centre for RHOMOLO and DG Economic and Financial Affairs for QUEST). The strength of these models lies in their distinct features. NEMESIS is considered one of the richest models covering *different types* of innovation.[10] QUEST is the most appropriate for assessing the impact of R&I policies *over time*. By modelling regional economies, RHOMOLO is the most suitable model to address the *geographical concentration* of innovative activities.

[9] European Commission, Directorate-General for Research and Innovation, Benedetti Fasil, C., Martino, R., Ravet, J. (2020), *Macroeconomic models for Research and Innovation policy: the present and the future*, Publications Office https://data.europa.eu/doi/10.2777/339051.
[10] Di Comite and Kancs (2015).

1.1. NEMESIS

Presentation of the model

NEMESIS was developed by a European consortium[11] in 2000 to analyse the macro-sectoral impacts of EU policies, based on R&D investments and related knowledge spillovers. The model became a reference tool for assessing EU and national R&I policies, and since 2004 has been used by the European Commission for several analyses. These include the assessments of: (i) the Lisbon Strategy target of 3% of EU GDP to be invested in R&D[12]; (ii) the RTD national action plan related to the Barcelona Objective[13]; and (iii) the impact of European R&I programmes (*ex ante* assessment of the 7th Framework Programme[14], of Horizon 2020[15], and of Horizon Europe[16]).

Structure of the model

NEMESIS is a detailed sectoral macro-econometric model estimated for every country of the EU. It distinguishes between 30 sectors operating within five-level nested-CES functions.[17] The model covers both the supply and demand sides of the economy and incorporates endogenous technical change. Specifically, the representation of technical progress in NEMESIS is derived from the new growth theories, where innovations result from investment in R&D by private firms, and from R&D undertaken by the public sector. In the latest version of NEMESIS used for this *ex post* evaluation (as well as for the interim evaluation of the H2020 programme in 2017), innovations still arise from private and public investments in R&D, as well as investments in two other complementary innovation inputs: ICT and other intangibles (OI), including training and software. These enable improved accuracy in assessing R&I policies by considering the most up-to-date theoretical and empirical findings of economic literature (Le Mouël, 2019; Akcigit et al., 2022).

Table 1: The innovation mechanism in NEMESIS

Schematically, the innovation mechanisms of the model, at the level of a firm (or a sector), can be described as follows:

- Firms determine their investments in the three innovation inputs (private R&D, ICT and OI), depending on their relative costs and their degree of complementarity.
- The investment effort by firms increases their own knowledge (stock variable) as well as the knowledge of other firms, sectors and countries, through the knowledge spillover matrices (knowledge transfers). For each innovation input, the knowledge stock is modelled as a weighted sum of the stock of assets, R&D, ICT or OI, belonging to all sectors

[11] Lab. ERASME / Ecole Centrale Paris (now SEURECO), Federal Planning Bureau of Belgium, E3M3 lab. / ICCS /NTUA and Chambre d'Industrie et de Commerce de Paris.
[12] Brécard, D., Fougeyrollas, A., Le Mouël, P., Lemiale, L. and P. Zagamé (2006), 'Macro-economic consequences of European Research Policy: Prospects of the NEMESIS model in the year 2030', *Research Policy*, No 35(7), pp. 910-924. Doi:10.1016/j.respol.2006.03.001.
[13] Chevallier, C., Fougeyrollas, A., Le Mouël, P., and P. Zagamé (2006), 'A time to sow, a time to reap for the European Countries: A macro-econometric glance at the RTD National Action Plans', *Revue de l'OFCE*, 2006/5 (No 97 bis), pp. 235-257. Doi:10.3917/reof.073.0235
[14] Delanghe, H. and U. Muldur (2007), 'Ex-ante impact assessment of research programmes: The experience of the European Union's 7th Framework Programme', Science and Public Policy, No 34(3), pp. 169-183, doi:10.3152/030234207X218125.
[15] European Commission (2012), *The Grand Challenge – The design and societal impact of Horizon 2020*, Directorate-General for Research and Innovation. Doi:10.2777/85874.
[16] European Commission, Directorate-General for Research and Innovation, (2018), *A new horizon for Europe: impact assessment of the 9th EU framework programme for research and innovation*, Publications Office https://data.europa.eu/doi/10.2777/194210.
[17] European Commission, Directorate-General for Research and Innovation, Benedetti Fasil, C., Martino, R., Ravet, J. (2020), *Macroeconomic models for Research and Innovation policy: the present and the future*, Publications Office. https://data.europa.eu/doi/10.2777/339051

and countries. The coefficients of the matrices used to build these stocks are calibrated based on patent citations between sectors and countries. These matrices combine the citations between patents allocated by technology classes and country with the OECD concordance table, in order to allocate these citations **between sectors (Johnson, 2002). For R&D, the knowledge stock is also influenced by the public investments undertaken by the public sector.**

- The growth in knowledge stocks will generate innovations at a rate that is a positive function of the knowledge absorption capacity of the firm (measured by its investment intensity in each innovation input).
- Innovations take two forms: product and process. Product innovations increase the intrinsic quality of the product sold by the firm, whereas process innovations improve the production process without changing the quality of the product (pure total factor productivity effect).
- Product innovations have a direct positive impact on the internal and external demands addressed to the firm, while process innovations reduce its production cost, and, in a competitive market context, lowers its market price and increases its demand.
- These dynamics at firm or sectoral level are brought together at the macro level by the input-output tables of the model, and the combination of the sectoral interdependencies ('bottom-up') with the 'top-down' macroeconomic forces finally drive the medium- and long-term dynamics of the model.

Key assumptions for the *ex post* evaluation

Key assumptions in NEMESIS for assessing the impact of the H2020 relate to the financing of the programme, the leverage effects of the framework programme investments[18], and the framework programme's economic performance (EU added value)[19]. For the purpose of this evaluation, it is assumed that the H2020 programme was financed by a reduction of public investment equivalent, at Member State level, to the EC contribution. The importance of this cut in public investment in the individual Member States is proportional to their historical contribution to the EU budget. There are net contributors and net beneficiaries, depending on how successful each Member State was at benefitting from the framework programme and their relative contribution to the EU budget.[20] Additionally, it is also assumed that the framework programme has no direct crowding-in and crowding-out effects on basic research. This assumption was retained from the *ex post* evaluation of FP7 by PPMI in 2017[21] and the survey of the dedicated literature realised for the *ex ante* assessment of Horizon Europe in 2018[22].

The assumptions retained are summarised in Table 2.

[18] Amount of additional R&I expenditure leveraged by the initial R&I investment. Note that besides this 'direct' crowding-in effect of the FP on the R&D investments made by its beneficiaries, there is an 'indirect' crowding-in effect that is the additional R&D investments engaged by a research entity, financed by the FP or not, as a response to the modification of the overall economic activity that the FP provokes (and not as the direct result of the EC financial support, as for the direct crowding-in effect). The total crowding-in is therefore the sum of the direct and the indirect crowding-in.

[19] i.e. how much the performance of the R&I investments provoked by the FP (in terms of R&I outcomes) is superior to those of the R&I support from other sources of funding (including national sources).

[20] Note that for the *ex ante* and *ex post* evaluations of FP7, and for the *ex ante* and interim evaluations of H2020, no financing of the programmes was considered, and the FP money was supposed to come from 'nowhere'.

[21] PPMI, 2017.

[22] Boitier et al., 2018.

Table 2: Key assumptions of the NEMESIS model

FINANCING	DIRECT CROWDING-IN EFFECT	EU added value
Equivalent decrease of public investments	Basic research: €0 Appl. res.: +€0.15 Average: +€0.087	+15%

The value of EUR 0.15 for the framework programme's direct crowding-in effect on applied research was retrieved from the review of dedicated literature realised in 2018 for the *ex ante* assessment of HE[23]. The value of +0.15% for the EU added value of the programme was already used in the *ex ante* impact assessment of H2020 with NEMESIS in 2012[24], based on the evaluation of past FPs. Finally, Table 3 reports the assumptions underlying the precise outline of the framework programme budget, its annual layout, and the distribution of the Commission contribution between basic and applied research, Member States and the different economic activities.

Table 3: Horizon 2020 budget and its repartition

Programme	H2020 budget (EC contribution, in constant billion € 2020)	average duration of FP7 projects (in month)	Repartition between basic and applied research	National allocation of funds	Sectoral allocation of funds
H2020	Horizon 2020 budget in constant prices	35	Basic: 42% Applied: 58%	Historical (based on H2020 dashboard)	Historical (based on H2020 dashboard and Orbis for private for-profit entities)

All the data used for this *ex post* evaluation of H2020 come from 'observed' information available in the H2020 dashboard. Out of a total budget of 68.4 billion 2020 euro in the H2020 dashboard[25], only 61.7 billion was retained in the study. This was done by subtracting the part of the EC contribution that benefits countries outside the EU-28. The split between basic and applied research was 42% for basic and 58% for applied[26], and 40% and 60% respectively if we take into account the total cost of the projects financed. The national allocation of the funds was also based on the H2020 dashboard, and appears very stable compared to FP7 data and to the H2020 data up to August 2016 used in 2017 for the interim evaluation. The sectoral allocation of applied research was itself based on the H2020 historical data for private corporations and on the Orbis database, to make the sectoral mapping using the NEMESIS model.

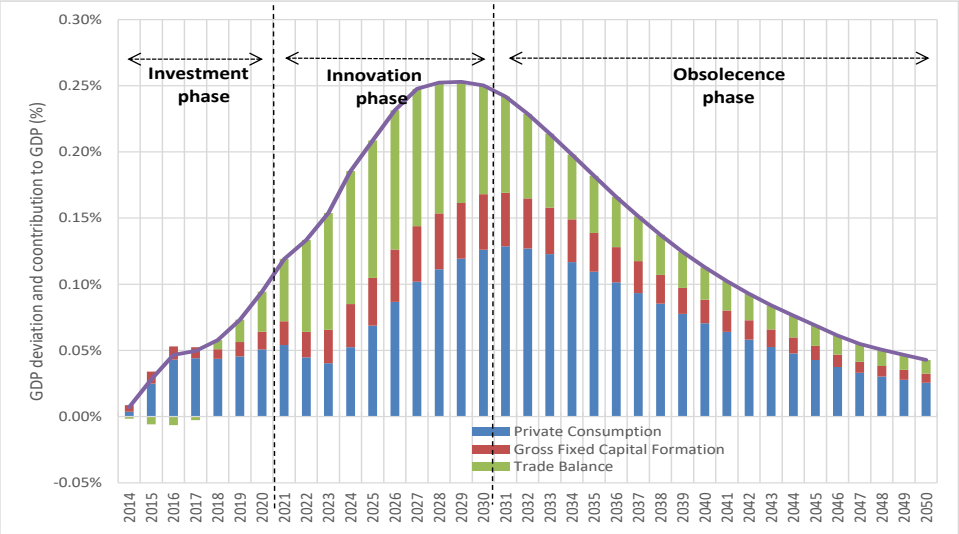
[23] Boitier et al., 2018.
[24] EC, 2012.
[25] With this limitation that the H2020 data used for this *ex post* evaluation include only the figures encoded in E-Grants, related mainly to grants agreements signed in the H2020 dashboard. The overall H2020 covers also other actions (i.e. studies, management and administrative expenditure for the programme, subscriptions, financial instruments, etc.) that are not encoded into E-grants. As such, the dashboard does not contain all the activities/actions/expenditure financed under the programme, and this may slightly (about 5%) under-evaluate the programme's impact on the main indicators presented in this report.
[26] For this repartition, the EC contribution that benefits public bodies and higher education institutions was considered as basic research, and the remaining as applied research. These shares of about 40% for basic research and of 60% for applied were also used in the interim evaluation of H2020 and correspond to the repartition targeted by the Commission when designing the H2020 programme.

Results

Results from the NEMESIS model indicate that Horizon 2020 produces positive effects on GDP. Figure 1 displays the results from the simulation across three main phases: 'Investment', 'Innovation' and 'Obsolescence'.[27] Positive, although limited, GDP gains are already observed in the investment phase: about +0.05 points in average between 2014 and 2020. During these first years, the positive effects of the programme on GDP come mainly from its crowding-in on the R&D investments by programme beneficiaries. The programme is financed by an equivalent cut in public investments in Member States, but the crowding-in effect induces a net positive impact on investment at the macroeconomic level. The high and direct content in labour of R&D investments, compared to other forms of investments, also raises households' income and final consumption, from where the main GDP gains during this first phase originate. There are in return inflationary pressures that deteriorate the external balance during the first 4 years of simulation, but the situation begins to improve from 2018 with the arrival of the first innovations the programme contributed to financing.

GDP gains increase significantly during the innovation phase, reaching a maximum of about +0.25 points in 2027 up to 2030, and an average of about +0.20 points on 2021-2030. After 2030, GDP gains start to gradually decline due to the gradual obsolescence of the new knowledge and the innovations the programme contributed to creating.

Figure 1: The impact of H2020 on EU GDP and its components



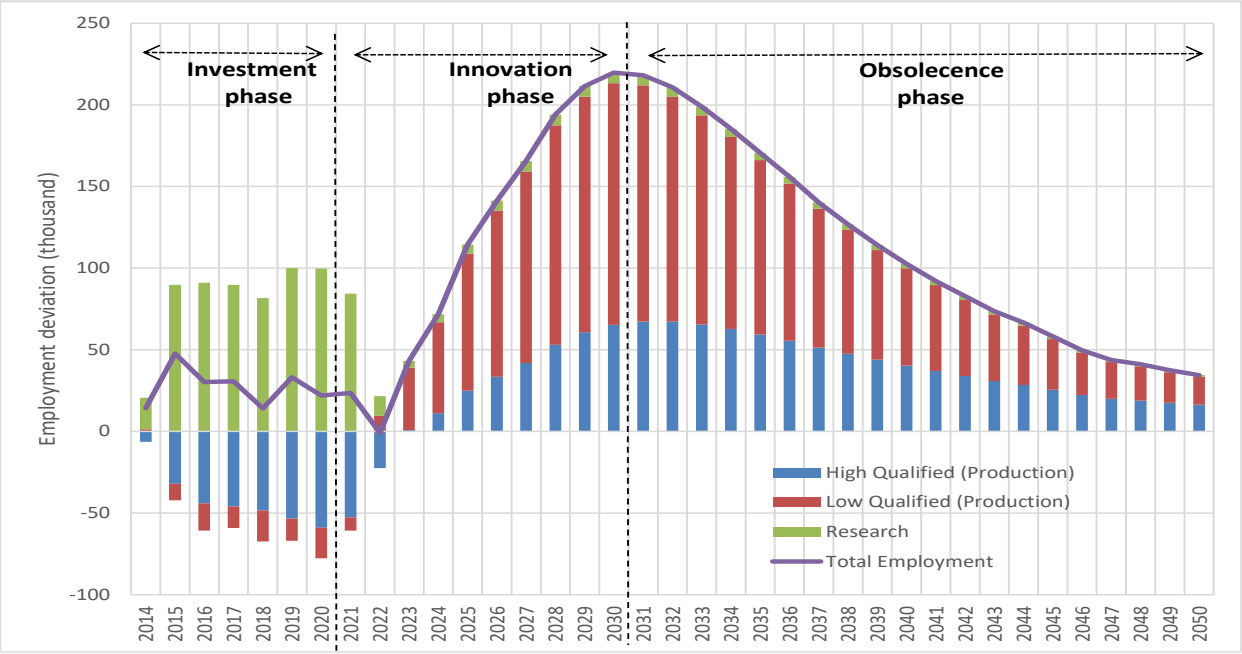
Source: PPMI - NEMESIS simulation.

Positive impacts are observed also on the employment level. As reported in Figure 2, the *investment* phase (up to 2020) is characterised by a significant increase in the number of people employed in the research sector, with the creation of up to 100 000 jobs in research by 2019-2020, and an average rise of about 85 000 jobs compared to the situation in the reference scenario. In turn, high-qualified employment in production activities experience a reduction,

[27] For simplicity, the three phases follow each other chronologically in the figures, but in reality they overlap.

partly due to a re-allocation of high-skilled workers from these sectors to research positions, and partly due to the rise in wages received by qualified workers, which in turn reduces the overall demand for this category of personnel. The same mechanism also induces a slight reduction in the number of low-qualified people employed in production. During the *innovation* phase, the market deployment of the innovations provoked by the H2020 programme translates into substantial job creation in every economic sector. On average, for 2021-2030 the gain in total employment is about +123 000 (with +15 000 for research employment, and +23 000 and +85 000 respectively for high- and low-qualified employment in production). As with GDP, the employment gains decrease gradually during the *obsolescence* phase, from +229 000 in 2030, when they are at their maximum, down to +36 000 in 2050.

Figure 2: The impact of Horizon 2020 on employment



Source: NEMESIS simulation.

Limitations of the model

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

1.2. QUEST

Presentation of the model

The QUEST model is a global dynamic general equilibrium model developed by the European Commission's Directorate-General for Economic and Financial Affairs.[28] The different model variants have been extensively used for macroeconomic policy analysis and research, e.g. analysing the impact of fiscal and structural reforms and assessing the impact of cohesion policies[29]. QUEST is a fully dynamic structural macro-model with rigorous microeconomic foundations derived from intertemporal utility and profit optimisation. The model also accounts for frictions in goods, labour and financial markets.[30]

Structure of the model

QUEST belongs to the class of micro-founded dynamic general equilibrium (DGE) models that are now widely used in economic policy institutions and are seen as the latest step in the development of macroeconomic modelling. These models are forward-looking and intertemporal, i.e. current decisions account for expectations about the future, subject to budgetary, technological and institutional constraints. The intertemporal forward-looking aspects are particularly relevant for the analysis of R&D promotion policies.

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

[28] For the different QUEST model variants and their applications, see https://economy-finance.ec.europa.eu/economic-research-and-databases/economic-research/macroeconomic-models/quest-macroeconomic-model_en

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

[30] As European Commission (2020) points out, one of the main strengths of the QUEST R&D model is its theoretically consistent micro-founded approach based on the forward-looking optimising behaviour of rational agents. As a general equilibrium model, it makes it possible to disentangle the dynamic transmission channels of R&I policies, and to account for reallocation effects and policy trade-offs. European Commission, Directorate-General for Research and Innovation, Annicchiarico, B., Licandro, O., Mohnen, P., et al., *Moving the frontier of macroeconomic modelling of research and innovation policy*, Publications Office, 2020, https://data.europa.eu/doi/10.2777/34199

multi-country model of the EU Member States and the rest of the world, in which individual country blocks are interlinked with international trade and knowledge spillovers.

Key assumptions for the *ex post* evaluation

The simulations assume that countries contributed to the Horizon 2020 budget according to their GDP shares. For this evaluation, results were produced based on three scenarios depending on the financing of the Horizon programme. The first and the second scenarios assume tax-based financing via (i) lump-sum taxes and (ii) value added taxes respectively. In the third scenario (iii), financing is done at the expense of an equivalent reduction in national public investment. Table 3 lists the key modelling assumptions.

Table 4: Key assumptions of the QUEST model

	Key assumptions (Horizon 2014-21)
Budget size	Horizon 2020 budget in constant prices
Budget allocation across years	Across countries and years of the Horizon programme's active operations from 2014 to 2021
Spillovers	International trade and knowledge spillovers, based on trade statistics and elasticities in the relevant literature
Direct leverage effect	Identical leverage of EU funding and national funding
Economic performance	Identical performance of EU funding and national funding
Financing	Increase in lump-sum or value added taxes or reduction in public investment

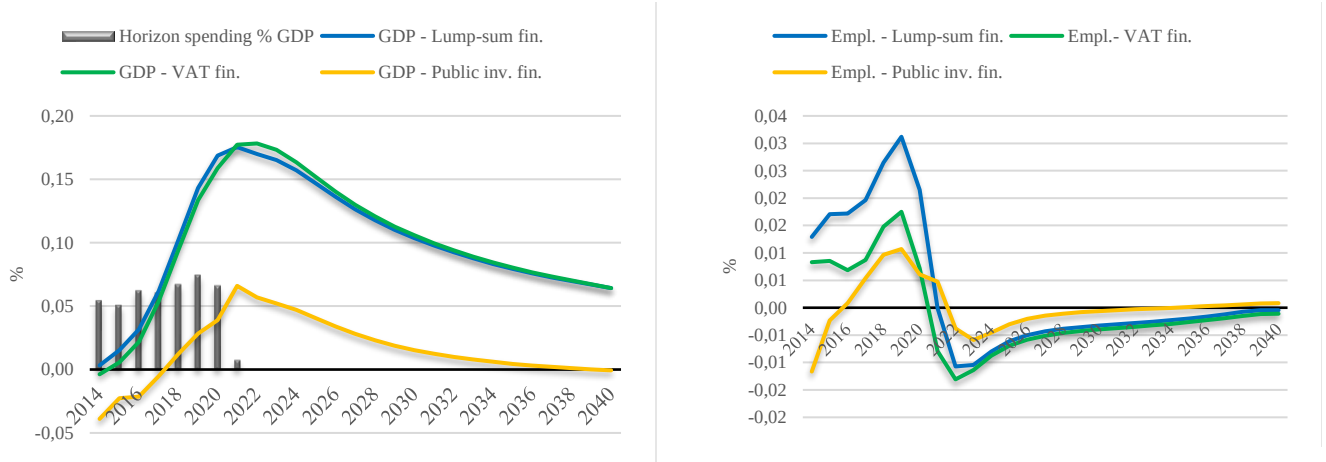
Results

As lump-sum and value added taxes are among the least distortive taxes, financing productivity-enhancing R&D investments from these resources is unambiguously beneficial at the EU level (Figure 3.a). By changing from lump-sum tax financing to public investment cuts (e.g. roads, buildings), Member States lose the potential productivity effects of these public investments and the GDP results are lower both in the short and long run.

The GDP effects build up gradually, as it takes time for the positive productivity effects to emerge in the production process via the accumulation of intangible (R&D) capital. Member States also benefit from the simultaneous support of R&D via knowledge spillovers: the international diffusion of innovations fosters intangible capital formation in the medium term. Short-term GDP effects are limited due to crowding-out effects at the beginning of the intervention period: R&D subsidies stimulate innovation by helping R&D-intensive companies attract more high-skilled labour from traditional production into research with higher wages. Because of supply constraints for high-skilled workers, part of the fiscal stimulus is offset by higher wages. In the first two scenarios, GDP gains are up to 0.18% by 2021 relative to the baseline and gradually decrease below 0.1% after the programming period due to the depreciation of tangible and intangible capital. Note that in the simulations, both EU- and nationally funded R&I have the same leverage and performance effects.

Figure 3: EU-27 GDP and employment impact of Horizon 2020, QUEST R&D results

a. GDP b. Employment



Source: European Commission, DG ECFIN, QUEST R&D simulations, 2023. The effects are expressed in percent deviation from the baseline.

In the third scenario, the expected GDP effects are much smaller compared to the tax-based financing scenarios. The output effects are even slightly negative in the short run and close to zero in the medium term. Similar to R&D investments, public investment is also productivity-enhancing. Therefore, this type of financing not only has a direct negative demand effect in the short run but also reduces the productivity and supply effects in the medium to long run.[31] This scenario illustrates that financing matters: even productivity-enhancing R&D programmes should not be implemented at the expense of reducing productive public expenditure.

Given that the programmes are simulated as productivity-enhancing measures, the model results suggest only a slight short-run increase in employment during the demand boost, which disappears with rising real wages in the medium to long run after the end of the implementation period (Figure 3.b).

Limitations of the model

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

[31] The productivity effects of public capital in the private sector's production process are captured via the output elasticity of public capital. This elasticity is calibrated based on empirical estimates in the literature. Bom, P., and Ligthart, J. (2014), 'What Have We Learned From Three Decades Of Research On The Productivity Of Public Capital?', *Journal of Economic Surveys* 28: 889-916.

1.3. RHOMOLO

Presentation of the model

RHOMOLO[32] is the macroeconomic model of the European Commission focusing on EU regions. It has been developed and maintained by the Joint Research Centre, in cooperation with the Directorate-General for Regional and Urban Policy. It is used for policy impact assessment and provides sector-, region- and time-specific simulations on investments and reforms covering a wide array of policies. RHOMOLO is built on a micro-founded general equilibrium approach and is used to provide a breakdown of results by region and sector.

Structure of the model

RHOMOLO is a spatial dynamic computable general equilibrium (CGE) model with new economic geography features. The version of the model used for this evaluation includes 276 EU NUTS-2 regions. Each region contains 10 economic sectors operating under monopolistic competition (apart from the agricultural sector and the public services sectors, which operate under perfect competition). Regional goods are produced by combining labour and capital with domestic and imported intermediates.

Final goods are consumed by households, the government and investors. Each region is inhabited by a representative household supplying labour of three skill types, consuming and saving a part of their income. The government levies taxes, purchases public consumption goods, invests in the economy, and transfers resources to the various agents in the economy. Goods and services can either be sold in the domestic economy or exported to other regions. Trade between regions is associated with a set of bilateral regional transportation costs[33]. The RHOMOLO model incorporates imperfect competition in the labour market, allowing for unemployment. Wage formation is modelled with a wage curve (Blanchflower and Oswald, 1995), so that lower levels of unemployment increase workers' bargaining power, thereby increasing real wages[34].

The RHOMOLO model contains two types of capital: sector-specific private capital, and public capital available to firms in all sectors within each region. Sector-specific private capital is accumulated by private investors. The investment-capital ratio is a function of the rate of return to capital and the user cost of capital, allowing the capital stock to reach its desired level in a smooth fashion over time. Public capital is accumulated by the government by means of public investment. Public capital services enter the production function as an unpaid factor of production, meaning that all firms in all sectors enjoy the same level of public capital at no cost. Public capital is subject to congestion[35], so that its efficiency decreases as production increases.

[32] Christou, T., Crucitti, F., García Rodríguez, A., Lazarou, N.J., and Salotti, S. (2023), 'The RHOMOLO ex-post impact assessment of the 2014-2020 European research and innovation funding programme (Horizon 2020)', *JRC Working Papers on Territorial Modelling and Analysis*, JRC133690.

[33] The transportation costs are modelled as iceberg costs and come from the estimates illustrated by Persyn, D., Díaz-Lanchas, J., and Barbero, J. (2022), 'Estimating distance and road transport costs between and within European Union regions', *Transport Policy*, 124, 33-42. https://doi.org/10.1016/j.tranpol.2020.04.006.

[34] Blanchflower, D.G., and Oswald, A.J. (1995), 'An introduction to the wage curve', *Journal of Economic Perspectives* 9(3), 153-167. DOI: 10.1257/jep.9.3.153.

[35] Fisher, W.H., and Turnovsky, S.J. (1998), 'Public investment, congestion, and private capital accumulation', *The Economic Journal*, 108(447), 399-413. https://doi.org/10.1111/1468-0297.00294.

Table 5: How RHOMOLO models innovation

How RHOMOLO models innovation
➢ Public expenditure in support for applied research is introduced into the model as a reduction in the user cost of capital, which in turn generates an increase in private investments. **R&I expenditure is modelled as private investments. Hence, R&I spending generates demand for capital goods, leading to a temporary increase in the private capital stock** (which depreciates at a 15% yearly rate)**. In addition, R&I spending leads to accumulation of an intangible knowledge capital stock** (the increase is subject to a 5% yearly decay rate) **positively affecting total factor productivity (TFP).** ➢ The impact of R&I expenditure on TFP through the accumulated knowledge capital stock is captured by a set of regional elasticities which are positively related to regional R&D intensity. The intuition is that firms in regions that are already spending much on R&D signal their pre-existing capacity to generate value from innovation activities. The range of the R&D elasticities is between 0.01 and 0.04, in line with the existing literature on the subject.[36] ➢ Public expenditure in support for basic research is introduced into the model as an increase in public investment, leading to a temporary increase in the public capital stock (which depreciates at a 5% yearly rate). This affects the productivity of firms, as public capital enters the production function as an unpaid factor of production. ➢ Expectations are assumed to be myopic and the model is solved sequentially, with stocks being upgraded at the beginning of each period. For this particular exercise, capital mobility within the EU was assumed, but no labour mobility.

Key assumptions for the *ex post* evaluation

Besides the modelling setup, the analysis for the *ex post* impact assessment of Horizon 2020 is constructed following the NEMESIS analysis, which is based on historical H2020 administrative data. The key assumptions retained for the simulation of the results are summarised in Table 4.

Table 6: Key assumptions for the RHOMOLO model

	Key assumptions
Budget size and allocation	Horizon 2020 budget in constant prices. Allocation across regions (NUTS2 level) and years
Support to basic vs applied research	It is assumed that 40% of the funds support basic research and 60% support applied research
Regional spillovers	Regional spillovers are conditional on R&D intensity within the regions
Direct leverage effect	Identical leverage of EU funding and national funding
Economic performance	Identical performance of EU funding and national funding
Financing	Lump sum

In RHOMOLO, the basic research funds are simulated via an increase in public investment, therefore leading to a temporary increase in the public capital stock of regions. Due to the role of public capital in the production function, besides the demand-side effect of increased (public) investments, this increases the productivity of firms. The applied research funds are assumed to reduce the user cost of capital, leading to an increase in private investment. This entails a demand-side effect, which also leads to a temporary increase in the private capital stock. Also, it is assumed that these R&I investments lead to an increase in TFP, with an elasticity which depends on R&D intensity, as explained above.

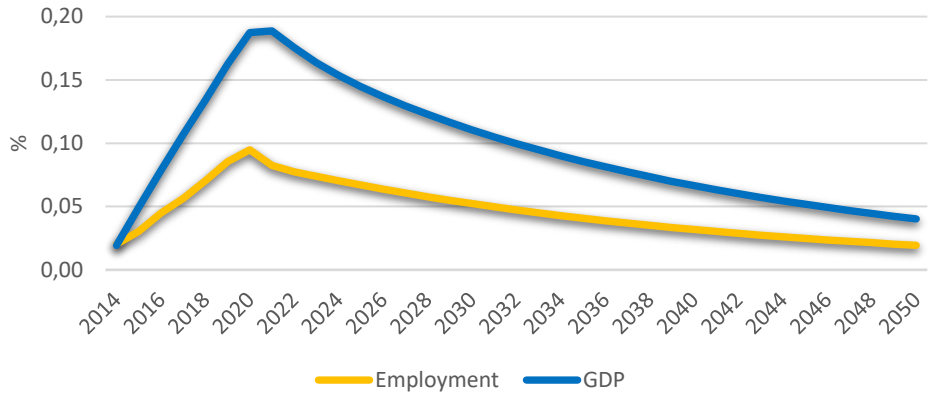
[36] See, for instance, Männasoo, K., Hein, H., and Ruubel, R. (2018), 'The contributions of human capital, R&D spending and convergence to total factor productivity growth', *Regional Studies*, 52(12), 1598-1611. DOI: 10.1080/00343404.2018.1445848.

The investment is assumed to be financed via lump-sum transfers. To mimic how the EU budget is financed, the regional contributions are proportional to the GDP weight of each region over the EU GDP. In other words, a region does not necessarily have to finance the programme with a contribution which matches the amount of H2020 destined to the region itself: the contribution depends on the proportion of EU GDP generated in the region.

Results

The GDP impact increases steadily during the implementation period to reach a peak of +0.189% in 2021. Subsequently, it declines gradually as the monetary injection related to the programme ends, the increased private and public capital stocks depreciate and the temporary increase in TFP decays. In 2050, the programme still has relatively small residual effects, as the GDP is 0.040% above its initial level (Figure 4). The investment also leads to improvements in employment, whose impact reaches a peak of +0.095% in 2020, amounting to almost 220 000 people[37].

Figure 4: Horizon 2020 impact over time on GDP and employment

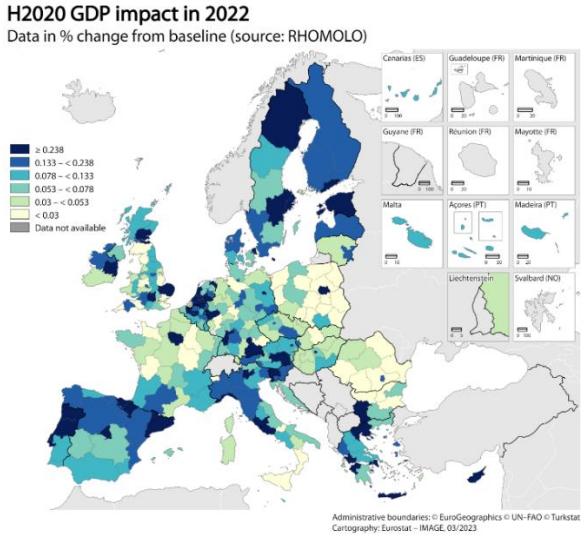


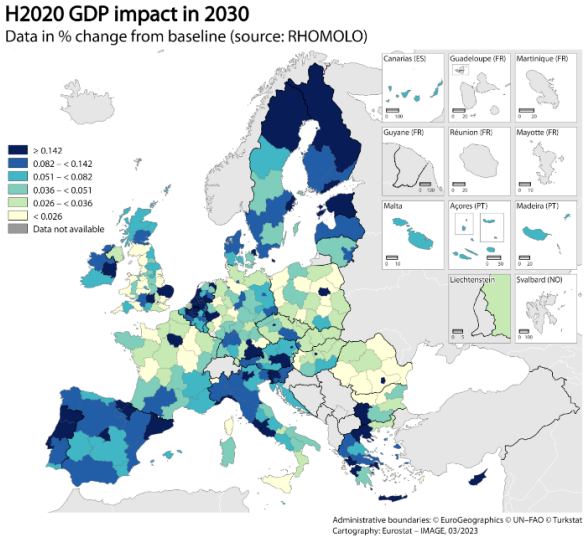
Source: JRC - RHOMOLO simulations, 2023.

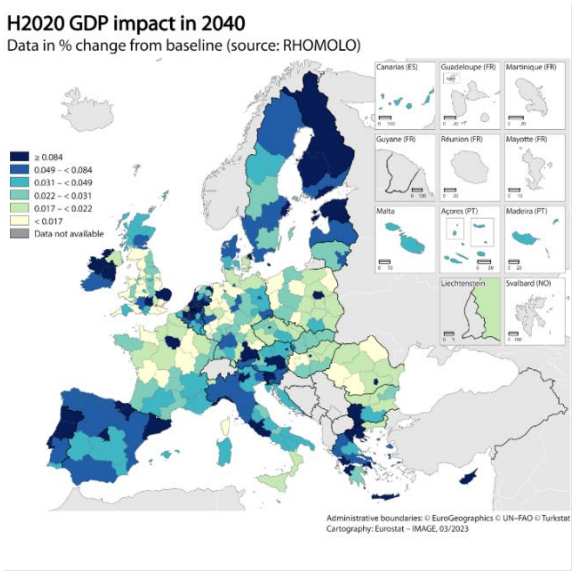
Figure 5 presents the territorial distribution of the GDP impact of H2020 investment, expressed as percentage deviations from the baseline (i.e. a hypothetical scenario without H2020) in 2022, 2030, 2040 and 2050. The GDP impact in 2022 is stronger in the regions with more H2020 investment. Specifically, the programme's macroeconomic effects are relatively larger in the Scandinavian regions, in Central Europe and in the Iberian Peninsula. Moreover, in most countries, the capital city regions benefit more than the other regions, a phenomenon particularly evident in countries like Poland, Czechia, Slovakia, Bulgaria and Romania. Over time, in countries like Spain, Italy, Greece, and Poland, the effects gradually spill over to regions receiving relatively less H2020 funds. Nevertheless, the spillover effects remain mostly concentrated in the richest regions. The magnitude of the impact decreases over time due to: (i) the H2020 investments being limited to the period 2014-2022; (ii) the depreciation rates of the temporarily increased private and public stocks of capital; and (iii) the decay rate of the TFP improvements.

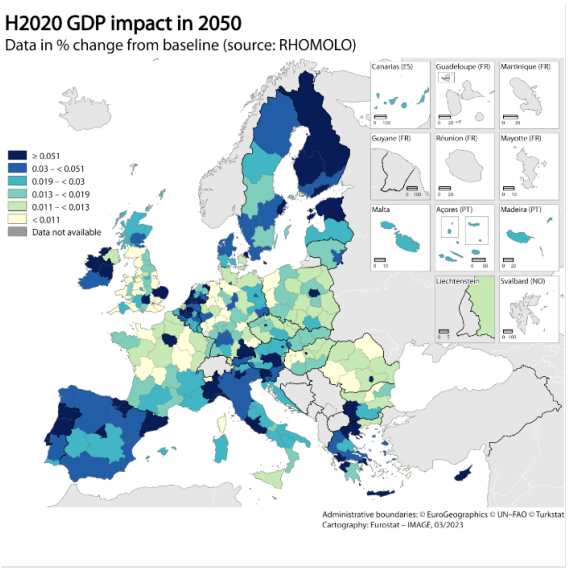
[37] The total number of employed people in the model base year in the EU-28 is about 231 826 000.

Figure 5: Territorial distribution of Horizon 2020's GDP impact, 2022-2050









Source: JRC - RHOMOLO simulations.

The RHOMOLO model is calibrated with data organised over the following 10 NACE Rev. 2 sectors (see Tables 7, 8 and 9 below). Sectoral results should be read keeping in mind that the shocks applied to the model in order to simulate the Horizon 2020 interventions are not sector-specific. Therefore, the results mainly reflect the steady-state data on sectoral production and the input-output relationships across sectors. We report value added because GDP is not available at the sectoral level.

Table 7: RHOMOLO economic sectors

Code	**NACE Rev.2**
A	Agriculture, forestry and fishing
B-E	Industry (except construction)
C	Manufacturing
F	Construction
G-I	Wholesale and retail trade, transport, accommodation and food service activities
J	Information and communication
K_L	Financial and insurance activities, real estate activities
M_N	Professional, scientific and technical activities; administrative and support service activities
O-Q	Public administration, defence, education, human health and social work activities
R-U	Arts, entertainment and recreation; other service activities; activities of household and extra-territorial organizations and bodies

Tables 8 and 9 present respectively the value added and employment sectoral results, for selected simulation years.

Table 8: H2020 sectoral value added impact in selected years

% change w.r.t. baseline	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2030**	**2040**	**2050**
A	-0.003	0.017	0.039	0.066	0.093	0.123	0.157	0.190	0.197	0.149	0.092	0.056
B-E	-0.002	0.030	0.061	0.098	0.132	0.166	0.205	0.240	0.237	0.159	0.095	0.058
C	-0.006	0.027	0.054	0.087	0.116	0.144	0.180	0.210	0.200	0.119	0.071	0.043
F	0.110	0.152	0.205	0.233	0.260	0.299	0.298	0.200	0.155	0.081	0.050	0.030
G-I	-0.006	0.026	0.052	0.085	0.113	0.143	0.178	0.209	0.202	0.132	0.079	0.048
J	0.023	0.067	0.107	0.147	0.180	0.216	0.245	0.247	0.223	0.123	0.073	0.044
K_L	0.007	0.042	0.073	0.108	0.140	0.173	0.208	0.230	0.221	0.155	0.093	0.057
M_N	0.012	0.052	0.087	0.124	0.156	0.189	0.220	0.233	0.214	0.122	0.073	0.044
O-Q	0.064	0.073	0.094	0.101	0.115	0.132	0.127	0.065	0.049	0.028	0.017	0.010
R-U	0.003	0.028	0.050	0.076	0.099	0.124	0.151	0.170	0.166	0.121	0.073	0.045
Change w.r.t. baseline in mn €	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2030**	**2040**	**2050**
A	-7	50	113	193	274	360	461	559	577	439	270	165
B-E	-10	137	277	444	598	751	930	1 086	1 076	721	432	261
C	-128	601	1 213	1 952	2 614	3 236	4 034	4 708	4 482	2 675	1 594	969
F	825	1 135	1 530	1 742	1 944	2 231	2 224	1 496	1 156	608	370	225
G-I	-155	684	1 384	2 237	2 995	3 770	4 694	5 539	5 337	3 479	2 100	1 274
J	159	462	736	1 015	1 243	1 492	1 693	1 705	1 538	848	502	304
K_L	144	921	1 595	2 362	3 064	3 785	4 540	5 031	4 839	3 383	2 046	1 236
M_N	188	821	1 385	1 972	2 470	3 000	3 500	3 693	3 389	1 944	1 161	704
O-Q	1 687	1 942	2 484	2 665	3 041	3 484	3 366	1 714	1 310	748	451	273
R-U	16	136	246	373	485	608	738	832	814	591	359	218

Source: RHOMOLO simulations (and DG REGIO for the H2020 contribution).

Table 9: H2020 sectoral employment impact in selected years

% change w.r.t. baseline	2014	2015	2016	2017	2018	2019	2020	2021	2022	2030	2040	2050
A	-0.024	-0.002	0.011	0.033	0.049	0.065	0.095	0.140	0.135	0.090	0.056	0.034
B-E	-0.026	0.001	0.015	0.040	0.058	0.075	0.106	0.152	0.143	0.090	0.055	0.033
C	-0.019	0.008	0.023	0.047	0.064	0.077	0.106	0.138	0.125	0.070	0.042	0.026
F	0.181	0.157	0.190	0.183	0.204	0.240	0.200	0.021	0.024	0.042	0.026	0.016
G-I	-0.021	0.002	0.016	0.037	0.053	0.069	0.096	0.134	0.127	0.081	0.049	0.030
J	0.014	0.030	0.047	0.063	0.073	0.089	0.099	0.095	0.084	0.047	0.029	0.017
K_L	-0.022	-0.006	0.006	0.026	0.041	0.058	0.082	0.122	0.124	0.089	0.054	0.033
M_N	0.001	0.024	0.042	0.062	0.076	0.093	0.111	0.119	0.106	0.059	0.035	0.022
O-Q	0.073	0.060	0.070	0.062	0.071	0.080	0.063	-0.018	-0.016	0.002	0.002	0.001
R-U	-0.011	-0.005	0.003	0.016	0.028	0.043	0.060	0.085	0.093	0.073	0.045	0.027
Change w.r.t. baseline in thousands of persons	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2030**	**2040**	**2050**
A	-0.694	-0.066	0.305	0.940	1.390	1.852	2.723	3.994	3.874	2.580	1.598	0.980
B-E	-1.458	0.055	0.861	2.260	3.257	4.189	5.933	8.517	8.053	5.038	3.080	1.881
C	-8.019	3.561	10.009	19.989	27.236	32.880	45.057	58.975	53.173	29.781	18.025	10.987
F	24.132	20.949	25.285	24.398	27.116	31.912	26.668	2.800	3.131	5.643	3.508	2.140
G-I	-10.263	0.869	7.713	18.542	26.190	34.246	47.426	66.126	63.003	40.200	24.472	14.901
J	1.428	2.993	4.596	6.173	7.176	8.824	9.797	9.338	8.263	4.675	2.828	1.723
K_L	-2.600	-0.655	0.696	2.967	4.754	6.759	9.548	14.191	14.466	10.325	6.269	3.810
M_N	0.262	6.140	10.900	15.965	19.617	24.065	28.506	30.790	27.337	15.186	9.125	5.543
O-Q	45.263	37.058	43.201	38.375	43.814	49.518	38.954	-11.001	-9.652	1.444	1.039	0.662
R-U	-0.988	-0.440	0.256	1.360	2.423	3.669	5.206	7.298	8.024	6.308	3.859	2.353

Source: RHOMOLO simulations (and DG REGIO for the H2020 contribution).

Limitations of the model

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

2. Analysis of monitoring data

Monitoring flashes on Horizon 2020, presenting internal analysis on specific topics of interest, were also used to feed into the evaluation report.

3. Documentary review / desk research

Extensive desk research was conducted to ensure background information, as well as to provide evidence that was then triangulated with other sources of information to draft the answers to the evaluation questions. Documents reviewed included legal texts, strategic documents, previous evaluations and policy analyses.

4. Analysis of unstructured data

Two main types of unstructured analyses were carried out: text mining and research topic analysis. Text mining was used to analyse the impact section of H2020 periodic reports and extract key sentences/claims of impact made by the beneficiaries. This work resulted in a dataset of the expected impacts of H2020 projects. This data was used to identify in-depth analysis/interviews to be conducted within case studies.

In parallel, research topic analysis was used to establish how far the framework programme actions addressed new or fast-growing research topics. Subject to availability of monitoring data, each H2020 project was linked to these topics and a score calculated. This 'FET' (future and emerging tech) score captures the extent to which different H2020 projects address new and growing R&I topics.

5. Interviews

The primary purpose of the interviews was to collect evidence from the different actors concerned by the framework programme. This would give an objective assessment of what has happened by taking into account the different points of view. This method was used in particular in case studies and international benchmarks. Interviews were also conducted to confirm and complement the data collection, with a view to drafting the findings and conclusions. Some 1 403 interviews were conducted (including some with the same actors on different topics), gathering the perspectives of Commission staff, Member States, associated countries, and a large range of stakeholders (universities, companies, umbrella organisations, etc.)

6. Targeted surveys

Different surveys were designed to collect data on the framework programme:

a) Survey of successful and unsuccessful applicants participating in parts of the **Excellent Science** programme parts

The survey programme in the Excellent Science evaluation study consisted of six online questionnaires designed to collect data on the opinions and perceptions of successful and unsuccessful applicants to Horizon 2020. In total, 5 417 complete and 449 partial responses were received.

The following groups were surveyed:

- Horizon 2020 beneficiary organisations (including beneficiary organisations that participated in MSCA, SEWP, INFRA and SwafS)
- Horizon 2020 unsuccessful applicant organisations (organisations that unsuccessfully applied for MSCA, SEWP, INFRA and SwafS)

- Horizon 2020 MSCA IF fellows
- Unsuccessful Horizon 2020 MSCA IF applicants
- Horizon 2020 ERC principal investigators
- Unsuccessful Horizon 2020 ERC applicants.

b) For the evaluation study on the European Framework Programmes for Research and Innovation for addressing Global Challenges and Industrial Competitiveness – Focus on activities for the **Digital and Industrial Transition**: Survey of H2020 LEIT applicants/participants, successful applicants

A single questionnaire was drawn up. It targeted all stakeholders, namely all partners in the projects funded (successful applicants) as well as all partners in proposals that were not funded even though the proposals reached scores above the threshold ('high-quality' proposals). A total of 1 342 valid responses to the survey were received, giving an overall response rate of 7%.

c) For the evaluation study on the European Framework Programmes for Research and Innovation for addressing Global Challenges and Industrial Competitiveness – Focus on activities related to the **Green Transition**

The survey of successful applicants was designed during the inception phase and further enriched and developed to take into account various factors. In total, the survey received 1 333 entries, with 771 of respondents reaching the end of the survey. The analysis (Annex 7 to the study) was organised by societal challenge for relevance, effectiveness and EU added value and for all societal challenges together for the evaluation criterion of efficiency. The analysis was also organised by topic within each evaluation criterion and included corresponding graphs.

The studies on Resilient Europe and Innovative Europe did not have a survey in their methodology.

7. Network analysis

Network analysis performed in the Excellent Science and Innovative Europe evaluation studies involved analysis of the structuring effect of framework programme funding, which was based on author networks. It also included analysis of funding concentration in Horizon 2020.

8. Patent analysis

This analysis – in the Innovative Europe study – served to explore patent productivity under the H2020 programme. Preparation of the Horizon 2020 patents dataset involved the download of data from the Cordis database[38]. It contained 2 003 unique applications for 1 714 unique patent families. Applications that covered the same or similar inventions were grouped into families; the technical content of these families is considered (almost) identical, and was therefore treated as a unique patent family, a unit of analysis. Subsequently, Cordis patents were matched with patents on the PATSTAT[39] database. A total of 36 patents in Cordis patents data were not found on the PATSTAT database, leaving 1 678 patent families. Only patents whose priority date was after

[38] https://data.europa.eu/data/datasets/cordish2020projects?locale=en
[39] https://www.epo.org/searching-for-patents/business/patstat.html

the start of the project were considered (referred to as 'foreground' patents). Removing patents with a priority date earlier than the start of the project left 445 patent families. Therefore, the 455[40] foreground patents constitute the basis for the analysis.

The analysis looked at the following key metrics:

- patent productivity, i.e. number of foreground patents produced by the H2020 pillar and programme;
- patent quality metrics based on: (a) number of forward citations; (b) patent family size; (c) number of claims/CPC classes by foreground H2020 patents;
- H2020 patents that are triadic, i.e. patents registered with the European, US and Japanese patent offices.

9. Bibliometric analysis

This method was used in the Excellent Science study and in the Digital and Industrial transition study to assess the Excellent Science indicators in Horizon 2020, using the key impact pathways (KIP) framework of Horizon Europe, in particular KIP No 1: 'Creating High-Quality New Knowledge', the aim being to be able to compare later on the evolution of these indicators over time. KIP1 proposes the use of several indicators that capture and benchmark the productivity and impact of the sponsored scientific outputs and in particular high-quality peer-reviewed publications influential in their field and worldwide.

The first indicator is a quantity- and productivity-focused indicator, measured by the number of peer-reviewed scientific publications. Based on the EC administrative and monitoring data submitted by Horizon participants combined with Scopus and Web of Science databases, data and values for this indicator were disaggregated by: type of scientific publication; Horizon pillar, cluster and component; type of Horizon Europe action; programme year; and field of science.

The second indicator is the impact and quality indicator. It uses the citations accrued by each of the above validated publications: field- or category-weighted (normalised) citation impact indicators are one of the most sophisticated indicators in the modern bibliometric toolkit[41]. A 'field-normalised' citation score (such as MNCS/CNCI/FWCI) calculates an indication of the citation impact of a publication. It is calculated by comparing the number of citations received by a publication with the number of citations expected for a publication of the same publication year and subject field. A citation impact score of more than 1.00 indicates that the publications in the treatment sample have been cited more than would be expected based on the global average for similar publications (the control). Based on Web of Science and Scopus information, data and values for this indicator can be disaggregated by: type of scientific publication; Horizon pillar, cluster and component; type of Horizon Europe action; programme year; and field of science.

The third indicator also looks at impact but tries to define world-class science. It does this by using the accrued citations to calculate the number and share of peer-reviewed publications resulting from the projects funded by the EC-funded programmes and that are core contributions to scientific fields, calculated

[40] Note that two patents were under two different projects, and these two projects were under two different pillars; this affects the sum of the totals in the tables. Patent IDs 68536640 and 62002358.

[41] Normalised citation impact indicators account for differences in citation accrual over time, differences in citation rates for different document ages (e.g. older documents are expected to have accrued more citations than more recently published documents), document types (e.g. reviews typically attract more citations than research articles) and subject fields (e.g. publications in medicine accrue citations more quickly than publications in mathematics).

as a percentage of top cited publications (PPTop1%)[42]. This indicator is similar to the second indicator, except for the citation threshold introduced to differentiate between highly cited publications and the remaining less cited and un-cited publications. Based on Web of Science and Scopus information, data and values for this indicator can be disaggregated by: Horizon pillar, cluster and component; type of Horizon Europe action; programme year; and field of science. As the PPTop 1% and 10% indicator is generally accepted, this indicator was calculated using either the platform CNCI (Web of Science) or the FWCI (Scopus).

Table 10: List of key metrics and dimensions

KEY METRICS	DESCRIPTIONS
Number of publications	Number of peer-reviewed scientific publications (indexed by Web of Science) resulting from the programme
Number of projects	Number of projects funded by the programme
Publications with at least one citation	The number of publications that have been cited at least once
Top 1% most cited publications	The top 1% highly cited publications
Field-normalised citation impact	Field-normalised citation score of peer-reviewed publications resulting from the programme
Open access publications	n/a
Dimensions	**Descriptions**
Call closure year	Call closure year
Project status	The status of the project, including ongoing, closed or cancelled project types
Thematic priority	EU.0 – EU.5 and Euratom
H2020 PILLARS	The three pillars of H2020, i.e. Excellent Science, Industrial Leadership and Societal Challenges
H2020 programme	Funding programmes under each pillar
Scientific discipline	250 Web of Science research areas are classified into 7 scientific disciplines, following the method proposed by CWTS[43]

In addition, in **the green transition evaluation study**, bibliometrics strategies have been deployed to measure the effectiveness of research activities in this area, at scale across thousands of SC2- to SC5-funded projects.

Descriptive findings, which provide bibliometric findings for selections of funded projects (in case studies) or partnerships measure absolute achievements by research area or thematic area relative to selected comparators. These analyses serve to uncover where H2020 support in green transition calls stands out relative to other EU research not funded by the framework programme. Any outstanding performance under H2020 could relate to the programme

[42] Bornmann, L., L. Leydesdorff and R. Mutz (2013), 'The use of percentiles and percentile rank classes in the analysis of bibliometric data: opportunities and limits', *Journal of Informetrics*, 7(1), 158–165.
[43] https://www.cwts.nl/pdf/nowt_classification_sc.pdf.

having successfully selected for projects/awardees that stand out from the reference populations and/or to the programme having exerted a positive effect on the performance of awardees. To assess the relative contribution of the latter factor in observed difference, a counterfactual analysis was performed (see below). In this context, it should be kept in mind that descriptive findings are not able to tell us whether any strong performances recorded by supported researchers were induced by H2020 support itself, or whether the supported researchers would have attained these achievements otherwise, with other funding opportunities. Demonstrations of high-calibre work for any indicator may reflect H2020 support, the peer-reviewed selection process of researchers, or neither or both of these causes.

In the **study on the proposal evaluation system for the EU R&I framework programme**, bibliometric analysis was used to analyse the predictive power of funding decisions by looking at whether proposal evaluation processes are effective in selecting the 'best' applicants in terms of their subsequent bibliometric performance. The analysis also addressed bias by analysing differences in bibliometric performance levels before and after the award, for success overall and for groups characterised by gender and country. To do this, the study identified the publication output of 3 815 applicants between 2009 and 2019 in the Web of Science databases; output including publications from before and after applications were submitted from 2014 to 2016. Research performance before and after application was analysed in terms of output (number of publications) and impact (metrics based on the number of citations). The change in performance was compared with the outcome of the application (successful or unsuccessful). A further consideration was whether gender or country affected the outcome of applications.

10. Counterfactual analysis

Introduction

A counterfactual analysis assesses the existence of a causal relationship between an observed outcome (e.g. the employment growth of a firm) and the intervention (for instance, Horizon 2020) and provides an estimate of the impacts compared to what would have happened in the absence of the intervention.

Before providing more details on the use of the methods for the *ex post* evaluation of Horizon 2020, we provide some relevant definitions using Crato and Paruolo (2019)[44].

Causality

This is the sufficient link from one factor or event, the cause, to another factor or event, the effect. In econometric methods, a plausible establishment of causality requires some type of experiment or the construction or identification of some counterfactual situation (see below 'Counterfactual impact evaluation (CIE)'). This allows for a reasonable comparison of what happened in the presence of a given factor with what happened or can be reasonably accepted as likely to have happened in the absence of the same given factor.

Control group

This is a group adequate for comparison with the group of units that were subject to a given policy (or treatment group, in statistical terminology). Prior to the policy intervention, the control group should display average characteristics that were otherwise similar to those of the group of individuals subject to

[44] Crato, N., & Paruolo, P. (2019), *Data-Driven Policy Impact Evaluation*, Springer Nature.

the measures. The identification of a control group is critical for measuring the effect of a policy intervention, as it indicates what the situation would be for the group subject to the policy intervention had the intervention not been implemented. (See also 'Counterfactual impact evaluation (CIE)'.)

Counterfactual impact evaluation (CIE)

This refers to statistical procedures for assessing the effect of a policy measure and gauging the degree to which it attained its intended consequences. In randomised control trials, one compares the outcomes of interest of those having benefited from a policy or programme (the 'treated group') with those of a group that are similar in all respects to the treatment group (the comparison or 'control group') except in that it has not been exposed to that policy or programme. The comparison group seeks to provide information on what would have happened to the members subject to the intervention had they not been exposed to it – the counterfactual case. The difference in the outcome of interest between the treated and control groups provides information about the effect of the policy.

Randomisation

This refers to the assignment of individuals to a group or groups (such as treated and control groups) at random.

Differences in differences (DiD)

This CIE technique estimates the average treatment effect by comparing the changes in the outcome variable for the treated group with those for the control group, possibly controlling for other observable determinants of the outcome variables. As this technique compares the changes and not the attained levels of the outcome variable, it is intended to eliminate the effect of the differences between the two populations that derive from potentially different starting points. Take, for example, an impact evaluation of the relative impacts of two different but simultaneous youth job-training programmes in two different cities. One should not look at the net unemployment rate at the end of the programmes, because the starting values for the unemployment rate in the two cities may have been different. A difference-in-differences (DiD) approach instead compares the magnitudes of the changes in the unemployment rate in the two cities. A basic assumption of DiD is the common trend assumption, namely that treated and control groups would show the same trends across time in the absence of policy intervention. Hence the change in the outcome variable for the control group can be used as an estimate of the counterfactual change in the outcome variable for the treated group.

The difference-in-differences (DiD) method was used to measure SMEs' performance in terms of employment, turnover and labour productivity. The control group of firms included non-funded framework programme applicants just below the funding threshold that never received H2020 funding due to budgetary constraints (i.e. their applications passed the minimum proposal quality thresholds). The Orbis database was used to retrieve longitudinal financial data for the panel analysis. In Orbis, longitudinal data can be retrieved for up to 10 years, which means that information on turnover, employment and labour productivity are available for the period 2013-2021. The analysis focused on private SMEs, i.e. firms that were flagged as private for-profit entities and SMEs in the CORDA database, which are validated via the Orbis database as being for-profit firms. In addition, the Orbis size classification was also applied to build the sample. Firms with inactive status variable in Orbis were removed (either because the firm has been dissolved or entered into bankruptcy or liquidation, or has been subject to a merger or takeover).

Regression discontinuity design (RDD)

This CIE technique exploits situations in which eligibility for the programme depends on certain observable characteristics, such as a requirement to be above (or below) an age threshold such as 40 years of age. Individuals close to the threshold on either side are compared, and the jump of the expected outcome variable at the threshold serves as an estimate of the local average treatment effect. As an example, consider an EU regulation that applies to firms above a certain size; regression discontinuity design (RDD) can be used to compare the outcome of interest, such as the profit margin, of treated firms above but close to the firm-size threshold with the same figure for control firms below but also close to the firm-size threshold. Firms that lie around the cut-off level are supposed to be close enough to be considered similar except for treatment status. RDD requires policy participation assignment to be based on some observable control variable with a threshold. RDD is considered a robust and reliable CIE method, with the additional advantage of being easily presentable with the help of graphs. Since the observations that contribute to identifying the causal effect are mainly those around the threshold, RDD may require large sample sizes.

Propensity score matching (PSM)

This CIE technique compares the outcome variable for treated individuals with the outcome variable for matched individuals in a control group. Matching units are selected such that their observed characteristics (controls) are similar to those of treated units. The matching is usually operationalised via a propensity score, which is defined as the probability of being treated given a set of observable variables. As an example, imagine that one needs to evaluate the impact of an EU-wide certification process for chemical firms on firms' costs. This certification process is voluntary. Because the firms that applied for the certification are more likely to be innovative enterprises, one should compare the results for the treated firms with those for similar untreated firms. One possibility is to define the control group by matching on the level of R&D spending. PSM requires a (comparatively) large sample providing information on many variables, which are used to perform the matching.

Counterfactual analysis in the *ex post* evaluation of Horizon 2020

It is important to stress that for such analyses a longer time frame would be ideal, not only due to the nature of innovation policies, which take longer to materialise than other fields, but also due to data reporting delays. Hence, a positive observed result at this stage might be an underestimation of the actual result observed over a longer timeframe. For the same reason, the absence of positive results should not be alarming at this stage.

Firms

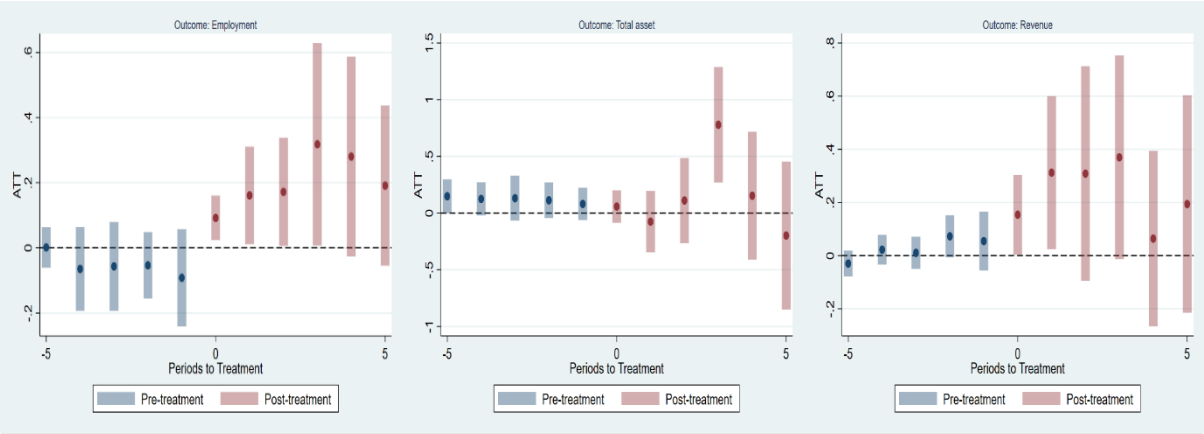
The overall causal impact of the Horizon 2020 on firm-level outcomes has been assessed by the mean of a difference-in-differences (DiD) approach[45], comparing the changes in outcomes for successful applicants to the changes in outcomes for unsuccessful applicants.[46] The study employs information on participants retrieved from CORDA and from Orbis balance sheets data from 2010 to 2022. To increase comparability between the treatment and control group, the analysis excludes unsuccessful applicants with low quality proposals, leading to a sample of about 41 000 unique private companies that applied for Horizon 2020 funding. The counterfactual results suggest that firms receiving H2020 grants increased on average their employment level by about 20% (compared to non-funded firms) and their total assets and revenues by about 30% in the years following the receipt of the first grant (Figure 6). Effects are

[45] As developed by Callaway, Brantly, & Pedro HC Sant'Anna (2021), 'Difference-in-differences with multiple time periods', *Journal of Econometrics*, 225(2), 200-230. Allowing for variation in treatment timing and heterogeneous treatment effects.

[46] Mitra, Alessio and Niakaros, Konstantinos (2023), *The Horizon Effect: A Counterfactual Analysis of EU R&I Grants*, https://data.europa.eu/doi/10.2777/584781.

present even after 2.5 years (the average duration of a project in our sample). Such a result confirms the positive and causal impact of the framework programme on beneficiary companies' growth.

Figure 6: DiD estimates on the effect of Horizon 2020 on firms' outcomes



Source: Mitra, Alessio, and Niakaros, Konstantinos (2023), *The Horizon Effect: A Counterfactual Analysis of EU R&I Grants*, https://data.europa.eu/doi/10.2777/584781
Note: Confidence intervals at 99% level. Doubly robust DiD estimates incorporate individual and time-fixed effects, NACE and country-fixed effects, as well as the number of times companies have applied to Horizon 2020 calls.

A counterfactual analysis[47] covering Horizon 2020 for-profit SMEs found effects on the employment and turnover of Horizon 2020 beneficiaries. The study employed a difference-in-differences (DiD) method. The control group included those programme applicants that were above the threshold (so they could have received EU funding) but did not receive it due to budgetary constraints.

A crucial assumption in a DiD setting is that in the absence of H2020 participation, the economic performance of the treatment group follows the same evolution of the control group ('the parallel trend assumption'). It is important to stress that for analysis, using the DiD method a longer time lag would be needed to claim causality with certainty; however, the study team did not have access to earlier data.

When looking at the whole programme, the employment level of the treated firms grew by more than 4% after 2016 compared to the control group, at an increasing rate until 2020. Similarly, the treatment group experienced a higher growth of turnover than the firms in the control group after 2014. After 2017, the treated firms grew more than 10% compared to the control firms. When restricting the analysis to the industrial leadership, firms in the treatment group experienced a higher growth of employment compared to the firms in the control group after 2014. In 2017, the treated firms grew 5% more than the control firms. The results for turnover are in line with the results for employment: firms in the treatment group experienced a higher growth of turnover than the firms in the control group after 2014. In 2018, the treated firms grew 12% more than the control firms. The study found no effect on productivity.

[47] Innovative Europe study (2023), Annex 4, https://data.europa.eu/doi/10.2777/467162.

When restricting the analysis to societal challenges, firms in the treatment group experienced a higher growth of turnover than the firms in the control group after 2014. In 2015, the treated firms grew 6% more than the control firms. The study found no effect on employment or productivity.

SME Instrument

A paper[48] focusing on the first 3 years of the SME instrument, phase II, studies various firm-level outcomes using an RDD approach, comparing successful applicants close to the threshold for funding.

The findings suggest that these grants lead to an increase in subsequent firm investment, particularly in intangible assets. They also result in a boost in innovation output, as indicated by a rise of between 15% and 31% in citation-weighted patents, which occurs both through the intensive and extensive margins. In other words, R&D grants not only affect firms already involved in innovative activities but also lead to more firms engaging in patenting. Additionally, R&D grants are a catalyst for subsequent equity investments, with firms experiencing over a 100% increase in likelihood to receive private equity, leading to more significant funding rounds and a higher number of deals. Moreover, these grants have a positive impact on the rate of firm growth (28-56%) and reduce the probability of failure by over 100%.

European Innovation Council Pilot

An assessment of the European Innovation Council (EIC) Pilot used a comparative and counterfactual analysis to compare beneficiaries' performance before and after the support and against a comparator group. Matching difference-in-difference (M-DiD) was applied to accelerator calls that took place in 2018.

The analysis only considered projects approved in 2018 since company performance needs to be observed at least 2 years after the treatment to consider projects' state of advancement. The analysis assessed company performance between 2015 and 2020. The years between 2015 and 2017 constitute the pre-treatment period, 2018 the treatment period, and the years between 2019 and 2020 are the post-treatment period. The control group was built using propensity score matching (PSM)[49].

Companies that received EIC support performed better than other applicants when compared for some key performance parameters. Data show that on average, before accessing the EIC, beneficiary companies were smaller and on a growth path that strengthened after the EIC support. This result can be interpreted as a positive sign of the programme's capacity to spot and select entrepreneurial and innovative talent. The counterfactual analysis results show a positive causal relationship between the EIC support and the companies' capacity to generate additional jobs.

However, it is important to stress that a more revealing analysis of economic impacts should be based on a longer time horizon than was possible for this evaluation. The short-term positive impact on beneficiary companies' turnover and staff reveals the immediate effects of the grant and cannot be considered a sign of successful product commercialisation.

Researchers: FP7 long-term impact

[48] Santoleri et al., *The Causal Effects of R&D Grants: Evidence from a Regression Discontinuity*.
[49] EIC Pilot study, technical annex, https://data.europa.eu/doi/10.2777/645064.

A recent paper[50] estimates the causal impact of receiving a European Research Council (ERC) grant on researchers' productivity, excellence, research networks and the ability to obtain additional funding up to 9 years later. The authors collected information on winning and non-winning ERC applicants between 2007-2013 as well as information on all their publications on Scopus until April 2021.

When looking around the funding threshold (in a regression discontinuity design fashion), i.e. at researchers ranked last among those funded compared with those who ranked first among the non-funded, this study[51] finds that obtaining an ERC grant does not improve researchers' productivity (number of publications), excellence (h-index, publications in top 1% or top 10% ranked journals) or the research network. Nevertheless, those receiving an ERC advanced or starting grant acknowledge on average more EU funds (the 'Matthew effect') than the rejected applicants do, in particular in the fields of physical science and engineering and of social sciences and humanities. However, when the authors look at the total number of funds acknowledged (both EU and all others) there are no significant differences.

Moreover, comparing the evolution of bibliometric outcomes before and after receiving the ERC grant between beneficiaries and non-beneficiaries (in a difference-in-difference fashion) the study finds that overall ERC grants increased research productivity in the long term, namely up to 9 years after receiving the grant (i.e. on. H-Index and publications in top 1% and top 10% ranked journals). When looking at different academic fields, some areas, like universe and earth sciences, chemistry, medicine, human mind studies and institutions and behaviour, showed positive effects on productivity and excellence, depending on the measure used (i.e. number of papers, number of paper in top 10 % or top 1% ranked journals, H-index) and type of grant received (i.e. starting or advanced grant). The results of the DiD model also confirmed the evidence of a 'Matthew effect' across all fields with researchers who received an ERC grant. They were more likely to obtain other EU grants by themselves (or through their co-authors) even if the total number of funds they received was similar to that of non-beneficiaries (i.e. they compensate by seeking other types of funds and in the 9 years after applying to the ERC).

11. Benchmarks

Benchmarking activities provided evidence to inform evaluation questions set out in the Terms of Reference for the impact area evaluation studies. They identified lessons learnt from best practices worldwide supporting research and innovation and they put in perspective the framework programme's performance in the area covered by the study. As a minimum, the benchmarks were based on data analysis and document review, completed by interviews with relevant stakeholders. The following benchmarks were used in the staff working document:

Table 11: Benchmarks

International benchmark	Comparison with:
Evidence from the benchmarking exercises demonstrated that the publication citation scores of Horizon 2020 were higher than all the other international funders in most of the analysed disciplines – both in terms of the share of top 1% most cited publications and average normalised citation score of its publications. [Excellent Science study]	NOW (the Netherlands), the French National Research Agency (ANR), the Australian Research Council (ARC), the FCT (Portugal), the Austrian Science Fund (FWF), the Natural Sciences and Engineering Research Council of Canada (NSERC) and the National Science Foundation (USA)
Benchmarking related to the direct leverage was also conducted cautiously by DG RTD, to compare between same types of leverage (in this case direct leverage, and not investments	National Science Foundation (USA) and ERDF funding for SME competitiveness (EU)

[50] Ghirelli C., Havari E., Meroni E. and Verzillo S. (2023) *The Long-Term Causal Effects of Winning an ERC Grant*, JRC133001.
[51] Ghirelli C., Havari E., Meroni E. and Verzillo S. (2023) *The Long-Term Causal Effects of Winning an ERC Grant*, JRC133001.

after the projects), and similar technology readiness levels (TRLs). Similar direct leverage factors were found. In particular, - The U.S. National Science Foundation generally does not allow voluntary committed cost sharing in its proposals. This means a funding rate of 100%, and hence a direct leverage factor of 0, similar to Horizon 2020 for this type of research (accounting for a third of Horizon 2020 funding). - ERDF funding for SME competitiveness has a leverage factor of 0.43. However, this funding is distributed to the Member States and regions, rather than directly to the SMEs. For Horizon 2020, the leverage factor of funds going to SMEs is 0.34.	

12. Case studies

Overall, 154 case studies were conducted, covering the different programme parts, as well as specific aspects of Horizon 2020 such as cross-cutting issues, the EIC Pilot and partnerships. The impact area evaluation studies had 15 case studies each, while the study on relevance and internal coherence had 20 case studies, the study on external coherence – 23, the study on cross-cutting issues – 14, the EIC Pilot evaluation – 15, and the study on the proposal evaluation system for the R&I programme – 7.

13. Policy workshops

Some 20 policy workshops were conducted to support this evaluation. The workshops were implemented in the context of the independent external studies. They were used to consolidate and increase the robustness of the findings and conclusions arising from the data collection conducted through other methods, addressing evidence gaps whenever needed.

14. Public consultation

The public consultation on the *ex post* evaluation of Horizon 2020 was part of a larger joint consultation exercise looking at the past present and future of the R&I framework programmes (*ex post* evaluation Horizon 2020, interim evaluation Horizon Europe and the 2025-2027 strategic plan). In full compliance with the Better Regulation requirements, the online questionnaire was published, among other places, on the Have your Say portal[52], also offering the possibility to submit position papers. It ran from 1 December 2022 until 23 February 2023.

Excluding the respondent characteristics questions, the section on the *ex post* evaluation of Horizon 2020 included 20 questions. Among the 20 questions, there were 5 questions where respondents could give further insights in an open answer box. In total, the Commission received 2 788 responses to the questionnaire, with 1 818 replies received for the Horizon 2020 section. Statistical analysis of closed questions was performed to explore differences in opinion between types of respondents. The affiliations of respondents (e.g. SME, academia, public authority) are self-reported, and were not verified. The analysis of the open questions followed a qualitative method of approach. The questions were analysed either with the use of basic qualitative analysis (i.e. grouping respondents into broad groups and reading the responses to get an overview of the key themes) or with the use of a word cloud function (the function is used to indicate the most frequently used words in the qualitative responses and present the results graphically).

[52] https://ec.europa.eu/info/law/better-regulation/have-your-say_en

In addition to the online questionnaire, 229 position papers were received as part of the public consultation. After the compilation of all the position papers and the first screening and the removal of duplicates, campaigns and documents not addressing the Horizon 2020 programme directly (e.g. promotional material), 21 papers were analysed. The factual summary report and position papers have been published on Have your Say portal[53]. The analysis followed a qualitative method of approach. Based on a sample of position papers, a coding frame of broad themes was constructed. The final analysis per theme and any emerging sub-themes was conducted by type of respondent: academia, research organisations, public authorities, businesses, NGOs, citizens and others.

Overall limitations of the Horizon 2020 *ex post* evaluation

Methodological and data limitations were identified (listed below). Thanks to thorough checks ensuring that data is robust, these limitations did not affect the overall reliability of the analysis and the findings. Nevertheless, the evaluation faced the following challenges and limitations:

a) The ongoing implementation of 40% of projects represents a challenge for assessing impact (a challenge faced also by the *ex post* evaluation of FP 7 when 50% of projects were still ongoing). This is compounded by the long period of time needed to contribute to impact in the field of R&I. However, the legal basis determined when the evaluation must be done - subsequent evaluations can follow up and assess the long-term impact of Horizon 2020.
b) Some parts of the programme, such as the EIC Pilot, were implemented at the end of the programme, and so only future analysis can provide more extensive information on its impacts.
c) As noted already in the interim evaluation, Horizon 2020 indicators refer only to parts of the programme's intervention logic. There are limitations on data on the programme's outcomes and impact (for example, most Horizon 2020 indicators focus on input/results but not on the uptake of the results or their impact). The set of official programme indicators did not cover the entire intervention logic equally across impact areas: economic effectiveness was thus easier to assess as official indicators focused on contribution to company turnover, employment and GDP. Similar indicators are not available for assessing contributions to the Innovation Union flagship or other EU policies.
d) Indicators are defined in a suboptimal way, as they are not systematically accompanied by baseline values (i.e. values before the programme) or by target values (i.e. expected values at the end of the programme). They are also sometimes ambiguous, particularly when presented in short form (e.g. KPIs 9, 10, 11).
e) Some cross-cutting issues did not have accompanying indicators, while others are so complex that the selected KPIs cannot really provide a complete picture of progress (i.e. ERA, Innovation Union, Widening participation).
f) Some indicators addressed only actions supported by a single DG, programme part or type of action, and their data could not be aggregated with data collected for other indicators (which addressed another target group, for example). This led to challenges in 'telling the story' of what the programme achieved as a whole, without delving into its parts. There were also challenges regarding: (i) the aggregation of datasets (for example, most indicators are collected for specific programme parts only and not for the whole programme, and monitoring data covering the entire programme come from various data sources, which are difficult to aggregate); and (ii) the disaggregation of datasets (for example, to see the results of partnerships alone).
g) Where possible, key performance indicators were to be calculated ad hoc for the evaluation, in most cases from Commission monitoring systems. For a few indicators (KPIs 1, 4, 9-10-11, 22-23), figures were provided by other Commission departments and implementing authorities. Occasionally, data from the 2022 programme statement for the framework programme are used, as publication of the Horizon 2020 data in the programme statement of 2023 was suspended.

[53] https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/13444-Horizon-2020-programme-final-evaluation/public-consultation_en

h) Monitoring data recorded in the Commission IT systems can minimise but not completely exclude cases of multiple counting. This is particularly true for indicators reported in aggregate form, such as innovations and dissemination activities. Granular reporting on intellectual property rights and publications is provided voluntarily by beneficiaries. This may result in inaccuracies, such as under-reporting (especially for patents) and poor formatting of data, which detract from the accuracy of counting and matching to external data sources. Both these points are examined more in depth below in this section.

i) Some specific weaknesses were identified for external impact evaluation studies:
   - The steering committees agreed that the data collected were adequate for their intended use and robust, despite being somewhat limited. (i.e. not all data is available in eCorda or Innovation Radar). In some areas of the studies, the evaluators collected too little additional data/evidence, in addition to what was provided by the Commission and the implementing bodies.
   - In evaluation studies, the analysis of data on IPR outputs was suboptimal as it did not systematically filter out obvious reporting errors.
   - Use of external data sources: presentation of figures from Orbis, Crunchbase and Dealroom databases could have acknowledged the match rate and explained issues in more detail, e.g. in terms of geographical representation.
   - Evaluation studies included several attempts to identify causal effects of participation in the framework programme. However, expert review highlighted critical points weakening the relevance of their findings. Typical shortcomings include: no distinction made between mono-beneficiary and multi-beneficiary schemes; short time series, with no data on firm performance available to the study team before 2013; not enough transparency on the characteristics of the control group and on limitations connected to matching to external data sources.
   - The analysis of equity raised could have been more granular, with reference to the type of funding entities, with particular attention to other public funding, and to the origin of such funding and to the type of entities funded. Limitations of matching to external sources should also be acknowledged more precisely. For the analysis on equity funding rounds, as no all-encompassing databases exist, contractors could have cross-checked the validity of the results with other data sources such as Crunchbase and Zephyr.
   - Occasional uneven thematic coverage in some areas of the programme: for example, findings and conclusions in the area of Societal Challenge 1 were too exclusively focused on research into pharmaceutical and medicinal results, with findings of research into demographic change and well-being remaining extremely limited (e.g. research related to mental health); also, findings and conclusions in digital and industrial technologies were highly developed for the LEIT programme parts, but weaker for coverage of other programme such as Pillar I bottom-up schemes.

A **monitoring system based on self-reporting has inherent limitations**. It is naturally prone to inaccuracies, especially when reporting questions may be interpreted differently by project participants. This limits the usability of figures reported in aggregate form by project beneficiaries, such as non-IPR innovation outputs, knowledge spillovers to other entities, and dissemination and exploitation activities.

Systems allowing for granular reporting, such as the one in place for publications and IPR, are less affected by the issue above, as they allow for easier identification and quality control of unique outputs. However, they remain prone to discretionary under-reporting, which could be temporary (delayed reporting) but could also be permanent. For example, since there is no legal obligation to declare IPR outputs supported by EU funding, applications linked to framework programme projects may well never be reported. At the same time, the monitoring system suffers from a specific type of over-reporting:

participants indicate IPR applications filed before or around the start date of the project. These '**background patents**' (see Glossary), which are an input of research rather than its output, are in fact a common occurrence, especially at the beginning of a new framework programme[54].

In this staff working document, we report figures on IPR from the monitoring system 'as they are' to ensure consistency with baselines and with other monitoring reports such as yearly programme statements[55]. Filtering out 'background patents' is an exercise subject to interpretation, as using the project date alone is not a guarantee that the IPR declared is a genuine project output[56].

Much of the analysis on innovation diffusion from the framework programme is based on analysis of patents and other IPR. However, **IPR productivity is an indicator to monitor in the longer term**. First, there is a considerable time lag between achieving research and innovation results and applying for protection. Evidence from earlier framework programmes shows that participants report them generally towards the end of the projects, and often well after project activities are finished[57]. This is even more important if the subject of interest is **awarded IPRs**: as also remarked in the Horizon 2020 interim evaluation, the European Patent Office may take up to 5 years to grant a patent[58]. With such a long time lag, it is difficult at this stage to assess basic patent quality indicators, such as the number of citations or their economic value.

Second, **IPR figures obtained right after the end of a framework programme – even 2 years later, as for this evaluation – are far from final**. As shown in Section 4.1.5 of the staff working document, the number of reported IPR applications in FP7 is currently much higher than known at time of the *ex post* evaluation for FP7. The difference with the *ex post* evaluation is not only composed of applications filed from 2015 onwards, but also of delayed project reporting. A sizeable number of patent applications (around 1 200) were indeed filed before 2015, but were reported by applicants later, and are hence not included in our FP7 baseline.

As regards the public consultation, the views represented by the respondents are **not representative** of the EU population due to self-selection bias.

To overcome/mitigate these limitations, the evaluation report is transparent in indicating its data sources. Evaluation results have not been based on one data source, but findings were triangulated using various data sources.

[54] European Commission, 'Patents in the Framework Programme – From Horizon 2020 to Horizon Europe', *R&I monitoring and evaluation flash*, August 2020, p. 5.
[55] European Commission, Programme Statement 2022, COM(2021) 300, June 2021, https://commission.europa.eu/system/files/2022-07/ps_db2023_he_h1_1.pdf
[56] The referenced Commission report on patents in the FP ('Patents in the Framework Programme – From Horizon 2020 to Horizon Europe', 2020) considers 'background' applications filed until one year after project start.
[57] European Commission, Directorate-General for Research and Innovation, *Patents in the Framework Programme: from Horizon 2020 to Horizon Europe*, Publications Office of the European Union, 2022, https://data.europa.eu/doi/10.2777/789674.
[58] European Commission, *Interim evaluation of Horizon 2020*, 2017, p. 133, https://research-and-innovation.ec.europa.eu/knowledge-publications-tools-and-data/publications/all-publications/interim-evaluation-horizon-2020-key-documents_en.

ANNEX III. EVALUATION MATRIX AND, WHERE RELEVANT, DETAILS ON ANSWERS TO THE EVALUATION QUESTIONS (BY CRITERION)

Horizon 2020 official indicators are highlighted in blue in the matrix below. For more information, see the following publication: European Commission, Directorate-General for Research and Innovation, *Horizon 2020 indicators: assessing the results and impact of Horizon*, Publications Office, 2015, https://data.europa.eu/doi/10.2777/71098

Indicators marked in orange come from Regulation (EU) No 1291/2013 of the European Parliament and of the Council of 11 December 2013 establishing Horizon 2020 – the Framework Programme for Research and Innovation (2014-2020), https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32013R1291

1. Effectiveness

Evaluation questions	Judgement criteria: *extent to which…*	Indicators and where available – targets	Main data sources
1.1. How effective was Horizon 2020 implementation?	Horizon 2020 strengthened Europe's science base	Share of researchers in the total labour force	Eurostat (RD_P_PERSLF), Professional position: Researchers, Percentage of population in labour force – numerator in FTE
		% of publications from ERC-funded projects which are among the top 1% highly cited [**KPI 1**, no baseline – new under Horizon 2020, target: 1.8%, achieved value: 6.4%]	European Research Council Executive Agency, Annual Activity Report 2022, p. 6
		% of publications published in the top 10% impact ranked journals at FET level [**KPI 2**, no baseline – new under Horizon 2020, target: 25 publications per EUR 10 million funding, achieved value: 25.4 publications per EUR 10 million funding]	Commission monitoring system (CORDA), data on 24 April 2023
		Number of researchers undertaking (a) international mobility under the MSCA, and (b) mobility between academic and non-academic sectors [**KPI 4**, baseline: 50 000 researchers (2007-2013) – out of which 20% PhD, target: for the MSCA: 65 000 researchers – out of which 25 000 PhD candidates, achieved value: 49 475 *unique* researchers – of which 25 676 PhDs]	Excellent Science study, Section 4.4.3, Table 19. Figure based on CORDA data, updated on 19 January 2023
		KPI 5: Number of researchers who have physical or remote access to research (e)infrastructures • Physical access: baseline: 22 000 researchers, target: 20 000 additional researchers, achieved value: 24 235 • Share of researchers with access to e-infrastructures: no baseline or target, achieved value: 35.6%	Commission monitoring system (CORDA), data on 24 April 2023
		Number of joint public-private publications – LEIT [**KPI 8**, no baseline – new under Horizon 2020, no target, achieved value: 10 907]	Commission monitoring system (CORDA), data on 24 April 2023

		Science with and for Society – SWAFS: Number of institutional change actions promoted by the programme [**KPI 21**, no baseline – new under Horizon 2020, target: 100, achieved value: 381 (total) – 348 (Member States only)]	Commission monitoring system (CORDA), data on 24 April 2023
		JRC's annual number of peer-reviewed publications in high-impact journals [**KPI 23**, baseline: 460, target: 500 in 2020, achieved value: 548]	Ex post evaluation of the activities of the Joint Research Centre under Horizon 2020 and Euratom 2014-2020
		Publication citation scores of Horizon 2020 compared to other international funders (share of top 1% most cited publications and average normalised citation score of publications)	Excellent Science study – benchmarking exercise (based on bibliometric analysis)
		Number of awards and prizes won by ERC grantees (including the Nobel Prize, Wolf Prize and Fields Medal)	Excellent Science study
		% of public consultation respondents who responded that Horizon 2020 contributed to the planned scientific effects 'somewhat' or 'to a great extent'	Replies to stakeholders' consultation
	Horizon 2020 has spread excellence and widened participation in the programme	Spreading Excellence and Widening participation – SEWP: Evolution of publications in high-impact journals in the given research field [**KPI 20**, no baseline – new under Horizon 2020, no target: achieved value: 1 263 before EU funding, 3 098 after EU funding]	Commission monitoring system (CORDA), data at 24 April 2023
	Horizon 2020 has boosted Europe's industrial leadership and competitiveness	EU research and development expenditure relative to GDP [target: 3%]	European Commission, Programme Statements 2022
		The innovation output indicator in the context of the Europe 2020 strategy	Science, Research and Innovation performance of the EU, 2022 report
		% of FP contribution to GDP in the EU: average annual GDP gain and medium gain	Macromodelling analysis. Models: RHOMOLO (by DG Joint Research Centre), QUEST (by DG Economic and Financial Affairs), NEMESIS (by SEURECO ERASME in the Innovative Europe study)
		% of FP contribution to employment in the EU: average annual employment gain and medium gain	Macromodelling analysis. Models: RHOMOLO (by DG Joint Research Centre), QUEST (by DG Economic and Financial Affairs), NEMESIS (by SEURECO ERASME in the Innovative Europe study)
		Number of patent applications and awards in FET per EUR 10 million of funding [**KPI 3**, no baseline – new under Horizon 2020, target: 1, achieved value: 0.84 applications and 0.55 patents awarded]	Commission monitoring systems (CORDA), data on 24 April 2023, Group of Independent Experts, Assessing the Influence of ERC-funded Research on Patented Inventions (2022)

		Number of patent applications and patents awarded in the different enabling and industrial technologies per EUR 10 million of funding – LEIT [**KPI 6**, no baseline – new under Horizon 2020, target: 3, achieved value: 0.56 applications and 0.38 patents awarded]	Commission monitoring systems (CORDA), data on 24 April 2023
		Percentage of participating firms introducing innovations new to the company or to the market – LEIT [**KPI 7**, no baseline – new under Horizon 2020, target: 100% of participating firms, achieved value: 124.2%[59]]	Commission monitoring systems (CORDA), data on 24 April 2023
		Total investments mobilised by Horizon 2020's debt and equity facilities (InnovFin) [**KPI 9, KPI 10:** no baseline – new under Horizon 2020, target: EUR 25 billion investments mobilised; achieved value: EUR 77.5 billion as of April 2022 (debt and equity combined)]	EIB group estimate based on implementation data. Figures reported in European Commission, DG Research and Innovation annual activity report 2021, p. 47. Available at https://commission.europa.eu/system/files/2022-05/annual-activity-report-2021-research-and-innovation_en.pdf
		Number of organisations funded and amount of private funds leveraged by Horizon 2020's debt and equity facilities (InnovFin) [**KPI 11**, baseline: 300, target: 5 000 organisations funded and EUR 35 billion of private funds leveraged, achieved value: 37 921 as of April 2022, EUR 43.6 billion in private funding]	EIB group estimate based on implementation data, reported in annual activity report, p. 47. Available at https://commission.europa.eu/system/files/2022-05/annual-activity-report-2021-research-and-innovation_en.pdf
		Number and percentage of participating SMEs introducing innovations new to the company or the market (covering the period of the project plus 3 years) [**KPI 12**, no baseline – new under Horizon 2020, target: 50%, achieved value: 118%]	Commission monitoring systems (CORDA), data on 24 April 2023
		Growth (turnover) and job creation in participating SMEs [**KPI 13**, no baseline – new under Horizon 2020, no target, achieved value: +4.2% turnover growth, +5.2% direct employment growth][60]	Commission monitoring systems (CORDA), data on 24 April 2023
		Number of organisations from universities, business and research integrated in the KICs [**EIT KPI 1**, baseline: 200	European Commission, Programme Statements 2022 (indicator 1 on p. 70), Innovative Europe study.

[59] The figure is reported as it appears in the monitoring system. Ambiguous reporting questions led beneficiaries to indicate more firms than unique participants in the programme. Since data are reported by beneficiaries in an aggregate way, no *ex post* controls on the figure are possible.

[60] Each SME is considered per each time it participated in a grant. The value reported should be intended as an average of all variations between turnover or employment at project start against the most recent value reported by the beneficiary (which may vary from project to project depending on reporting date). Turnover and employment values are used for the calculation as they are self-reported by participants and may be inconsistent with official sources.

		organisations in the 2010-2013 period, target: 1 200, achieved value: 2 153 in 2020]	
		Number of new graduates from EIT-labelled PhD and Masters programmes [**EIT KPI 2**, achieved value: 3 845]	Innovative Europe study (2023), Table 14, p. 45
		Number of business ideas incubated [**EIT KPI 3**]	Innovative Europe study
		Sum of knowledge transfers/ adoptions [**EIT KPI 4**]	Innovative Europe study
		Number of new or improved products/services/ processes launched onto the market as a direct output of a KIC activity [**EIT KPI 5**, achieved value: 1 501]	European Commission, Programme Statements 2022 (Indicator 2 on p. 71: collaboration inside the knowledge triangle leading to the development of innovative products, services and processes) Innovative Europe study
		Attractiveness of education programs: Ratio of the number of eligible applicants for EIT-labelled PhD and Masters programmes divided by the number of available places on these programmes [**EIT KPI 6**]	Innovative Europe study
		Number of start-ups and spin-offs created as a direct output of a KIC activity [**EIT KPI 7**, baseline: 33, target: 66, achieved value: 305 start-ups and spin-offs across Climate KIC, EIT InnoEnergy, EIT Digital, EIT Health and EIT Raw Materials in 2010-2016; additional 36 start-ups created by students enrolled in and graduates of EIT-labelled MSc and PhD programmes in 2017-2020; 99 start-ups created as a result of innovation projects for the indicated KICs]	European Commission, Programme Statements 2022 (Indicator 2 on p. 71: collaboration inside the knowledge triangle leading to the development of innovative products, services and processes) Innovative Europe study
		% of public consultation respondents who responded that Horizon 2020 contributed to the planned economic effects 'to a great extent'	Replies to stakeholders' consultation
	Dissemination, exploitation and communication *measures* have made it possible to reach these outcomes and impacts	Communication: % of public consultation respondents who rated 'communication activities on Horizon 2020 to attract applicants' as 'very good' or 'good'	Replies to stakeholders' consultation
		Exploitation: % of respondents who reported the following developments since the end of their grant: (a) the project results have contributed to opening a new stream of research and innovation in the institution; (b) the project results have been/will be used in other (follow-up) projects; (c) the project results have been/will be commercialised (i.e. used to create new products and/or services); (d) the project results have been/will be used to improve available products and/or services	Replies to stakeholders' consultation

		Dissemination: % of respondents who believe that various EU platforms and dashboards helped to disseminate, exploit and access research and innovation results	Replies to stakeholders' consultation
		Dissemination: Extent of compliance with the open access requirements of Horizon 2020, for both publications and research data	European Commission, *Monitoring the open access policy of Horizon 2020* (2021) Replies to stakeholders' consultation
	Horizon 2020 increased research and innovation's contribution to key ***societal challenges***	Number of publications in peer-reviewed high-impact journals per EUR 10 million funding, for societal challenges [**KPI 14**, no baseline – new under Horizon 2020, target: 20 for all societal challenges, achieved value: 7 per EUR 10 million funding]	Commission monitoring systems (CORDA), data on 24 April 2023
		Number of patent *applications* and patents *awarded* across the societal challenges, per EUR 10 million of funding [**KPI 15**, baseline: to discuss, target: 2, achieved value: 0.35 applications and 0.26 patents awarded, per EUR 10 million of funding]	Commission monitoring systems (CORDA), data on 24 April 2023
		Number of prototypes and testing activities, [**KPI 16,** no baseline – new under Horizon 2020, no target, achieved values: prototypes 262 297, testing activities 386 078[61]]	Commission monitoring systems (CORDA), data on 24 April 2023
		Number of joint public-private publications, for Societal Challenges [**KPI 17**, no baseline – new under Horizon 2020, no target, achieved value: 13 436]	Commission monitoring systems (CORDA), data on 24 April 2023
		Number of new products, processes and methods launched into the market [**KPI 18** – not legally compulsory. No baseline – new under Horizon 2020, no target, achieved values: Total number of projects introducing either a new methodology, a new process or a new product: 5 970; Total number of projects introducing a new methodology: 2 955; Total number of projects introducing a new process: 2 941; Total number of projects introducing a new product: 5 306[62]]	Commission monitoring systems (CORDA), data on 24 April 2023
		% of the overall energy societal challenge funds allocated to renewable energy, end user energy efficiency, smart grids and energy storage activities [**KPI 19**, no baseline – new approach under Horizon 2020, target: 85%, achieved value: 69.6%]	Commission monitoring systems (CORDA), data on 24 April 2023

[61] Data self-reported by beneficiaries in aggregate way: controls for e.g. duplication are not possible. The figures are reported as they appear in the monitoring system.
[62] Data self-reported by beneficiaries in aggregate way: controls for e.g. duplication are not possible. The figures are reported as they appear in the monitoring system.

		Annual number of occurrences of tangible specific impacts on European policies resulting from technical and scientific support provided by the Joint Research Centre [**KPI 22**, baseline: 248, target 330, achieved value: 513]	Ex post evaluation of the activities of the JRC under Horizon 2020 and Euratom 2014-2020 (Table 2[63], p. 69)
		% of public consultation respondents who responded that Horizon 2020 contributed to the planned societal effects 'to a great extent'	Replies to stakeholders' consultation
	international cooperation and, more specifically, association of third countries to the Horizon 2020 has made a difference in achieving its objectives	International cooperation [CCI KPI **7**]: - % of third-country participants in Horizon 2020 - % of budget of topics in the work programmes mentioning at least one third country or region	Commission monitoring data (R&I Dashboard, data on 31 December 2022)
		Level of agreement among stakeholders that Horizon 2020 enabled international collaborations that otherwise might not have come into existence	Replies to stakeholders' consultation 5 impact area evaluation studies (links in Annex 2)
	use of different instruments, including partnerships, made it possible to achieve impact for science, economy and/or society	Adequacy of the policy mix	Evaluation study on the Relevance and Internal coherence of Horizon 2020 and its Policy Mix
		% of public consultation respondents who reported that partnerships have been 'very much' more effective than regular collaborative research	Replies to stakeholders' consultation 5 impact area evaluation studies (links in Annex 2)
1.2. To what extent has the FP contributed to achieving the EU policy priorities?	Horizon 2020 strengthened the European Research Area	Contribution to realising the European Research Area [CCI KPI 1]: - Annual number of research positions advertised on EURAXESS Jobs - Number of national research infrastructures networked - Number and percentage of open access articles published in peer-reviewed journals - Number of projects that make scientific data accessible and re-usable and number of scientific datasets made accessible and re-usable - Number of multiannual implementation plans adopted by joint programming activities	Evaluation study on the implementation of cross-cutting issues in Horizon 2020
		Level of agreement among stakeholders that Horizon 2020 influenced the national policies	Replies to stakeholders' consultation

[63] Impact is defined as 'the use of JRC results for policy preparation (e.g. impact assessments), monitoring (e.g. COM reports), implementation (e.g. methods, materials, guidance) and evaluation'.

	enhanced participation of Horizon 2020 widening countries in the programme and supported the expansion of a pan-European R&I network	Widening participation [CCI KPI 2]: Total number of participations by EU-28 Member States	Evaluation study on the implementation of cross-cutting issues in Horizon 2020
		% of respondents who agreed or strongly agreed that 'Horizon 2020 spread excellence and widened participation in R&I'	Replies to stakeholders' consultation
	cross-cutting issues were implemented within the FP projects	SME participation [CCI KPI 3]*:* % of EU financial contribution committed through the SME instrument	CORDA data Evaluation study on the implementation of cross-cutting issues in Horizon 2020 Replies to stakeholders' consultation
		Social sciences and humanities: % of SSH partners in selected projects in all Horizon 2020 priorities [CCI KPI 4]	Evaluation study on the implementation of cross-cutting issues in Horizon 2020
		Science & society: % of projects where citizens, civil society organisations and other societal actors contribute to the co-creation of scientific agendas and scientific contents [CCI KPI 5]	Evaluation study on the implementation of cross-cutting issues in Horizon 2020
		% of respondents who agreed or strongly agreed that 'gender equality as a cross-cutting issue was effectively implemented'	Replies to stakeholders' consultation European Commission, 'Study on the proposal evaluation system for the EU R&I framework programme' (2022)
		Gender [CCI KPI 6]: - % of women participants in Horizon 2020 projects - % of women project coordinators in Horizon 2020 - % of women in EC advisory groups, expert groups, evaluation panels, individual experts, etc. - % of projects taking into account the gender dimension in research and innovation content	Evaluation study on the implementation of cross-cutting issues in Horizon 2020 European Commission, 'Study on the proposal evaluation system for the EU R&I framework programme' (2022)
		Sustainable development and climate change [CCI KPI 8]: - % of EU financial contribution climate related in Horizon 2020 [target: 35%, achieved value: 32%] - % of EU financial contribution in Horizon 2020 related to sustainable development [target: 60, achieved value: 64.4%]	Evaluation study on the implementation of cross-cutting issues in Horizon 2020 Evaluation study on the relevance and internal coherence of Horizon 2020 and its policy mix (Annex C – eCorda data analysis) European Commission, 'Informing global climate action' (2022)
1.3. To what extent has the FP contributed to achieving the SDGs?	projects funded by the FP contributed to EU policy priorities and SDG implementation	Top three SDG projects contributed to, by impact area	5 impact area evaluation studies (links in Annex 2)

1.4. Did the FP successfully reach a wide and balanced range of stakeholders?	allocated funding is concentrated geographically	% of funding allocated by Member States % of funding allocated to EU-15, widening countries and associated countries	Evaluation study on the implementation of cross-cutting issues in Horizon 2020
	allocated funding is concentrated to smaller or larger projects	Comparative likelihood of smaller and larger projects to get funded	Evaluation study on the Relevance and Internal coherence of Horizon 2020 and its Policy Mix Replies to stakeholders' consultation

2. Efficiency

Questions	Judgement criteria: *extent to which…*	Indicators	Main data sources
2.1. How efficient have the implementation processes of the FP been, and in particular the simplification measures taken in Horizon 2020?	administration and management have been efficient	Time-to-inform Time-to-sign Time-to-grant	European Commission administrative data 5 impact area evaluation studies (links in Annex 2) Replies to stakeholders' consultation
		% of public consultation respondents who replied that cumbersome project implementation may have prevented participation in the framework programme	Replies to stakeholders' consultation
	project application and selection processes have been efficient	% of public consultation respondents who replied that less or much less effort was required for the application process than expected	Replies to stakeholders' consultation
		% of public consultation respondents who replied that the effort to participate in Horizon 2020 was similar or lower than for the previous framework programme	Replies to stakeholders' consultation
	tangible benefits have resulted from simplified / streamlined rules, procedures or processes	Tangible effects of specific key changes, e.g. reduced administrative burden, faster decision-making	5 impact area evaluation studies (links in Annex 2) European Commission administrative data
		% of public consultation respondents who replied that the following measures largely or hugely reduced the administrative burden: • alignment of funding rules applicable to all EU funds • harmonisation of processes and guidance documents across the programme • using an electronic-only grant management system • further use of the two-stage application process (for some programme parts) • using a new funding model with a single reimbursement rate and a single flat rate • selected projects funded as proposed (no negotiation during grant preparation)	Replies to stakeholders' consultation

2.2. How proportionate were the costs of application and participation borne by different stakeholders groups, taking into account the associated benefits?	administrative costs borne by applicants and participants were lower compared to the previous FP	Ranges of the average applicant's cost of applying under Horizon 2020	Replies to stakeholders' consultation
		Ranges of the average number of person days needed for proposal development under Horizon 2020	Replies to stakeholders' consultation
		Qualitative stakeholder feedback on application cost under Horizon 2020 compared to FP7	5 impact area evaluation studies (links in Annex 2) Replies to stakeholders' consultation
	barriers at application stage and during project implementation did not have negative consequences for the researchers and organisations involved	Identification of barriers Level of agreement among applicants that these barriers did not have negative consequences	5 impact area evaluation studies (links in Annex 2) Replies to stakeholders' consultation
	drivers at application stage and during project implementation had positive consequences for the researchers and organisations involved	Identification of drivers Level of agreement among applicants that these drivers had positive consequences	5 impact area evaluation studies (links in Annex 2)

3. Coherence

Questions	Judgement criteria: *extent to which…*	Indicators	Main data sources
3.1. How coherent has the R&I Framework Programme been between its programme parts, and with other EU programmes serving similar objectives and with national, regional and international initiatives?	implementation of Horizon 2020 was consistent *between programme parts*	Level of consistency/coordination of policy mix in terms of: (i) types of actions (e.g. grants, financial instruments, procurement support); (ii) forms of call implementation (e.g. calls for individual projects, use of focus areas, public-public partnerships, public-private partnerships); (iii) technological readiness levels covered; (iv) targeted beneficiaries	Evaluation study on the Relevance and Internal coherence of Horizon 2020 and its Policy Mix Innovative Europe study European Commission, 'Opportunities and challenges in targeted funding of Research and Innovation' (2021)
	implementation of Horizon 2020 was consistent with the European Structural and Investment Funds	Degree to which implementation of Horizon 2020 was consistent with Structural and Investment Funds' European Research and Development Fund (including through the Seal of Excellence)	Evaluation study on the external coherence and synergies of Horizon 2020 with the European research and innovation support system Special report 2022/23 of the European Court of Auditors: 'Synergies between Horizon 2020 and European Structural and Investment Funds' Replies to stakeholders' consultation

	implementation of Horizon 2020 was consistent with relevant national, regional initiatives and joint programming	Degree to which implementation of Horizon 2020 was consistent with the objectives of national policies and programmes (especially partnerships and ERANETs)	Evaluation study on the external coherence and synergies of Horizon 2020 with the European research and innovation support system Sections on ERANETs and joint programming (art. 185 initiatives) in the impact area studies
	Horizon 2020 has worked in synergy with other relevant EU programmes	Degree to which implementation of Horizon 2020 was consistent with other EU programmes such as (i) the Connecting Europe Facility; (ii) the European Fund for Strategic Investments; (iii) Erasmus+; (iv) Life	Evaluation study on the external coherence and synergies of Horizon 2020 with the European research and innovation support system Special report 2022/23 of the European Court of Auditors: 'Synergies between Horizon 2020 and European Structural and Investment Funds' Replies to stakeholders' consultation

4. EU added value

Questions	Judgement criteria: *extent to which…*	Indicators		Main data sources
4.1. What was value resulting from the FP that is additional to the value that could result from interventions which would be carried out at regional or national level?	the stakeholders could not have implemented their research and innovation in another way (i.e. through other national or regional support)	Level of stakeholder agreement that without Horizon 2020 projects would likely not have secured funding and would not have taken place at all		5 impact area evaluation studies (links in Annex 2) Replies to stakeholders' consultation
		% of respondents who stated that participation in Horizon 2020 was beneficial compared to national and/or regional R&I programmes in EU Member States (for various reasons)		Replies to stakeholders' consultation
	Horizon 2020 minimised duplications via collaboration	Level of stakeholder agreement that Horizon 2020 minimised duplication through:	- Collaborative research	Excellent Science study
			- Direct actions by JRC	Ex post evaluation of the activities of the JRC under Horizon 2020 and Euratom 2014-2020
			- EIT and its KICs	European Commission, Programme Statements 2022 Innovative Europe study
			- H2020 widening actions	Excellent science study
			- Innovation actions (demonstration and tests)	Innovative Europe study
	Horizon 2020 leveraged additional resources for R&I	Leverage factor of partnerships: additional resources mobilised by industry and Member States (absolute number in EUR)		Partnerships Biennial Monitoring Report (2022, Section III)

	Horizon 2020 created transnational cooperation	Level of support for distinctive projects that are unlike those that the Member States and their regions fund	Replies to stakeholders' consultation Impact area studies (links in Annex 2)
	Horizon 2020 increased excellence	Degree to which Horizon 2020 increased participants' competitive advantage	PPMI counterfactual analysis Mitra, Alessio, and Niakaros, Konstantinos (2023). The Horizon Effect: A Counterfactual Analysis of EU R&I Grants
		Degree to which Horizon 2020 spread excellence to lower R&I performing countries	Excellent Science study
		% of public consultation respondents who reported that stepping up support to breakthrough innovations through the introduction of the EIC Pilot strengthened the impact of Horizon 2020	Replies to stakeholders' consultation

5. Relevance

Questions	Judgement criteria: *extent to which…*	Indicators	Main data sources
5.1. How relevant has the support to innovation by the Framework Programme (FP), including partnerships, been given the stakeholders' needs and considering the scientific, technological and/or socio-economic problems and issues identified at the time of its design and over time?	the design of the FP (including partnerships) was based on the analysis of ***needs*** of groups targeted for application/participation	Existence of needs falling outside the scope of the FP	Evaluation study on the Relevance and Internal coherence of Horizon 2020 and its Policy Mix
		Degree to which the policy mix mobilised ***newcomers***	Evaluation study on the Relevance and Internal coherence of Horizon 2020 and its Policy Mix Newcomers monitoring flash
		% of respondents who reported that the FP reached its objectives	Replies to stakeholders' consultation
	the FP demonstrated that it was ***flexible*** in coping with changing circumstances in Europe and in the world	Degree to which the programme integrated lessons learnt during implementation	Evaluation study on the Relevance and Internal coherence of Horizon 2020 and its Policy Mix
		Degree to which the programme responded to unforeseen and emergency circumstances, such as the COVID-19 pandemic Speed of response to COVID-19 compared to Zika and Ebola crises	Evaluation study on the Relevance and Internal coherence of Horizon 2020 and its Policy Mix – case study no 21 on how Horizon 2020 and its policy mix came into play in reaction to the COVID-19 crisis Replies to stakeholders' consultation 5 impact area evaluation studies (links in Annex 2) European Commission, 'Meeting the pandemic challenges - Contribution of EU R&I funding to COVID-19 related research' (2022)

Additional details on societal effects of Horizon 2020 projects

A more complete account of societal impacts of Horizon 2020 projects is provided below and in the underlying set of evaluative studies and materials, to complement Section 4.1.2 on Effectiveness: societal impacts.

SC1 – Health, demographic change and well-being

As a minimum, some of the SC1 project publications have been effective **in shaping EU public health policy development**[64]. The effects range from project reports being cited in EU reports and the Eurosurveillance journal[65], to influencing changes in WHO guidelines. The European Centre for Disease Prevention and Control (ECDC) cited the highest number (33) of SC1 publications, followed by the Directorate-General for Health and Food Safety (DG SANTE). In total, 53 (unique) EU policy papers were found to have cited 81 (unique) SC1 project publications. The policy papers include types of documents aimed at informing public health policy and providing guidelines[66].

Case studies on SC1 actions have been able to identify with some certainty an **effect from some Horizon 2020-funded projects on the global health policy discourse**. Examples include the BEAT-AMR project, which developed clinical recommendations and a roadmap on antimicrobial coatings in healthcare settings, and members of the AMR project 'DARWIN' [67], who co-authored international recommendations for the WHO. Several partnership projects have equally contributed to shaping policies and global health advice. One such example was the AMBITION[68]-cm phase III clinical trial, whose results directly shaped an update of WHO guidelines[69].

Positive impacts were achieved by strengthening international collaboration in research between European and African countries and institutions. The public-public **European & Developing Countries Clinical Trials Partnership (EDCTP)[70]** boosted the number of clinical studies and research activities by between 30 and 40% in South Africa, Uganda and Tanzania, and increased by over half the number of studies registered in other countries. It also helped secure a critical mass of resources and expertise, particularly in sub-Saharan Africa. This international collaboration in research was particularly relevant in these areas, where the existing activities had been fragmented.[71] Globally, EDCTP2[72] was identified as the third-largest financial enabler of tuberculosis research globally and the second largest public funder.

[64] This finding is underpinned by analysis of SC1 projects cited in EU policy papers, studies supporting impact assessment, in combination with an assessment of the public health policy impacts in SC1.
[65] See for example the Eurosurveillance journal, https://www.eurosurveillance.org/.
[66] E.g. 'Eurosurveillance: special edition: advanced diagnostics to inform public health policy. March 2019.' and 'Recommendations on FAIR metrics for EOSC.'
[67] The DARWIN–AMR project co-authored international recommendations for the WHO aimed at promoting local national action plans and sociotechnical AMR mitigation options for countries around the world.
[68] The AMBITION-cm – EDCTP2 project led to the updated WHO guidelines on HIV treatment: 'New guidelines developed by WHO strongly recommend a single high dose of liposomal amphotericin B as part of the preferred induction regimen for the treatment of cryptococcal meningitis in people living with HIV'.
[69] https://www.who.int/news/item/20-04-2022-rapid-advice-new-guidelines-for-simpler-safer-treatment-for-cryptococcal-disease-in-plhiv
[70] Resilient Europe study (2023), Annex1, Section 2.3.1 and case study 2.
[71] Evaluation study of the European FPs for Research and Innovation for a Resilient Europe, p. 66.
[72] https://www.treatmentactiongroup.org/wp-content/uploads/2021/12/tb_funding_2021.pdf.

ANNEX IV. OVERVIEW OF BENEFITS AND COSTS, TABLE ON SIMPLIFICATION AND BURDEN REDUCTION

1. Benefits of Horizon 2020

Horizon 2020 gives rise to a range of benefits, presented in Section 4.1 (Effectiveness) in the context of the framework programme's structure and Intervention Logic. In the framework of Better Regulation this means Horizon 2020 generates:

1. Indirect long-term welfare benefits for EU society derived from scientific impact, and related benefits for participants

The R&I framework programmes, including Horizon 2020, **support activities that generate scientific outputs** (e.g. scientific publications) **and outcomes/results** (e.g. positive effects on researcher careers after participation), which are **direct and indirect benefits for its participants** (reported in section 4.1.1, 4.1.6, and also 4.1.2). The direct outputs of Horizon 2020 and some indirect long-term outcomes of FP7 have been quantified and are summarised below. (Table 1, I. Benefits; column: Beneficiaries).

In the long run, these effects on beneficiaries have a strong potential to lead to **indirect welfare benefits for EU society**, i.e. to positive social, environmental, or economic impacts from scientific progress (e.g. improvements in public health). These long-run benefits have not been systematically assessed and are only mentioned in Table 1 (column: Citizens/EU Society): Horizon 2020's future long-term welfare benefits are difficult to predict and may arise in yet unknown areas. The links between past R&I support programmes and currently observable welfare improvements from scientific progress are not systematically monitored. In addition, many external factors contribute to any scientific breakthrough or advancement, which makes it difficult to establish a causal link with specific instances of R&I funding.

2. Indirect wider economic benefits for EU society from diffusion of innovation, and related economic benefits for participants

Horizon 2020 supported industrial research and innovation 'from idea to market', which had the aim to improve innovation diffusion in products, processes, and services. The related **innovation outputs** (e.g IPR applications) and resulting economic **outcomes/results** (e.g. improved economic performance of firm after participation) constitute **direct and indirect economic benefits for private sector participants** (reported in section 4.1.3, 4.1.6, and also 4.1.2). Innovation outputs of Horizon 2020 and some of the indirect (micro-)economic benefits for participants have been quantified or monetised and are summarised below. (Table 1, I. Benefits; column: Beneficiaries).

In the long run, with the effects of innovations in processes and products spreading through sectors of the economy and increasing **productivity** and competitiveness, Horizon 2020 has a strong potential to lead to **indirect, wider economic benefits for the European economy as a whole** (reported in section 4.1.3), ultimately raising the welfare of EU society. Macroeconomic impacts of Horizon 2020 have been estimated in terms of GDP gain and jobs created and are reported below. (Table 1, I. Benefits; column: EU society).

Note on the effects of 'Societal Challenges' programme part: Horizon 2020 supports specific activities focused on tackling **societal challenges** by means of R&I, which have generated scientific outputs (included in benefit 1. above) and innovation outputs linked to economic benefits (included in benefit 2. above). Some activities on societal challenges are geared towards generating **positive direct, non-market effects**, such as informing the policy debate,

which are expected to contribute to **indirect, non-monetary social and environmental benefits** *(*e.g. positive impacts on gender equality, Europe's security and on achieving SDGs), thus **increasing the welfare of society in the long run**. Although it is considered likely that at least some of these benefits have materialised, they have not been systematically assessed by the evaluation, due to the lack of a monitoring and evaluation framework.

2. Costs of Horizon 2020

The framework programme, including the processes through which it was implemented, has given rise to four main types of costs incurred by different stakeholder groups, which also influence its efficiency:

1. Horizon 2020's operational expenditure - is the main direct cost of the framework programme. It is incurred by EU society and constitutes the input that enables the R&I activities and leads to the generation of benefits to society. The money is invested through calls and other activities (e.g. PPPs, events, studies) and comes out of the programme's voted budget. (Reported below in Table 1, II. Costs)

2. Administrative Cost of the European Public Sector – are funded separately through the Union's budget as Horizon 2020's **Administrative Expenditure**. This cost of administrating and running the framework programme is borne by the **public sector at European level**[73] (and ultimately EU society) and is the second main cost factor that affects its overall efficiency. (Reported below in Table 1, II. Costs)

Evidence collected on the **cost of the proposal evaluation process** (included in the total administrative cost) suggests that an average public sector time cost[74] for the evaluation of one proposal to arrive at between 43.6 hours (multi-stage process) and 58.6 hours (single stage process) of evaluation expert time. An approximate monetised value of the evaluation of one proposal was estimated[75] to about **€ 2 500** (multi-stage) and **€ 3 300** (single stage process), excluding administrative costs of organising the evaluation, based on the pay rate[76] of an evaluation expert.

3. Administrative costs of Horizon 2020 beneficiaries (non-additional, compensated for in operational expenditure) - The 41 575 participants[77] of Horizon 2020 spent substantial effort on the actual research and innovation activities, which generated the benefits, reported under effectiveness. In addition, participants also incurred costs (i.e. spent effort, money and time) to fulfil **Horizon 2020's administrative requirements** for each of their 178 104 participations[78]. These **administrative costs of programme beneficiaries**, while to an extent operationally unavoidable, are not directly productive in terms of benefits. They have the potential to introduce substantial inefficiencies into R&I support. Reducing the administrative costs of beneficiaries was one of the aims of the simplification measures of Horizon 2020 (see section 4.2.2)
In the **public consultation**, the majority of respondents stated that **the effort needed to participate in Horizon 2020 was 'similar' (39%; 692 respondents), or even 'greater' (17%; 303) compared to that under FP7**. Only a minority of respondents (**12%; 219**) **spent less effort** (with one-third

[73] Public sector administrative costs related to the FP at a national, regional, and local level are not covered in the evaluation.
[74] Study on the proposal evaluation system for the EU R&I framework programme. Annex (2022), p. 152.
[75] Horizon 2020's Evaluation support study on Resilient Europe; Annex1 Section 5, Table 60, p. 122.
[76] The Horizon 2020 Model Contract for Experts indicates that the expert is entitled to a fee of EUR 450 for each full day worked in accordance with Article 3(2). Calculation assumes 8-hour day. (https://ec.europa.eu/research/participants/data/ref/h2020/experts_manual/h2020-experts-mono-contract_v1.1_en.pdf).
[77] Corda dashboard data: Unique participants in signed grants, as of 1/1/2023.
[78] Corda dashboard data: Participations in signed grants, as of 1/1 2023.

of the respondents not providing an opinion). Although exact percentages differed, the overall pattern of the feedback matched that of responding EU citizens (34% similar, 13% greater, 9% lower effort) and was influenced by responses from **academic and research institutions** (41% similar, 21% greater, 12% lower effort), with over 190 respondents (over one-fifth) of this stakeholder group reporting a cost increase relative to FP7. Improvements seem to have been slightly more pronounced for the private sector, according to responses from **business associations** (44% similar, 16% greater, 28% lower effort) and **companies/business organisations** (40% similar, 12% greater, 14% lower effort).

When comparing the participation of Horizon 2020 to 'other research and innovation programmes', **a larger share considered the relative effort under Horizon 2020 'similar' or 'greater', than 'lower'.** Responses varied substantially by sub-group. Whereas approx. 20% (26) of respondents from Associated Countries reported Horizon 2020 required comparatively lower effort, this was the case for only half that share of respondents from EU Member States (EU15: 12.3%, EU13: 10.1%). compared the programme favourably to alternative sources of funding. Effort to participate in Horizon 2020 vis-à-vis other R&I programmes: among half of the respondents from both EU-associated countries as well as third countries **was greater**, compared to only 33% among EU-13 respondents. Similarly, 50% of academic institutions reported the same, along with business associations (41%), companies and business organisations (37%) as well as EU citizens (40%). A lower share of respondents, notably from NGOs (33%), non-EU citizens (31%) and public authorities (29%), indicated that the effort was higher – leading to the assumption that for these respective groups, Horizon 2020 was more accessible.

Around 300 respondents provided information on the **time cost to manage participation** in terms of the '**average number of person-days**[79] spent during the entire project', which allows for some very approximate quantification. As expected, projects of longer duration experienced higher total administrative time costs, however, particularly the 12-month (71 person-days) and 48-month (332 person-days) long projects showed **high average administrative time costs** of **6 to 7 person-days per month**. Projects of 24 months (103 p.-d.) and 36 months (157 p.-d.**)** length spent **just under 4.5 person-days per month on average**.

Expressing the two modes of average values, of 4.5 person-days/month and 7 person-days/month, as **order of magnitude money values**, would imply that the **total beneficiaries' administrative cost of Horizon 2020** amounted to between **EUR 135 million and EUR 215 million[80].** The upper bound of the range could, however, **be too low by an order of magnitude**. A spot check[81] against project reporting information suggests that projects **of 60 months duration and more** may have average monthly time costs (of tasks that constitute additional administrative burden) that **far exceed 10 person-day per months**. As the grouping of tasks into work packages and the numbering and labelling of these packages is different for each project, the reported cost information cannot be systematically used for an *ex post* assessment. The time ranges for projects of the same duration, reported in the public consultation, were in some cases vast, likely reflecting the diversity of circumstances as well as potential question design issues: The 156 respondents with projects of **36 months duration**, for instance, reported costs from **2 person-days per month to a value of 1,500 person-days per months** (even correcting for

[79] i.e expressed in multiples of working days of one person.

[80] This monetisation uses the programme's total number of project months (1 284 101 months) and is based on the wage tariffs of Better Regulation Tool 58 (footnote 836; One-In-One-Out calculator, using Eurostat and 2018 Labour Force Survey data), with an assumed 8 hour working day, European average values and the assumption that work is carried out by a person with profile ISCO 4.

[81] The average values have been spot checked for plausibility against a small number of randomly selected Horizon 2020 projects of different project durations, using reported effort by the coordinator (reported in person-months, that use 220 working days per year) The effort was taken from the work package that in each case closest matched tasks representing additional administrative burden.

outlier), the latter value suggesting that about 82 people were occupied with administrative requirements full-time. It cannot be excluded that responding beneficiaries may have interpreted the question in an unintended way, reporting too high values (including time for internal coordination or for project activities overall) or too low values (as not all time spent was perceived by them, due to the respondent's role in the project).

The uncertainty the respondents' interpretation of the question, the non-representative nature of the public consultation as such, and the small sample of respondents overall (particularly for some project types) means that there is a **very high level of uncertainty around the (time) cost values representing beneficiaries' administrative costs of participating in Horizon 2020. The presented values are insufficiently robust to inform programme design**.

4. Costs of applicants - Successful and unsuccessful applicants to the framework programme incur a one-off cost: they invest effort, time, and money to prepare proposals. Application costs are mainly determined by the specific requirements of the programme part and rise with an increase in competition between applicants. For an evaluation, from the point of view of EU society, these application costs are relevant. They have the potential to introduce substantial external inefficiencies into the R&I support, as time, effort, and money spent by unsuccessful applicants can, to a great extent, become a deadweight loss to society unless captured suggests otherwise. High application costs also drive away potential applicants and so have the potential to distort the participation of applicants with respect to relevant characteristics, such as capital constraint, lack of experience, and the availability of outside options of funding to the applicant.

How high were the costs of applicants?
The evaluation has brought together around 40 individual instances of evidence of variable but generally low levels of robustness on the actual cost of application. The cost data received suggest that actual costs seem to **vary widely by funding instrument**. They are also **influenced by the evaluation process (multi/single stage) and type of stakeholder group** targeted. **The information available is of insufficient quality to generate a robust aggregated cost of applicants for the programme. It nevertheless illustrates the order of magnitude of the costs of preparing a proposal**.

In the context of several support studies, the evaluation collected some evidence from beneficiaries on costs of applications[82] expressed in money terms. The **average monetised cost of a single proposal varies substantially by funding instrument** (and likely also by the potential grant size), with the lowest average value of **€ 6 000** for a SME Instrument phase 1 proposal[83] to over **€ 73 400** for an upper range INFRA proposal[84]. Past application cost evidence, provided by the European University Association (EUA) in the context of the Horizon 2020 interim-evaluation, can serve as a point of comparison, even though the reported range of € 10,000 to € 100 000 per proposal applies only to researchers[85].

[82] Although the evidence predominantly stems from beneficiaries, success is not assumed to be generally correlated with application costs across the FP, although it likely has some influence at the margin.
[83] Evaluation study on Innovative Europe, the reported range for SME I proposals is approx. €6 000 to € 25 000.
[84] Evaluation study on Excellent Science, the reported range for INFRA proposals is approx. €44 900 to € 73 400.
[85] European University Association (2016), estimates based on a member survey with contributions from more than 150 universities from 28 Europe countries; https://eua.eu/resources/publications/346:eua-member-consultation-a-contribution-to-the-horizon-2020-mid-term-review.html

The application costs for some instruments appear to fall closer together than for others[86] further reflecting the diversity of applications. The **average cost of one proposal for Horizon 2020 was estimated[87] to fall into the range of €18 000 to €37 000**.

This suggests that the **application costs of beneficiaries** alone, who submitted 33 806[88] successful proposals, would amount to between **€609 million and €1.25 billion**. This value is rendered very uncertain by the lack of adequate, systematically collected evidence and should be read as a **rough illustrative figure only**.

Unsuccessful proposals[89] did not directly lead to productive outputs under to Horizon 2020 but also cost effort and money to prepare. Unsuccessful applicants are a stakeholder group the evaluation has not systematically consulted. Due to a severe lack of robust evidence the estimation of this cost has to rely on strong simplifying assumptions. Two available estimates calculated in the context of the evaluation are highly uncertain but provide an idea of magnitude: the evaluation support study on Resilient Europe arrived at **totals between € 5 410 million** (based on project size weights) **and € 9 160 million** (based on consortium size weights). The evaluation support study on Excellent Science generated a range **between € 4 758 million** and **€ 9 694 million**[90]. The evaluation interprets these results as an indication that **the total application cost embodied in the large number of unsuccessful proposals is likely very substantial and may well reach a value in the order of magnitude of € 5 billion to € 10 billion**.

Evaluations of earlier framework programmes did not report estimates that could be used as direct points of comparison. Quantitative evidence available from the interim evaluation also presented wide ranges: The EUA estimated that, in the first year of Horizon 2020 alone, its members spent between € 268 million and € 2.68 billion on unsuccessful applications. Based on EUA's figures, the interim evaluation estimated that around € 1.7 billion would be spent annually on writing unsuccessful proposals, of which € 643.0 million for non-funded high-quality proposals alone[91].

Public Consultation responses provide basic **time cost ranges**[92] and show a pattern of diminishing proportions of applications as application time costs rise: Responses suggests that **56% of applications take less than 50 person-days, with 80% of applications under 100 person-days**. The study on the proposal evaluation system[93] finds that the average time spent by 'applicants' [94] on a **single-stage application was 25 person-days** and 47 person-days for

[86] For instance, relatively narrow ranges were found for ERC (approx. €19 600 to €28 700, evaluation study Excellent Science); as well as SC1 (€34 000 to €42 000, evaluation study on Resilient Europe. Wide range of application costs was reported by MSCA beneficiaries (around €11 800 to €35 600).

[87] Evaluation study on Resilient Europe estimated a range between €20 000 and €34 000 and the evaluation study Excellent Science €18 257 to €37 169 for one proposal.

[88] Dashboard, Horizon 2020, 'Retained Proposals' as of 01.01.2023

[89] Unsuccessful proposals here includes all proposals, which are effectively unsuccessful as they not lead to any funding under Horizon 2020, including those of high quality.

[90] Evaluation study Excellent Science, Annex I, https://data.europa.eu/doi/10.2777/353383.

[91] SWD on the interim evaluation of Horizon 2020, SWD(2017) 220 final, Section 7.3.2 (Application and evaluation process), p. 60. Scaling the annual value up to a seven-year total for the framework programme is not possible, in the absence of evidence on the distribution of costs over time. An (unlikely) uniform distribution would imply € 11.9 billion, a similar order of magnitude as the higher value of the range found by this evaluation.

[92] Annex 5: Cost of proposal preparation, p. 94.

[93] Study on the Proposal Evaluation System for the EU R&I framework programme, 2022, Table p. 3, https://data.europa.eu/doi/10.2777/16211.

[94] No further breakdown was reported for the question, however, beneficiaries dominate responses. The time cost of the multi-stage application captures the higher time cost of successful applicants. The vast majority of (unsuccessful) applicants only incur costs for the simplified first application stage. The overall average may therefore be expected to be at least equal if not lower than for a single stage procedure.

a (successful) multi-stage application. For **Societal Challenges 2 to 5**[95] (588 responses) lower time costs are reported, **with 47% of applications taking less than 10 person-days** to prepare and **over 80% taking under 20 person-days**.

Project size and the programme part may be two key determinants of the time cost but the evidence collected is insufficient to asses this overall. Time costs of reported LEIT proposals[96]were split by project size and suggest that costs for **projects under €500 000** had a wide range from **15 to over 30 person-days,** whereas the majority of projects of **€500 000 and above** reported time costs **over 30 person-days.** At least half of all projects in all size ranges reported time costs of over 30 person-days, including 75% of coordinators of projects with a budget of at least €5 million, 70% of projects of € 2 million to €5 million and still over 50% of projects between €500 000 and €2 million.

What does the oversubscription and low success rate mean for the efficiency of Horizon 2020?

Horizon 2020 attracted an exceedingly high number of proposals, and even the number of proposals of sufficient quality to warrant funding was a multiple of those actually funded.

In principle, oversubscription of an individual programme part primarily indicates where the resource constraint of the budget is particularly binding. The competition between applicants depends to some extent on the oversubscription of a programme, which in turn increases the likelihood that the eventually funded projects are of good quality and generate benefits and value-for-money.

Very high oversubscription rates, however, have a negative effect on the overall efficiency as **a very large proportion of the effort spent on preparing, and then evaluating, proposals does not lead to any benefits**. **Measures that ensure the costs of the application process are kept as low as possible and measures that allow successful yet unfunded proposals to be re-used in future applications at national or EU level** therefore have the potential to address the situation and increase the programme's efficiency from the point of view of society.

Were application costs 'proportionate' for applicants, taking into account the potential benefits?

The level of oversubscription of Horizon 2020 strongly suggests that up front, at the time the decision is made, the programme is relevant and attractive enough for a very large number of potential applicants to go ahead and invest effort.

Potential applicants chose up front whether to face this application cost or not (in contrast to costs imposed on citizens by a regulation). They consider factors such as how likely they are to receive a grant, the size of the grant, the expected size of the application cost, their own risk profile, their capital constraint, and any alternative routes for funding that are open to them. They may also factor-in that they plan to apply again in the future, or that they can reuse parts of a previously unsuccessful proposal.

[95] Study on the Green Transition, 2023, https://data.europa.eu/doi/10.2777/422725.
[96] Study on the Digital and Industrial Transition, 2023, Annex VI, https://data.europa.eu/doi/10.2777/882919.

Once proposals have been evaluated the situation changes. The vast majority of applicants will not receive a grant. For **unsuccessful applicants** the application costs are to a great extent lost and are unlikely proportionate. For **successful applicants** the proposal in the end leads to substantial benefits. Grants are typically vast relative to the costs of application. The fact that a beneficiary breaks even is, however, not automatically a sign that application costs had been proportionate, as the grant is meant to mainly cover R&I activities and administrative costs. The larger the grant, the higher the success rate of the call and the larger a consortium, the more likely application costs may be experienced as 'proportionate' by an applicant. In contrast, factors such as a smaller or financially weaker applicant (e.g. SME), stronger competition between applicants (low success rates) and a comparatively smaller grant size, increase the risk that the application costs were disproportionate, even for a successful applicant.

Even applicants who directly compete, and therefore face similar application costs and the same level of competition, have different characteristics (e.g. risk aversion) and thus likely consider different rates of return acceptable and different levels of application costs 'proportionate'. Quantitative evidence on what is seen as 'proportionate' by different stakeholder (sub-)groups of R&I funding is not available. Qualitative evidence from the public stakeholder consultation confirmed past feedback that the level of application costs ('cumbersome application process') and success rates ('too low to be worth applying') are seen as problematic for respondents[97].

At the level of the framework programme, in relation to the € 71 195 million of R&I support, applicants spent an indicative total of € 5 610 million (**approx. 8%)** to € 11 250 million (**approx. 16%)** of application costs. Given the insufficient level of confidence in the cost estimates it is not possible to base any firm conclusions on these values and it is a topic for further discussion, what percentage would still be acceptable and constitute 'proportionate' costs. Taken together, the available information is, however, sufficient to suggest that it cannot be ruled out that disproportionate application costs may have been an issue in Horizon 2020, particularly in some areas of the framework programme, possibly also at an aggregate level. The question of proportionality of application costs of R&I support therefore deserves continued attention.

Participation of consultancies in Horizon 2020 consortia

In the context of the evaluation, the question was discussed, whether the (perceived) common participation of 'consultancies' in consortia of Horizon 2020 can be interpreted as an indirect indicator of the framework programme's too high complexity and therefore a sign of its inefficiency. The participation of firms that could be considered consultancies is not monitored but has been assessed *ex post*. It was identified that 228 consultancy companies participated in 6.7% of all multi-beneficiary projects in Horizon 2020[98] overall. It also found that around half of the proposals submitted included a firm in the consortium (not necessarily as coordinator) that was identified by the study to fall within this category[99]. Anecdotal evidence from National Contact Points suggests that consultants frequently attend information events for the framework programme.

In of itself, the involvement of consultancies cannot be seen as an indicator for inefficiencies in the framework programme. Participants organise themselves using division of labour. Different skill sets are involved to carry out research and to prepare a proposal. The splitting of tasks may also just reflect the fact

[97] See, for instance, public consultation responses on 'reasons preventing participation in Horizon 2020', presented in Annex 5, (pp. 83 -85), Table 16,17 and 18, Figure 17.
[98] Study on Resilient Europe (2023, https://data.europa.eu/doi/10.2777/60819. These were consultancy firms 'involved' in any role in Horizon 2020 consortia. Overall, 382 firms were identified using keyword search in Technote database with cross-referencing participants. Website information used to narrow down to 228 consultancy companies.
[99] Study on Resilient Europe, 2023, p. 38, https://data.europa.eu/doi/10.2777/60819. Also Annex 1, p.140, https://data.europa.eu/doi/10.2777/57680. Their presence in the consortia was found to be correlated with a higher success rate but it is unclear whether this association is meaningful.

that consortia include individuals whose time is very valuable (e.g. top researchers, etc) and that there are costs associated with applying and fulfilling administrative obligations of projects (which is not an issue in itself, as long as these are proportionate). The involvement of consultancies in the application process would further point at the existence of economies of scale in proposal writing. Consultancies invest the hassle cost of finding relevant information and to get to know the structure of the framework programme, the rules and procedures, and may have practical experience on how to apply for it. In using this human capital, they add value to the consortium for which they get compensated. Having a niche for firms to specialise on certain tasks may just be the most efficient way for the applicants to organize themselves.

When would the current situation constitute an efficiency problem for the framework programme? - This was the case if employing one of the consultancies was effectively a necessary condition for a successful application and consultancies therefore acted as gate keepers to the framework programme. This would be particularly problematic for applicants with resource constraints (including those from countries to benefit from 'widening' or SMEs). Competition in the specialised consultancy sector (of a region/language) therefore matters. If the consultancy sector is not very competitive and substantial market power exists, consultancies can extract excess profits. Too high application costs and administrative costs of beneficiaries (particularly due to unclear and cumbersome requirements) can generate barriers and favour such a situation, which also would negatively affect the efficiency of the framework programme. Costs of applicants and beneficiaries are therefore key areas to monitor and assess in any future evaluation of the framework programme, as is the share of applicants that make use of specialised consultancies in the different programme parts.

Annex IV Table 1

Table 1. Overview of costs and benefits identified in the evaluation									
		Citizens/ EU Society		**EU Public Administration**		**Horizon 2020 Beneficiaries**		**Horizon 2020 Applicants**	
		Quantitative	Comment	Quantitative	Comment	Quantitative	Comment	Quantitative	Comment
I. BENEFITS									
1. Indirect long-term welfare benefits for EU society from **scientific impact** & related benefits to participants (Sections 4.1.1, 4.1.2, 4.1.6)	one off	**-.-** (No estimate available**)**	**Horizon 2020 strengthened frontier research, contributed to scientific breakthroughs and advancements. It increased the human capital of researchers through furthering EU-wide career development and access to research infrastructures.** In the long run, the supported activities are expected to lead to **sizable and wide-ranging welfare benefits to EU society** (economic, social, and environmental benefits).			**1. Peer-reviewed publications** H 2020: **276 784** **3.9%** in top 1% most-cited publications **26%** on 'future & emerging research& technology fields' FP7+3yrs***: 219620** (*no FP data on % top 1% most-cited and % in future and emerging fields) FP7 (ERC): **9 yrs persistent** (+)long-term effect on **publication activity of researchers** **2. Researchers undertaking cross-sector and cross-country mobility**, incl. PhD candidate	**Direct scientific output** of Horizon 2020 **(benefit to researcher)** linked to expected long-term welfare benefits from scientific impact (Number as of 24/04/2023) **Indirect benefit of FP7 to researcher** **Direct output**		

						H 2020: **49 475**, of which PhDs: **25 676** (**52%)** Target: **65 000**, of which PhDs: **25 000** (**38%)** FP7: **50 000**, of which PhDs: **20%** **3. No. researchers who gained access to research (e-)infrastructures** H 2020: **24 235*** (incl. e-infrastr.: **162 810**) Target: **20 000** FP7: **22 000** (excl. e-infrastructures) **4. long-term effect on visibility, productivity, and career of scientists** FP7: **2 -5 years,** after proposal, persistent (+) effect	of Horizon 2020 **(benefit to researcher)** linked to expected long-term welfare benefits (KPI4, Number shown as of 01/01/2023; FP7 figures for 2007-2013.) **Direct output** of Horizon 2020 **(benefit to researcher)** (KPI 5; *access gained from FP support; Horizon 2020 figures as of 01/01/2023.) **Indirect benefit of FP7 to researcher**		
2. Indirect wider economic benefits for the EU economy from **diffusion of innovation** & related benefits to participants (sections 4.1.3, 4.1.6, 4.1.2)	one off	**Total impact on GDP** (2020 prices) **estimated:** **€ 429 bn** (range: €421 bn to € 798 bn) **(2014-2040)**, of which	**Horizon 2020 supports industrial research and innovation "from idea to market**", with a view to improve innovation diffusion in products, processes and services, and thereby **improving the competitiveness of industry participants**			**5. Intellectual Property Rights applications** H 2020: **3 898** (0.57/€10m) of which patents **3 012** (77.3%, 0.44/€10m)	**Innovation output** under Horizon 2020, **(benefit to participant**) linked to expected long-term economic benefits. (IPR figures for H2020 as of 24/04/2023, expected to increase; for FP7 as of		

		309bn (€287 bn to €420 bn) over 17 years (2014 -2030**)** Average GDP gain of around €15.9 bn (€15.6 bn to €28.5 bn) annually over 2014 -2040 FP7: Total impact on GDP estimated 380bn over 17 year (2007-2023) **----** **Peak annual impact on employment** in all sectors: **220 000 jobs created** in 2020. (NEMESIS: 229 000 jobs in 2030) Interim eval.: 110 000 to 179 000 jobs created (2014-2030)	**and ultimately boosting the productivity and competitiveness of the EU's economy as a whole.** GDP impact forecast: central scenario presented uses RHOMOLO model output; range/sensitivity uses QUEST, NEMESIS) --------- Employment impacts: central scenario presented uses RHOMOLO model output.			trademarks **499** (12.8%, 0.44/€10m) H2020 excl. ERC: **3 210** IPR appl. (0.58/€10m) FP7+2yrs excl. ERC*: **2 266** (0.6/€10m) of which patents **1742** (77%) FP7 +9yrs: **6 328** of which patents **5545** (95.4% awarded) **6. Monetised value of one patent** ranges between **under €100 000** and **€1.1 million** depending on sector **7.Start-ups created (**EIT KICs) H2020: **440** Target: **600** Baseline 2012: **33** **8. Innovations generated** H2020: **8 000** tracked by Innovation Radar, of which **31%** new products **28.6%** significantly improved product	01/12/2015, 2 years after end of FP). *Due to monitoring limitations at the time IPR applications linked to ERC could not be reconstructed **Innovation output** under Horizon 2020, **(benefit to participant)** (EIT Knowledge & Innovation Communities (KIC) **Innovation output** under Horizon 2020 **(benefit to participant)** **Innovation output under Horizon 2020 (benefit to participant**		

						9. Access to additional private capital for SMEs Horizon 2020**: €9.36 billion** (LEIT) **10. Growth of firm** H 2020 (all private firms): **20%** increase in jobs compared to non-funded firms **30%** increase in total assets and revenue growth compared to non-funded firms (persistent > 2.5yrs) -- (SME Instr.ph II) **28-56%** increase in growth of firm **11. Increase in patenting (SME)** Horizon 2020: **15% -31%** increase in cite-weighted patents	**(Micro-)economic benefit for SME** (sect 4.1.3 access to risk capital) **(Micro-)economic benefit for firm** **(Micro-)economic benefits for firm**		

II. COSTS									
		Citizens/ EU Society		**EU Public Administration**		**Horizon 2020 Beneficiaries**		**Horizon 2020 Applicants**	
		Quantitative	Comment	Quantitative	Comment	Quantitative	Comment	Quantitative	Comment
1. Direct economic cost of R&I funding to EU society (Operational Expenditure)	one off	**€62 133.6 million**	Actual paid **Operational Expenditure** of Horizon 2020 (as of 01/01/2023)						
2. Administrative costs of implementing the R&I framework programme **to EU Public Sector** (Administrative Expenditure)	one off		Costs of administrating Horizon 2020 are incurred by the public sector at European level but are ultimately a cost on EU Society.	**€ 4 292. 3 million** In year 2020: **3.37%** Target for 2020: **max 4.6%**	Actual paid **Administrative Expenditure** of Horizon 2020 (as of 01/01/2023) **Administrative expenditure as share of budget envelope** (excl. JRC, EIT; committed as of 01/01/2023)				
3. Beneficiaries' administrative costs of participation (**Not additional - already included in no.1** Operational Expenditure)	one off					**Time cost:** on average **4.5 - 7 person-days per month of project duration** **€ 135 million – € 215 million** Note: **evidence not robust**. Particularly upper bound value may be substantially higher	**Administrative costs per participation** incurred to meet requirements (e.g. reporting). Monetised order-of-magnitude estimate: A**dministrative costs of beneficiaries**		

						as projects of 60 months and more exceed 10 person-day per project months.			
4. Costs of applications Direct costs of preparing proposals **of successful and unsuccessful applicants**	one off							**€18 000 to €37 000** (evidence not robust) Successful: **€609 million to €1.25 bn** Unsuccessful: **€ 5bn to 10 bn**	**Cost per proposal** (evidence not robust) **Total cost of applications** (evidence not robust)

3. Simplification measures - additional information on performance

Expectations - simplification in Horizon 2020

As presented under section 4.2.2 in the discussion of efficiency, 'simplification' was a central to Horizon 2020 and efforts to simplify the programme influenced its design, its rules, financial management, and its implementation.

The ambition was comprehensive, and expectations were clearly expressed. The interim evaluation report of the Seventh Framework Programme had concluded that a more radical approach was needed to achieve a 'quantum leap' in simplification, and that the risk-trust balance needed to be redressed. The European Parliament[100] and the European Council[101] had called to radically simplify access, to simplify to boost the attractiveness and lower the associated burden of EU research funding. The 'radical overhaul' of the administration of FP was seen as the highest priority to be tackled.

The 2011 'Green Paper on a Common Strategic Framework for EU Research and Innovation Funding' picked up on these findings and requests. It identified simplification as a 'top priority' in order to make EU research and innovation funding generate more impact and be more attractive to participants; it also prompted to simplifying participation by lowering administrative burden, reducing time to grant and time to payment, as well as achieving a better balance between cost and trust based approaches.[102]

In consequence, Horizon 2020 substantially changed the set-up and management of R&I support. Previous expectations were repeated in the Regulation establishing the programme, which explicitly introduced 'simplification' as a central aim[103]. Simpler funding rules were expected to reduce the administrative costs of participation and to contribute to the prevention and reduction of financial errors[104].

Horizon 2020 performance against time cost targets (TTI, TTS, TTG)

The quantitative administrative target on time to grant shines a spotlight on one specific aspects of administrative efficiency. Horizon 2020's binding TTG target of 8 months (245 days) per call was more stringent than FP7's previous TTG target of 270 days. Even stricter TTG targets were set for the SME Instrument phase 1 calls (3 months or 92 days), SME I phase 2 calls and FTI calls (6 months or 183 days). An overview over targets and actual achieved values for Horizon 2020 and FP7 are summarised in Table 14. Table 15, and Figure 13 below. Variation across Horizon 2020 remained within a **range of average actual TTGs of 154 to 218 days** (FP7: 271-359 days) and of **74% to 98%** of agreements signed on time (FP7: 9% - 60%).

The performance was not uniform, with **in particular the initial period of the EIC pilot generating delays for companies of up to up to 12 months and considerable uncertainty**. According to the EIC pilot evaluation (2022), 'the EIC Fund was incorporated on 22 June 2020 and operations effectively

[100] 'Simplifying the implementation of the research framework programmes', European Parliament resolution of 11 November 2010 on simplifying the implementation of the Research Framework Programmes (2010/2079(INI)).
[101] Council conclusions on Europe 2020 flagship initiative: Innovation Union. 26.11.2010.
[102] GREEN PAPER From Challenges to Opportunities: Towards a Common Strategic Framework for EU Research and Innovation funding (COM(2011) 48 final).
[103] Ambition outlined in Recital 20 to Regulation No 1291/2013 of the European Parliament and of the Council of 11 December 2013 establishing Horizon 2020 - the FP for Research and Innovation (2014-2020), OJ L 347, 20.12.2013, p. 104.
[104] Ibid.

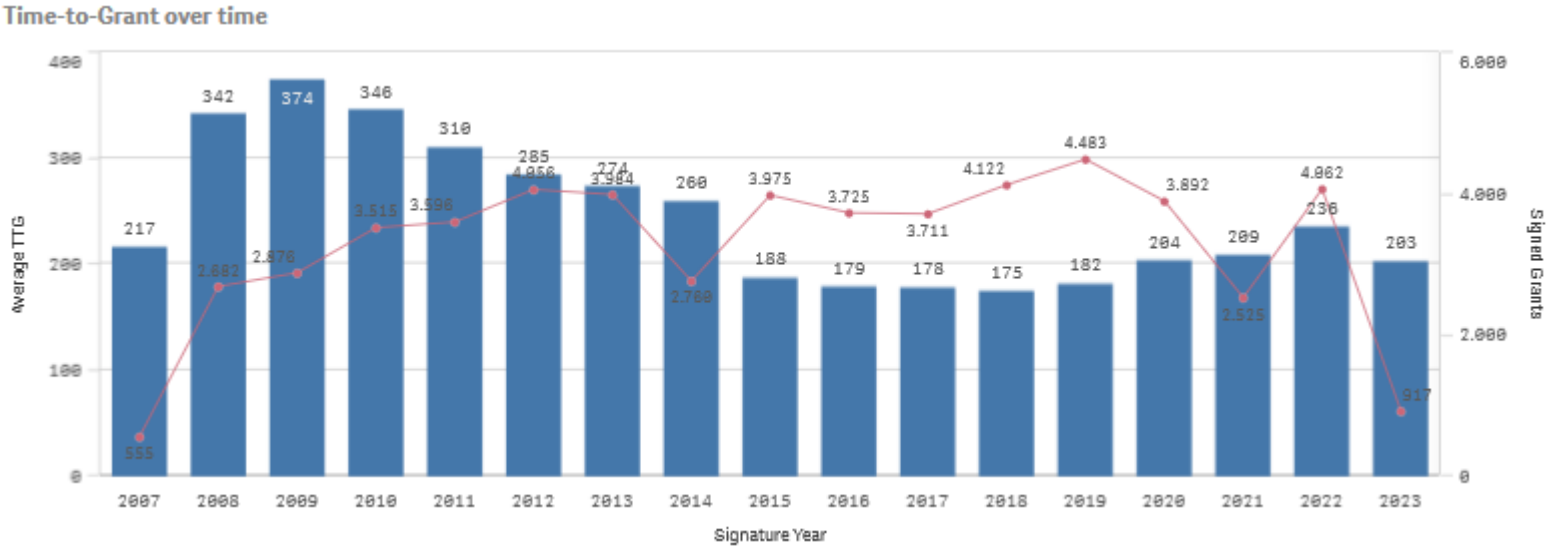
started on 1 September 2020. By that time, 140 companies had already been selected for investment support since the first call was launched in October 2019. Due diligence only started in August 2020. During this process, some companies were surprised when they were eventually offered a convertible loan instead of a full equity investment. Others were taken aback when they understood the implication of the co-investment requirement and realised, they had to look for an additional investor by themselves'.

Table 12: Actual Time-to-grant (TTG)

Programme	**FP7**	**H-2020** (excl ERC)	**H-2020** (excl. ERC, SMEI phases 1&2, FTI)	**H-2020** SMEI phase 1	**H- 2020** FTI	**H-2020** SMEI phase 2
Target [avg. days]	270 days	245 days	245 days	92 days	183 days	183 days
Actual TTG [avg. days (% < t)]	**313 (41%)**	**187 (90%)**	**208**	**92**	**194**	**152**

Source: Monitoring dashboard data frozen 1.1.2023; FP7 TTG based on an overall number of 23'122 FP7 grants, excluding JTI, RSSF and Fusion grants.

Figure 7: Actual average Time-to-Grant values of R&I support over time



Source: Monitoring dashboard data of FP7 and Horizon 20202. Average TTG values (blue bars) and number of signed R&I support grants of both FPs pooled.

In addition to the Time-to-Grant target, covering the entire period from submission of proposal to signature of grant agreement, further (non-binding) expectations on sub segments of this process were formulated for Horizon 2020:

- **Time-to-Inform (TTI) - target 5 months (153 days)** - measures the time from the deadline for submission of proposals to the notification of the applicant on the evaluation outcome.
- **Time-to-Sign (TTS) - target 3 months (92 days)** - measures the time from the notification on evaluation outcome to the signature of the grant agreement.

Horizon 2020 met expectations on time-to-inform and time-to-sign, with the **actual average TTI** (**112 days**[105]) beating the target by 41 days and the **actual average TTS** (**76 days**) by 16 days**.** This suggests that the TTS component of the time before grant signature was the more challenging period, which is also reflected that two programmes ('Societal Challenge' TTS: 99 days; 'Other priorities' TTS: 117 days) on average did not meet TTS expectations. In both the TTS period exceeded the TTI period, however, due to short average TTI periods (SC: 93; Other: 94) the overall TTG targets were met. Variation across the remaining programmes remained within a range of average actual TTIs of 79 to 139 days, and average actual TTSs of 61 to 80, meeting the expectations. A comparison to FP7 is not possible with respect to TTI and TTS as these periods were not monitored at the time.

[105] TTI and TTS monitoring dashboard data (frozen 1.1.2023). For 98.27% of the main listed proposals the TTI of Horizon 2020 stayed under 153 days. (Annual Activity report 2022)

Table 13: Actual average Time-to-Inform, Time-to-Sign and Time-to-Pay achieved under Horizon 2020

	H- 2020 TTI	H-2020 TTS	H-2020 TTG	H-2020 TTP
Target [avg.days]	153 days	92 days	245days	90 days; 30days if prefinanced
Horizon 2020	**112**[106]	**76**	187 (**90%**)	**68**; **6.7(91.5%)**
Excellent Science	139	61	199 (97%)	
Industrial Leadership	79	76	154 (84%)	
Societal Challenges	93	99	191 (83%)	
Spreading Excellence and Widening Actions	138	80	218 (98%)	
Other Priorities	94	117	211 (74%)	

Source: Horizon 2020 Dashboard data, 1.1.2023; Time-to-Pay: (ABAC) accounting data

4. Potential for further simplification - additional information

Adaptation costs linked to changes to programme design, rules and procedures, including simplification measures

The evaluation found that the complexity of the framework programme overall has remained persistently high, resulting in a burden for applicants and beneficiaries. A potential for the reduction of this burden therefore does not only stem from the characteristics of any new design, rules or processes as such (i.e. costs of a new steady state) but also from the transition period during which the changes are designed, tested, announced, introduced and rolled out. The 2018 ECA report[107] highlighted the (one off) **adaptation costs for beneficiaries from any changes to the programme** and the associated **legal uncertainty,** where changes occurred in too quick succession**.** Participants have to inform themselves about updates, interpret the changes, establish with certainty which rules apply to them at a given time and then adjust. The report therefore emphasised **the importance of stable and well-designed rules to minimise participants' administrative costs**. This implies that, even where beneficiaries' administrative costs or application costs would be lower once

[106] Calculated based on dashboard data grant numbers and pillar TTI TTS. Sum of Weighted averages/ total H2020 grant number (all excl ERC).

[107] Court of Auditors. Special Report. N.28 (2018) - Concretely, the report pointed at the introduction of simplified rules on personnel costs, which had to be adjusted again shortly after in response to negative side-effects that had emerged, leading to 'confusion and legal uncertainty'.

simplification measures have taken hold, the transition process is costly and can cancel out at least some of these positive effects. This suggests that **infrequent, carefully designed and piloted step-wise adjustments**, which pay close attention to **the participants' perspective** and are accompanied by **clear communication measures and *ex post* assessments** can have a simplification potential in of themselves.

Table 2 – Achieved simplification and burden reduction (see next page)

As a European framework programme, Horizon 2020 strives to be as simple and efficient as possible. It falls under the Regulatory Fitness Programme (REFIT) of the European Commission, seeking opportunities to simplify and reduce administrative burden for people, businesses and administrations. As presented in section 4.2.2 of the evaluation report, Horizon 2020 introduced two main strands of simplification measures:

- **Structural simplification and a general overhaul of implementation processes**, that had primarily the objective to 1) lower the direct administrative cost of applicants and beneficiaries that are associated with participating in Horizon 2020, and 2) increase the EU public sector's efficiency of administering the framework programme through accelerating all processes relating to proposal and grant management,
- **Simpler funding rules and a revised 'control and risk strategy'.** These measures primarily set out to optimise the balance between the administrative costs of beneficiaries and the benefits of reducing financial errors.

Time to grant – any potential for further simplification?

The average time-to-grant values reported outperform the targets across the programme (see Annex IV.3 above). At a first glance, a further tightening of the targets could hold further potential for simplification. However, like every target, the time to grant target is an imperfect proxy, in this case for the efficiency of activities related to the evaluation of grants and the preparation of the grant agreement. The setting (or tightening) of the target -without any accompanying measure that would make such a change plausible- is associated with the risk of generating (or increasing) negative unintended consequences, particularly when other connected administrative processes are changed at the same time. A shorter time span for grant preparation is associated with an increase in risk of errors. Considering the already material error rates of the programme, any such increase in risk would not be welcome. Furthermore, while an increased use of lump sum funding is expected to keep financial error rates in check, it will simultaneously shift some of the burden of financial checks from the reporting stage to the evaluation (of the proposed lump sums) of proposals. This will potentially reduce again the current scope to further tighten the time-to-grant target. Once a wider use of lump sums has been established, a new assessment of the performance against the target can be carried out to assess any room for manoeuvre. The evaluation therefore finds that it is not recommendable to incentivise a further shortening of the time-to-grant period until the effects of lump sum funding on the timing of the proposal evaluation and on the resulting error rate can be established.

TABLE 2: Simplification achieved and further potential

PART I: *Simplification and burden reduction (savings already achieved)*

*Simplification, burden reduction and cost savings **achieved already** by Horizon 2020, including points of comparison where available.*

	Citizens/ EU Society		EU Public Administration		Horizon 2020 Beneficiaries		Horizon 2020 Applicants	
	Quantitative	Comment	Quantitative	Comment	Quantitative	Comment	Quantitative	Comment
Administrative cost savings of applicants and beneficiaries (costs associated with participating in Horizon 2020) due to the structural simplification and general overhaul of implementation processes of Horizon 2020. **Enforcement cost savings for beneficiaries**, due the introduction of a revised 'control and risk strategy'.								
One-off (change from FP7 to Horizon 2020)		.			**Approx. 2 500 unique beneficiaries** (5.74 percentage points reduction) Share of unique beneficiaries audited: H2020: 6.02 % FP7: 11.76% target: max. 7 %	**Number of beneficiaries** who experienced **enforcement cost saving** (relative to FP7 "control and risk strategy".) Evidence on administrative costs of beneficiaries are not systematically collected. Savings due to measures have not been monetised.		Evidence on costs of applicants are not systematically collected. Savings due to measures have not been quantified.
Administrative cost savings of the EU public service (costs associated with administering the framework programme) through accelerating all processes relating to proposal and grant management. The evaluation found that the introduction of the **electronic grant management workflow** and the **withdrawal of the negotiation stage** were key drivers of the acceleration								
One-off (change from FP7 to Horizon 2020)			**Time-To-Grant (TTG) reduction** Horizon 2020 saved over **9 500 years of time** in the EU public sector, relative to	**Time cost saving for public sector from accelerated**	**Start dates of beneficiaries' projects** brought forward in total by over 9 500 years of time. **.**	**Time cost saving for beneficiaries** from accelerated administrative processes.		

			what it would have taken at the speed of FP7. H2020*****: **saving of 126 days per grant** on average vs. FP7. Expected saving was **100 days per grant** on average vs FP7. H2020 average TTG: **187 days** per **grant.** 90% within target*of **245 days per grant**. FP7 average TTG: **313 days per grant.** 41% within target of **270 days per grant**.	**administrative processes** (from end of deadline for proposals to grant agreement signature) * excluding ERC <u>Key drivers:</u> - electronic grant management workflow; - removal of negotiation stage.				

PART II: <u>Potential</u> simplification and burden reduction (savings)

*Identified further potential simplification and savings **that could be achieved** with a view to make the initiative more effective and efficient without prejudice to its policy objectives[108].*

	Citizens/ EU Society		**EU Public Administration**		**Horizon 2020 Beneficiaries**		**Horizon 2020 Applicants**	
	Quantitative	Comment	Quantitative	Comment	Quantitative	Comment	Quantitative	Comment
Application of unsuccessful applicants are an area with a potential for efficiency savings for the framework programme. The evidence base of the evaluation does not allow to specify any new simplification measures to the extent, that they could be assessed in terms of their expected costs savings'. Potential existing measures that could be extended include: a targeted, carefully tested and designed use of the **two-stage evaluation processes**; and any measures that prevent the loss of the value inherent in successful-unfunded proposals (proposals above the quality threshold but that remained unfunded due to the budget constraint) and allow it to be captured for alternative funding applications at EU or national level. This may include the Seal of Excellence measure, after a detailed *ex ante* assessment.								
One-off			n/a	Public sector administrative expenditure related to proposal evaluation costs are an area with a potential for efficiency savings, to the extent that a duplication of an evaluation can be avoided.			n/a	Application costs of unfunded proposals are an area with a potential for efficiency savings for the framework programme overall.
Lump sum funding involves the paying out of pre-agreed lump sums (that were specified in the proposal by the grant beneficiary) after the completion of a work package. It renders obsolete the financial reporting (by beneficiary) and the checking of financial reports, as well as the reimbursement of detailed eligible costs by the EU public administration).The evaluation of the lump sum pilot suggests that a wider use of lump sum funding likely has some simplification potential to reduce <u>beneficiaries' administrative costs</u> and address the persistence of frequent <u>financial errors</u>, highlighted by the European Court of Auditors. The net effect on costs depends on details of implementation.								
One-off	n/a	The use of lump sums has the potential to reduce financial errors by removing financial reporting and the reimbursement on the basis of eligible costs (both sources of	n/a	Public sector administrative expenditure is expected to change due to multiple factors. The direction of the net effect on public	n/a	The use of lump sums has potential to reduce the net administrative costs of beneficiaries, who no longer	n/a	Application costs may increase, as proposals have to submit an additional budget table for the project, to justify the lump sums. The cost of generating the budget information

		financial errors in R&I funding). The extent to which a reduction of errors can be achieved, and a reduction of the error rate can be observed, depends on details of implementation, including that of *ex post* project reviews and any changes to the audit strategy. While the rationale of lump sum funding supports the assumption that financial errors will overall be reduced, the piloted projects have not yet generated any *ex post* evidence to allow for a validation of this assumption and an *ex ante* estimation of future simplification effects.		sector costs depends on implementation details that determine the additional workload of proposal evaluators and possible adjustment costs for project officers. The net effect will also be affected by beneficiaries' strategic behaviour (unintended effects) in response to the measure over the medium-term. The currently available evidence base is insufficient to assess the direction or magnitude of the net effect on public sector administrative costs.		have to report on eligible costs and resources for reimbursements, but receive shares of the lump sum, once work packages have been completed. The net effect for beneficiaries depends on details of implementation and beneficiaries' strategic behaviour (unintended effects) in the medium term.) The currently available evidence base is insufficient to assess the magnitude of the benefit to beneficiaries.		is not fully additional but to a large extent part of the baseline: Project management best practice and existing requirements of the programme mean that applicants are assumed to calculate the project budget at proposal stage already. However, adapting the budget to the format, structure and level of detail requested in the proposal template and filling in the template gives rise to additional costs. Any change will be affected by details of implementation, including the availability and user friendliness of guidance for applicants. The currently available evidence base is qualitative and does not allow a quantification of the expected effect on applicants.

[108] This assessment is without prejudice to a possible future Impact Assessment.

5. *Value-for-money for EU Society (Benefit cost ratio calculation)*

Table 14 below shows the costs and benefit figures used in the benefit cost ratio calculation presented in Section 4.2.1 of the evaluation report. The evaluation calculates a benefit cost ratio over the **period 2014-2040**. This period was chosen to allow time for the emergence of wider benefits of R&I investments. Projects will only have all ended by December 2028, eight years after the programme period came to an end in 2020. **The 2040 cut-off date allows for a minimum of 13 years for all projects to have been completed and results to feed through to impacts that affect society.**

The benefit cost ratio uses GDP impacts, as the closest proxy for the overall welfare benefits for EU society. Macroeconomic impacts have been adjusted for inflation and are reported below in current prices. (GDP impact figures in section 4.1.3 are reported in 2020 prices.) In this way they could be used in a calculation with the expenditure figures. All the three model outputs have been used to reflect uncertainty. **The results suggest that the benefit cost ratio (BCR) of Horizon 2020 is at least 5**, which means that **one euro of costs to society associated with the programme (programme costs and costs to applicants) is expected to bring about five euros of benefits for EU citizens (measured through GDP impact) in the period up to 2040.**

For comparison, a set of benefit cost ratios over the shorter period until 2030 has also been calculated, again using the three model outputs to reflect uncertainty. The three models describe different trajectories of how much and by when benefits grow and peak over time, which explains the difference in ranking (see Figure 9 in Section 4.1.3 of the evaluation report for a visualisation). During this shorter period, the total cost value does not change, as all costs are incurred at the start. As can be expected, **by 2030 the BCR values are lower**, with a **central BCR still closer to 4.** This is because in 2030, the last projects had only ended 2 years prior, and benefits had 10 years less to channel through to a marketable impact and for GDP gains to accumulate.

Table 14: Benefit Cost Ratio calculation

Costs of Horizon 2020		
(1) **Operational Expenditure** (budget, current prices)	EUR 71.195 billion	
(2) **Administrative Expenditure** (budget, current prices)	EUR 4.428 billion	
(3) **Cost of application** (Note: range of low to high average values; costs include successful and unsuccessful applicants.) Please note: evidence not robust/ low level of confidence in figures.	EUR 5.61 billion	EUR 11.25 billion
Total Cost of Horizon 2020 (low, high; current prices)	**EUR 81.233 billion**	**EUR 86.874 billion**

Benefits of Horizon 2020	
(1) **Total Benefits of Horizon 2020 - up to 2040** (Note: GDP impact used in calculation as closest proxy to welfare impact; period 2014-2040; current prices)	EUR 915.1 billion - estimated by NEMESIS model **EUR 492.0 billion - estimated by RHOMOLO model** EUR 482.3 billion - estimated by QUEST model

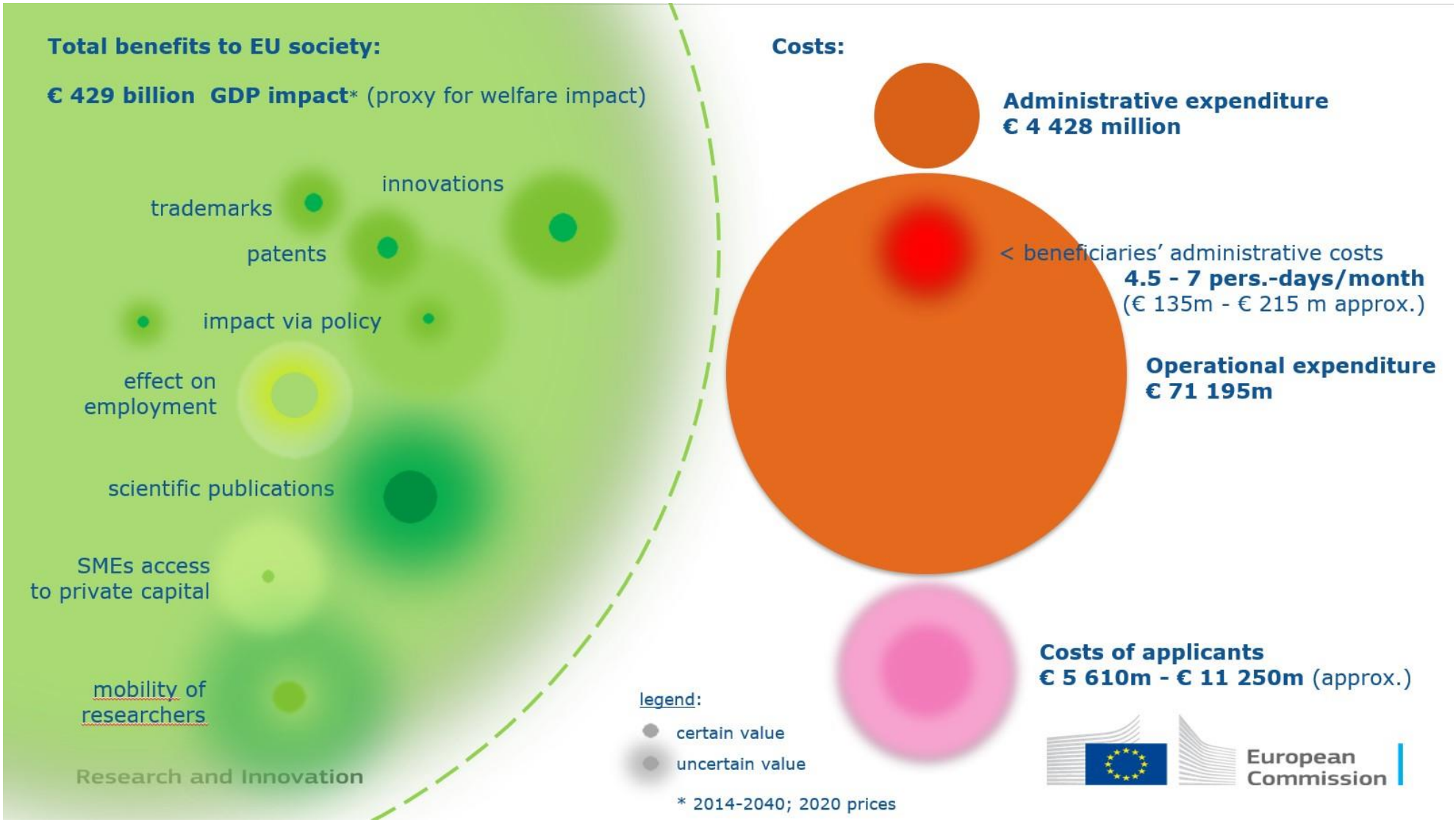
Benefit Cost Ratio (BCR) – up to 2040	**low**	**high**
NEMESIS	10.5	11.3
RHOMOLO	**5.7**	**6.1**
QUEST	5.6	5.9

Benefit Cost Ratios using a shorter 2014 - 2030 period:

Benefits of Horizon 2020	
(2) **Total Benefits of Horizon 2020 - up to 2030** (Note: GDP impact used in calculation as closest proxy to welfare impact; period 2014-2030; current prices)	EUR 481.6 billion - estimated by NEMESIS model / EUR 354.7 billion - estimated by RHOMOLO model EUR 328.9 billion - estimated by QUEST model /

Benefit Cost Ratio (BCR) – up to 2030	low	high
NEMESIS	5.5	5.9
RHOMOLO	4.1	4.4
QUEST	3.8	4.0

Figure 8: Comparison of approximate magnitudes of costs and wider economic benefit of Horizon 2020



Source: EU Commission illustration. Fuzzy edge indicates uncertainty with regards to the size of impact.

ANNEX V. STAKEHOLDER CONSULTATION – SYNOPSIS REPORT

In support of this evaluation, a broad range of consultation activities were conducted: the call for evidence, the public consultation, interviews, surveys of participants and beneficiaries as well as targeted consultations.

To ensure that all possible views are well reflected and to ensure transparency and accountability, consultations with various categories have been held in the frame of the *ex post* evaluation of Horizon 2020. The consultation process did not start from zero, as the Commission based its work on the consultations that took place in 2016 for the interim evaluation of Horizon 2020[109] which provided useful information on the mapping, priorities and views of all major interested parties.

Stakeholder mapping

Stakeholder groups that are concerned by Horizon 2020 as a whole can be broken down into the following categories: academia, businesses (including small and medium-sized enterprises), National Contact Points[110] and public authorities as well as non-governmental, research and umbrella organisations.[111]

Beyond that, the following Institutions have in the past contributed to the evaluation of the Framework Programme:

- the Council conclusions[112] on the Interim Evaluation of Horizon 2020, adopted on 01/12/2017,
- the European Parliament, which reported on the assessment of Horizon 2020[113] and the implementation in line with the interim evaluation,[114]
- the European Economic and Social Committee that provided recommendations for the Interim Evaluation of Horizon 2020,[115]
- the Committee of the Regions and the European Research Area and Innovation Committee which is a policy advisory body whose main mission is to provide strategic input on any research and innovation issue relevant to the development of the European Research Area.[116]

Other consultation activities conducted under the remit of the external evaluation studies

Next to the consultation activities that were accessible via the 'Have your say' portal, targeted consultations in the forms of workshops, interviews and surveys were conducted under the remit of the various external evaluation studies, specifically addressing applicants, participants national and regional authorities as well as business representatives.

Interviews

The main objective of conducting interviews was to gather evidence from different actors concerned by the Framework programme, offering the possibility to give an objective assessment by taking into account the different views. Interviews were particularly used in case studies as well as international benchmarks. Beyond that, interviews were conducted to confirm and complement data collection to

[109] Results of the Horizon 2020 Stakeholder Consultation, 2018, https://op.europa.eu/s/yXBt
[110] National Contact Points (NCPs) are independent organisations of different nature (e.g. Ministries, Academies of Science, Research agencies) that act as information providers to applicants in their native language. They are based in all EU countries and Associated States as well as in some non-European countries.
[111] So-called 'umbrella organisations' are industry-specific associations of EU public interest.
[112] Council conclusions 15320/17 https://www.consilium.europa.eu/media/31888/st15320en17.pdf
[113] Briefing: Interim evaluation of Horizon 2020 https://www.europarl.europa.eu/RegData/etudes/BRIE/2018/614771/EPRS_BRI(2018)614771_EN.pdf
[114] European Parliament Report on the assessment of Horizon 2020 implementation (A8-0209/2017) https://www.europarl.europa.eu/doceo/document/A-8-2017-0209_EN.pdf
[115] European Economic and Social Committee recommendations: interim evaluation of Horizon 2020 https://www.eesc.europa.eu/en/our-work/opinions-information-reports/information-reports/interim-evaluation-horizon-2020
[116] European Research Area and Innovation Committee, https://www.eumonitor.eu/9353000/1/j9vvik7m1c3gyxp/vh7ej5swwyyh

support the drafting of findings and conclusions. In total, 1 403 interviews[117] were conducted in support of this evaluation – these interviews do include same actors on different topics by gathering large amounts of qualitative data among Member States' and associated countries' representatives, Commission staff and other stakeholders (as explored in the stakeholder mapping section).

Surveys

In the frame of the evaluation studies, different surveys were designed, disseminated and analysed to gather both quantitative and qualitative data on Horizon 2020.
By conducting six separate online questionnaires, successful and unsuccessful participants were surveyed under the **Excellent Science study** – in total, 5 417 complete and 449 partial responses were received. The following groups were targeted by these surveys:

- Horizon 2020 beneficiary organisations (including beneficiary organisations that participated in MSCA, SEWP, INFRA and SwafS).
- Horizon 2020 unsuccessful applicant organisations (organisations that unsuccessfully applied for MSCA, SEWP, INFRA and SwafS).
- Horizon 2020 MSCA IF fellows.
- Unsuccessful Horizon 2020 MSCA IF applicants.
- Horizon 2020 ERC principal investigators.
- Unsuccessful Horizon 2020 ERC applicants.

For the Evaluation Study on the European Framework Programmes for Research and Innovation for addressing Global Challenges and Industrial Competitiveness with a focus on activities for the activities related to the **Digital and Industrial Transition**, Horizon 2020 LEIT applicants and participants were targeted: A single questionnaire was developed that targeted all stakeholders, namely all partners in the projects funded (successful applicants) as well as all partners in proposals that were not funded even though the proposals reached scores above threshold ('high-quality' proposals). A total of 1 342 valid responses were received on the survey, reaching an overall response rate of 7%.

In view of the **Green Transition** evaluation study, a survey was conducted targeting successful applicants – this survey was designed during the inception phase and was later further enriched and developed with gateways to take into account various factors. In total, the survey received 1 333 contributions from respondents among which 771 were filled out in its entirety. The survey and following analysis was ordered by societal challenges probing for relevance, effectiveness and EU added value whereas for efficiency and the overall green transition process information was analysed at an aggregated level. Still, the analysis was further organized by topic within each evaluation criterion illustrated with respective graphs.

The studies on Resilient Europe and Innovative Europe did not conduct surveys within the frame of their methodologies.

Policy workshops

20 policy workshops were conducted in support of this evaluation. The workshops were implemented in the frame of the external evaluation studies. They aimed to consolidate and increase the robustness of findings and conclusions arising from the data collection conducted through other methods with the aim of addressing evidence gaps whenever needed.

Call for evidence

The 'call for evidence' opened on 1 July, 2022 and closed on 29 July 2022. The overall number of responses submitted was 35. This number includes two responses that were not considered in the analysis as they were out of scope, i.e. not concerning the Horizon 2020 programme. Four comments were

[117] This included 223 interviews in the frame of the Resilient Europe study, 138 for the study on Relevance, 217 in view of Digital and Industrial Transition, 224 on Excellent Science, 195 on Innovative Europe, 131 on External Coherence and 85 in view of cross-cutting issues.

submitted from the same person and have been then considered as a single contribution. Moreover, 4 organisations and one individual submitted the same response to the 'call for evidence' on the final evaluation of Horizon 2020 and the interim evaluation of Horizon Europe. Five position papers were received and all of them were considered in the scope of the consultation. As for the geographical distribution of the responses received, Germany is the country with the highest number of responses (11), accounting for more than one third of the responses, followed by France (6) and Belgium (4). In total, replies came from 11 different countries, including two non-EU Member States (the United Kingdom and Switzerland).

The findings from the feedback received during call for evidence were taken into consideration in the survey design for the public consultation. In view of content moderation, no feedback had to be unpublished as all contributions were in line with the content moderation rules. For additional content-related information, please consult the 'Supporting Information: Call for evidence' section further below.

Public consultation: scope and objectives

In line with the Better Regulation guidelines and toolbox[118], the public consultation on Horizon 2020 forms part of a combined consultation and evaluation exercise.[119] It aimed to explore stakeholders' views regarding the key aspects of the past and the present as well as the future of the EU Framework Programme for Research and Innovation, notably for the *ex post* evaluation of Horizon 2020 (2014-2020), the interim evaluation of Horizon Europe (2021-2023) as well as to receive inputs from stakeholders to be used for the definition of strategic orientations for the Horizon Europe Strategic Plan (2025-2027).

The reason for conducting a joint consultation is the relatively short time span between the legal obligation for the Horizon 2020 *ex post* evaluation and the legal obligation for the Horizon Europe interim evaluation. Additionally, another reason for conducting a joint consultation instead of reaching out to the broad public on three separate instances was to counter stakeholder fatigue, also bearing in mind that all three dimensions concern the same group of stakeholders. Nevertheless, it is important to note that this public consultation was geared towards anyone with an interest in the EU R&I Framework programmes, not only towards beneficiaries and the main stakeholder groups delineated in the section above but also unsuccessful applicants as well as independent experts.

The combined public consultation was accessible in English, French and German on the Have Your Say web portal from 01/12/23 until 23/03/23. Respondents had the possibility to submit their replies any official EU language resulting in in 2 788 responses and 265 position papers in total. For the section on Horizon 2020, 1 818 responses were submitted along with 21 position papers. The factual summary report, along with all contributions to the three dimensions covered in this public consultation as well as position papers are accessible on the Have your Say portal. Findings in this consultation did not only feed into the analysis presented on the following pages as well as highlighted in the respective sections in the main Staff Working Document but also form basis for the development of the 10th Framework Programme for Research and Innovation.

Methodology used for the analysis of the responses received through the public consultation

Quantitative analysis

Quantitative analysis was conducted by means of descriptive statistics, differentiating and comparing responses of different groups of respondents. Correct representation and interpretation of results are fundamental to drawing coherent conclusions which is why the number of respondents has been shown along with percentages. Linkages between answers and respondents' characteristics such as participation in the programme, country affiliation and type of respondent (e.g. Member State and business organisation representatives, researchers). When evident, correlations between answers given in closed

[118] Better Regulation Toolbox, notably Tool #52.
[119] Better Regulation Toolbox, Tool #50, p. 434.

questions have been explored. The summary statistics were bundled in .xml format which allowed for swift cross-comparison among the various dimensions covered in the public consultation survey.

Qualitative analysis

Key messages were extracted from qualitative contributions, primarily position papers and open questions present in the public consultation survey. Same holds true for the analysis of the feedback contributions received for the call for evidence. As only 21 position papers exclusively addressed Horizon 2020, instead of using tools such as Nvivo or Python, contributions were clustered by topics and specific aspects raised in both position papers and open questions by means of using Excel, presenting findings in a contribution matrix.

Content moderation according to Better Regulation Tool #54[120]

In view of content moderation, only three contributions were unpublished: all three were taken into consideration content-wise, however in two cases GDPR-related concerns led to unpublishing on the Have your say portal. Another respondent reached out to the support team of the public consultation via the indicated functional mailbox asking to unpublish the contribution as a wrong attachment was uploaded as a position paper – for the analysis, the newer position paper was taken into account.

Identification of campaigns[121]

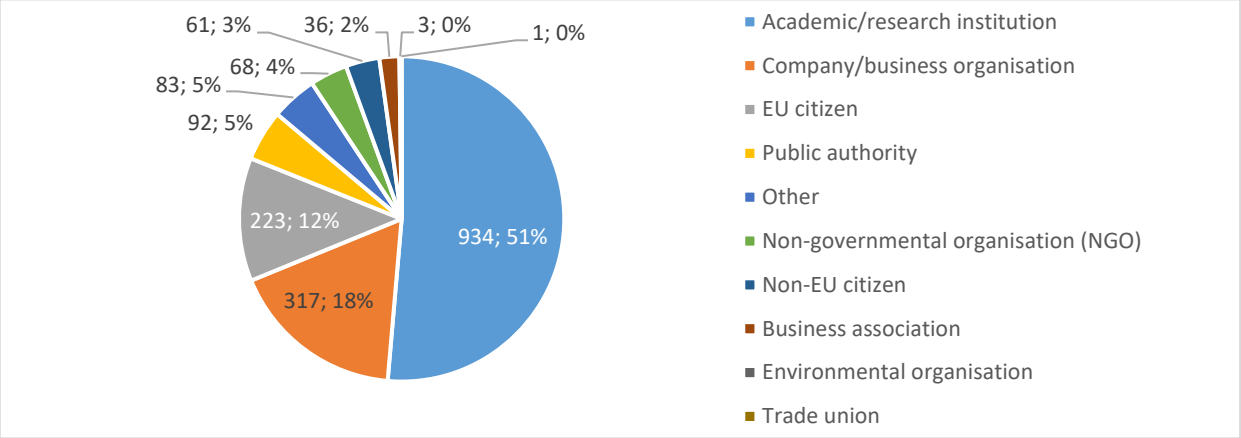
Although there was some coordination between some of the respondents (e.g., those participating in the same network, cluster, or country), as testified by the uploading of the same position paper by multiple respondents, the analysis of the consultation results does not indicate any campaign affecting the overall results.[122]

[120] Better Regulation Tool #54, p. 478.
[121] Better Regulation Tool #54, p. 476.
[122] Overall, 23 campaigns (coordinated responses to the survey by more than one respondent and up to 8). The 23 campaigns include responses by 70 respondents, representing 3.9% of all responses.

Public consultation: Participants

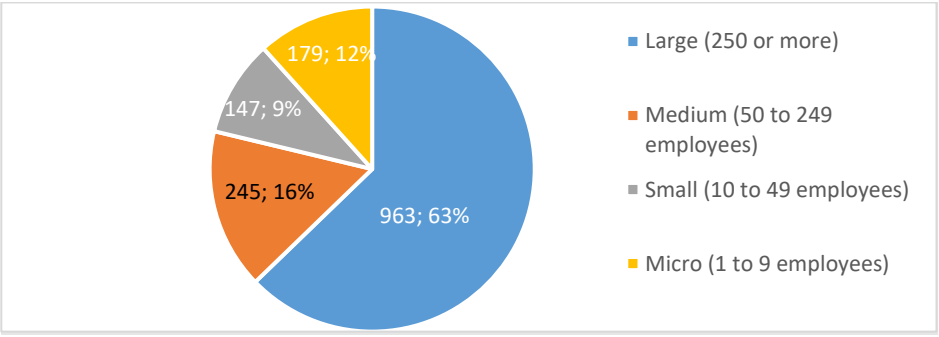
In total, **1 818** chose to complete the section of the consultation on Horizon 2020 programme. **Contributions were received from a wide range of actors**. 51% (934) of the respondents are part of academic or research institutions, 18% (317) are companies or business organisations, and 16% (284) are citizens (EU and not EU). The remaining 16% (283) of respondents cover different types of stakeholders (e.g., public authorities, NGOs, business associations, environmental organisations, trade unions). Among the 92 public authorities that responded, 38 represent the national level, 21 the international level, 19 the regional level and 14 the local level.

Figure 9: I am giving my contribution as… (N=1 818)



Two-thirds (1 191) of the respondents provided personal views, whereas one-third (586) contributed as a representative of an organisation or institution. Two-thirds (963) of organisations that responded were large, while one-third of respondents comprised micro (179), small (147) or medium (245) size organisations.

Figure 10: What is the size of your organisation? (N=1 534)



Geographical coverage

The consultation gathered responses from **74 different countries, including all 27 EU Member States + UK**[123]. 89% (1 620) of the contributions came from respondents based in **EU28 Member States**, 8% (139) from Horizon 2020 Associated Countries, and 3% (59) from Third Countries[124]. The largest number of contributions came from Italy (13%; 244), followed by Spain (12%; 212), Germany (12%;

[123] An EU Member State when Horizon 2020 was implemented.

[124] The responses received from Third Countries are from: Argentina (3), Australia (2), Bangladesh (1), Belarus (1), Brazil (6), Canada (3), Cape Verde (1), China (4), Colombia (4), Congo (1), Egypt (2), El Salvador (1), Ethiopia (1), Guatemala (1), India (5), Japan (1), Jordan (1), Kenya (2), Kosovo (1), Lebanon (1), Mexico (1), Mozambique (1), New Zealand (1), Pakistan (1), Palestine (1), Philippines (1), Russia (1), South Africa (1), Taiwan (1), Uganda (1), United States (5), Venezuela (1), Yemen (1).

211) and France (10%; 183). Looking at non-EU countries, the largest number of contributions came from Switzerland (2.3%; 42), Norway (1.8%; 32) and Turkey (1.3%; 24).

Figure 11: What is your country of origin? – EU 28 Member States (N=1 620)

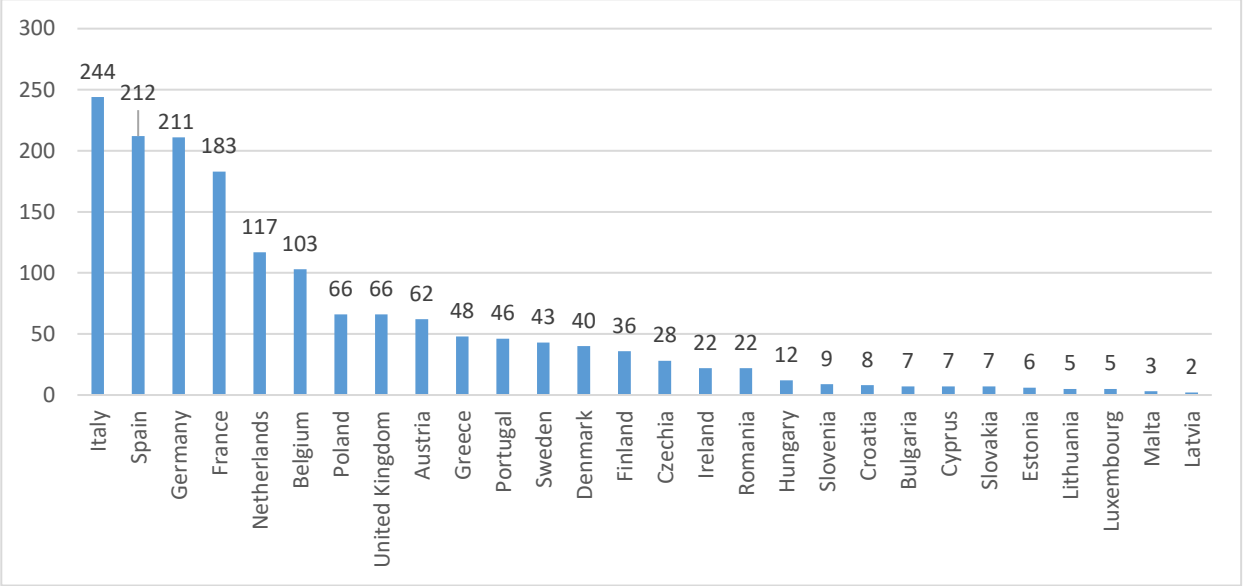
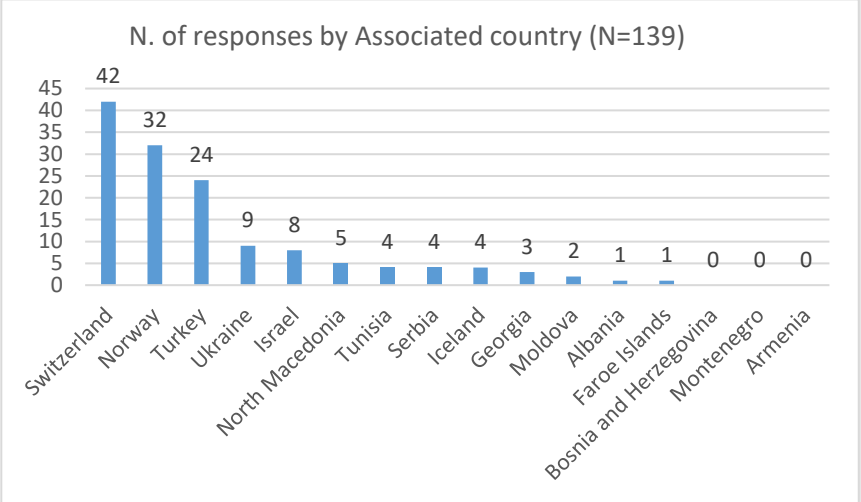


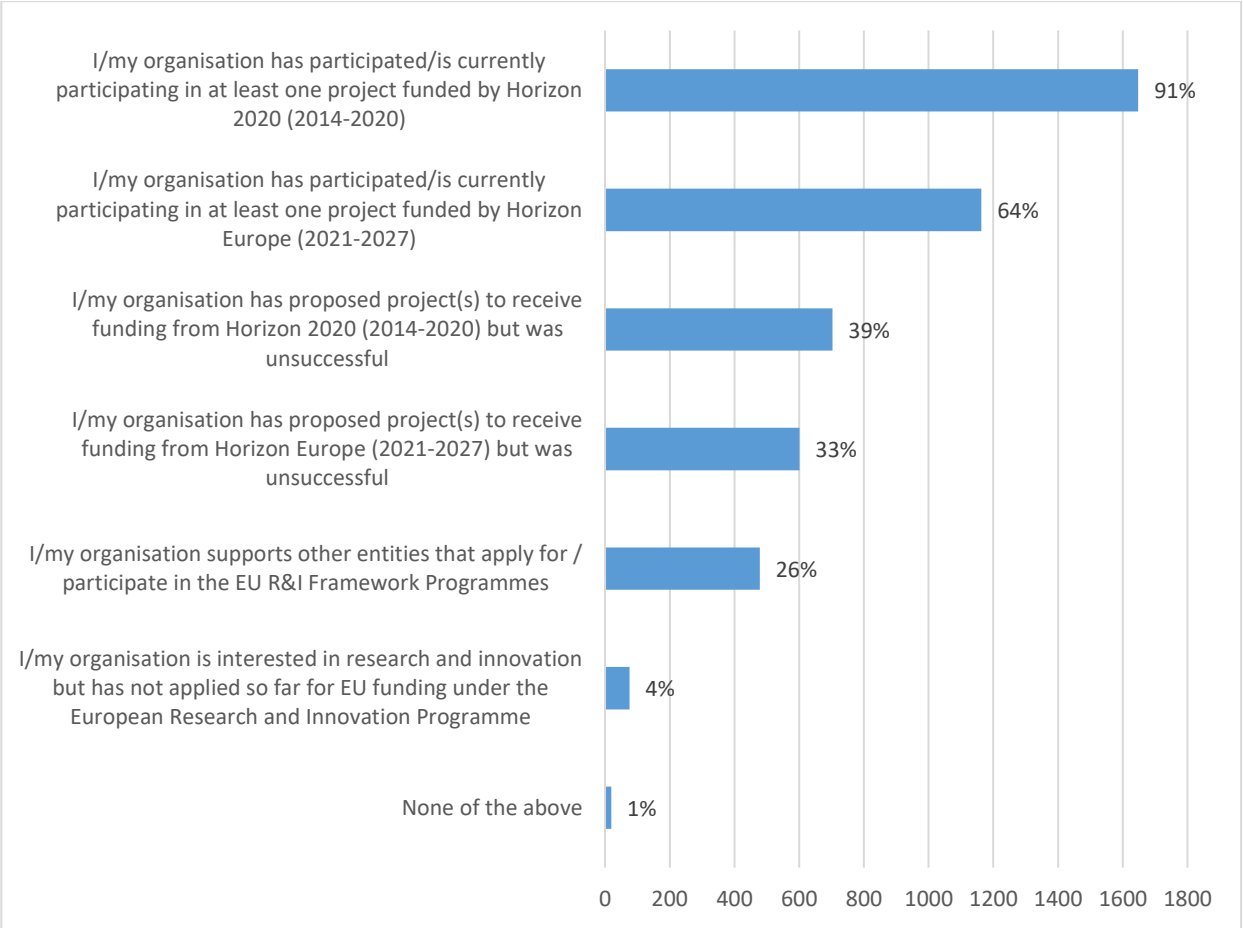
Figure 12: What is your country of origin? – Horizon 2020 Associated Country (N=139)



Experience with the framework programmes

The respondents were asked to select one or more options describing their experience with Horizon 2020 and Horizon Europe.[125] 91% of respondents (1 648) **participated in Horizon 2020**[126] and 64% (1 163) are **Horizon Europe beneficiaries.**[127] 39% (703) of respondents stated that they 'proposed project(s) to receive funding from Horizon 2020 but were **unsuccessful**'. However, considering that the same respondent could select multiple options, only 2.5% (45) of respondents applied for Horizon 2020 funding and were never successful.[128] Respondents also include **organisations supporting other entities** that apply for or participate in the EU R&I framework programmes (26%; 478) and **organisations that have never applied** for funding but are interested in R&I (4%; 76).

Figure 13: Please select the option(s) that best describe(s) your experience with the European Research and Innovation programmes (N=1 818; multiple answers possible)



The majority of respondents (73%; 1321) were mainly active or interested in the part of Horizon 2020 concerning **societal challenges** (Pillar III) and more than one-third of them participated or were interested in **Excellent Science actions** (Pillar I), namely the Marie Skłodowska-Curie Actions (MSCA)

[125] 'Please select the option(s) that best describe(s) your experience with the European Research and Innovation programmes)'. The question allowed multiple answers. Therefore, the same organisation could be, for instance, a beneficiary of both Horizon 2020 and Horizon Europe, or an unsuccessful applicant of Horizon 2020 but a beneficiary of Horizon Europe, or both an unsuccessful applicant and a beneficiary of Horizon 2020, if it submitted multiple proposals with different outcomes.

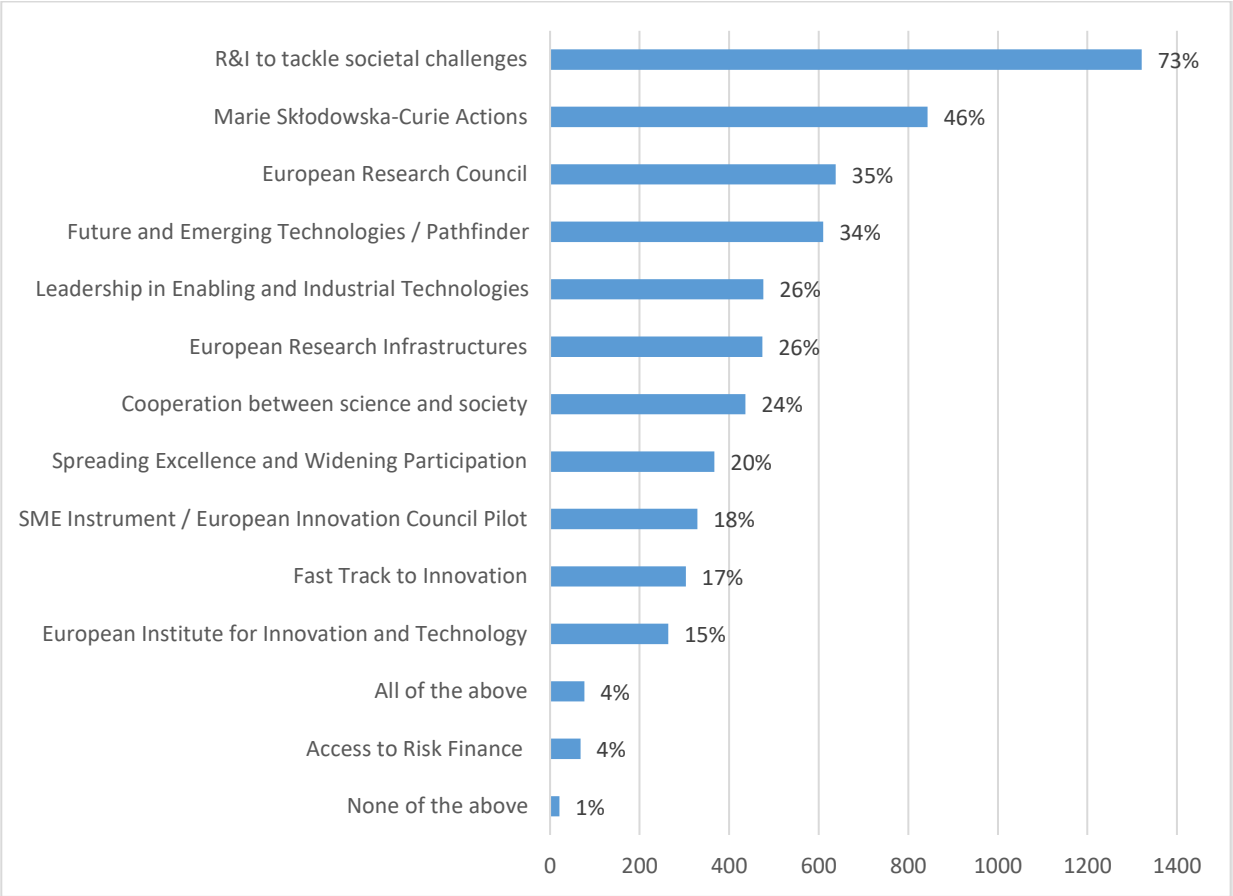
[126] They selected the response option 'I/my organisation has participated/is currently participating in at least one project funded by Horizon 2020 (2014 – 2020)'.

[127] They selected the response option 'I/my organisation has participated/is currently participating in at least one project funded by Horizon Europe (2021 – 2027)'.

[128] They selected the response option 'I/my organisation has proposed project(s) to receive funding from Horizon 2020 (2014 – 2020) but was unsuccessful' alone or with other response options, but they did not select 'I/my organisation has participated/is currently participating in at least one project funded by Horizon 2020 (2014 – 2020)'.

(46%; 843), the European Research Council (ERC) (35%; 638) and Future and Emerging Technologies / Pathfinder (34%; 310).

Figure 14: In which of the following areas of Horizon 2020 are you or your organisation mainly active and or interested in? (N=1 818; multiple answers possible)



Overview of position papers

21 position papers uploaded in response of this consultation included content relevant to the part of the consultation on Horizon 2020. Among the 21 position papers, 8 were written by academic or research institutions, 6 by non-governmental organisations and 3 by business associations. The largest number of position papers came from Belgium (5) and France (3).

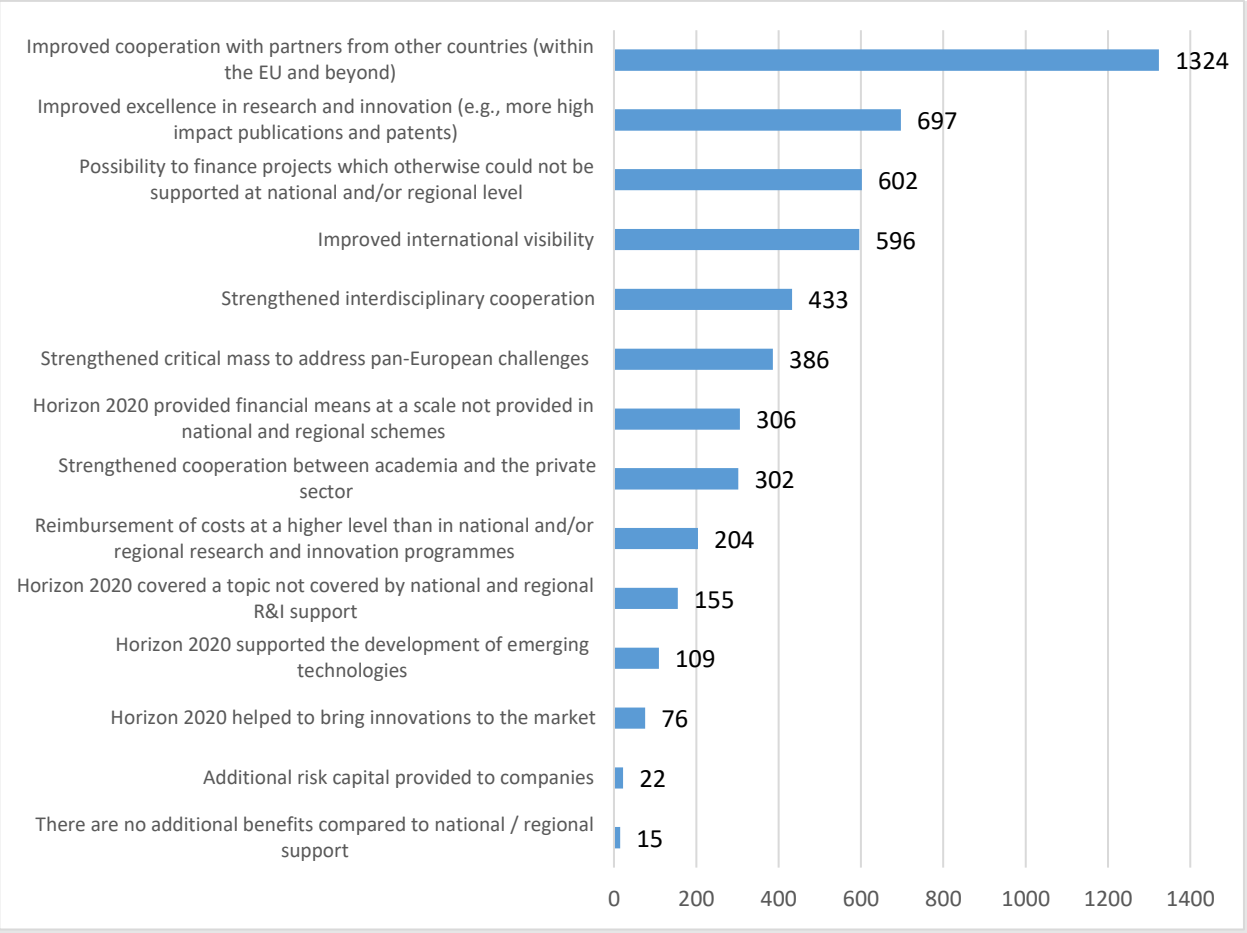
Results of the consultation

The respondents' experience with Horizon 2020

The benefits of participating in Horizon 2020

The majority of respondents (74%; 1 324) agreed that participating in Horizon 2020 'improved cooperation with partners from other countries (within the EU and beyond)', 39% (697) agreed that Horizon 2020 'improved excellence in research and innovation' compared to other programmes available in EU Member States or Associated Countries, and 34% (602) agreed that Horizon 2020 brought the 'possibility to finance projects which otherwise could not be supported at national and/or regional level'. Less than 1% (0.08%; 15) of respondents stated that there was 'no additional benefit' in participating in Horizon 2020 compared to other national and/or regional R&I programmes.

Figure 15: According to you, what are the main benefits of participating in Horizon 2020 compared to national and/or regional R&I programmes in EU Member States or Associated countries? Select maximum 3 answers (N=1 790)



The analysis by country group shows that, although the ranking of response options is aligned, certain benefits are considered particularly relevant for some country groups:

- 76.6% of respondents from EU Associated Countries selected 'improved cooperation with partners from other countries' compared to 74% of respondents from EU15, 73.3% from EU13 and 61% from Third Countries.
- 49.4% of respondents from EU13 and 45.3% from EU Associated Countries selected 'improved excellence in research and innovation' compared to 42.4% of respondents from Third Countries and 36.8% from EU15.
- 45.8% of respondents from Third Countries and 40% from EU13 selected 'improved international visibility' compared to 38.7% of respondents from EU Associated Countries and 31.4% from EU15.
- 23.6% of respondents from EU15 selected 'strengthened critical mass to address pan-European challenges' compared to 19% of respondents from EU Associated Countries, 12.8% from EU13 and 6.8% from Third Countries.

Table 15: According to you, what are the main benefits of participating in Horizon 2020 compared to national and/or regional R&I programmes in EU Member States or Associated countries? Select maximum 3 answers (EU15 N= 1 414; EU13 N= 180; EU Associated Countries

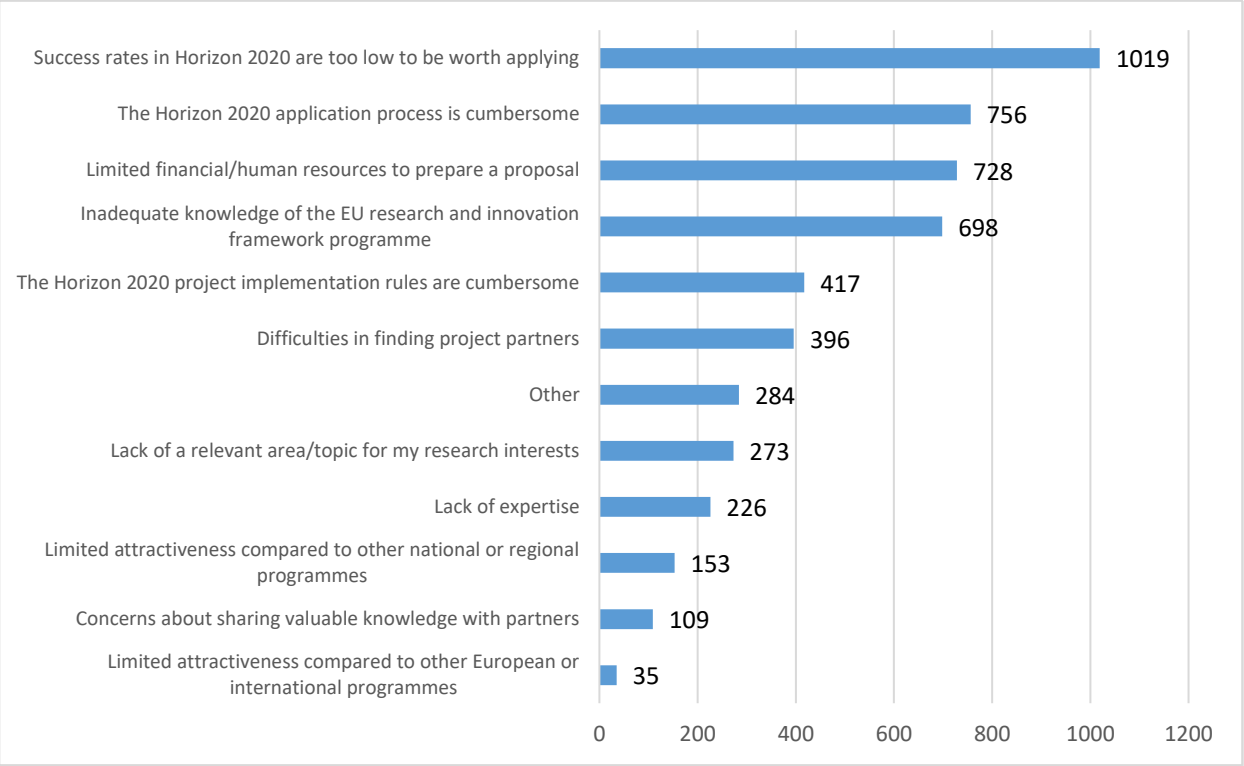
RESPONSE OPTION	EU15	EU13	EU ASSOCIATED COUNTRIES	THIRD COUNTRIES
Improved cooperation with partners from other countries (within the EU and beyond)	74.0%	73.3%	76.6%	61.0%
Improved excellence in research and innovation (e.g., more high impact publications and patents)	36.8%	49.4%	45.3%	42.4%
Possibility to finance projects which otherwise could not be supported at national and/or regional level	35.3%	28.3%	25.5%	28.8%
Improved international visibility	31.4%	40.0%	38.7%	45.8%
Strengthened interdisciplinary cooperation	24.3%	22.8%	23.4%	28.8%
Strengthened critical mass to address pan-European challenges	23.6%	12.8%	19.0%	6.8%
Horizon 2020 provided financial means at a scale not provided in national and regional schemes	17.3%	19.4%	11.7%	18.6%
Strengthened cooperation between academia and the private sector	16.7%	15.0%	19.7%	20.3%
Reimbursement of costs at a higher level than in national and/or regional research and innovation programmes	11.9%	9.4%	10.2%	8.5%
Horizon 2020 covered a topic not covered by national and regional R&I support	8.3%	10.0%	11.7%	5.1%
Horizon 2020 supported the development of emerging technologies	6.2%	6.7%	4.4%	6.8%
Horizon 2020 helped to bring innovations to the market	4.2%	2.8%	5.8%	5.1%
Additional risk capital provided to companies	1.3%	1.7%	0.7%	0.0%
There are no additional benefits compared to national / regional support	1.0%	0.0%	0.0%	1.7%

The reasons preventing participation in Horizon 2020

The **main reasons that held back potential beneficiaries** from Horizon 2020 were all linked to application costs, namely the **low success rates of applicants**, which both successful and unsuccessful applicants agree on (57%; 924 and 69%; 31 respectively), the **cumbersome application process** (42%; 681 among successful and 53%; 24 among unsuccessful applicants, and 50%; 67 respondents from associated countries), as well as the **lack of resources:** Interestingly, a larger fraction of successful applicants (41%; 670) than unsuccessful candidates (27%; 12) deemed the potential applicant's lack of resources to prepare a proposal as a reason negatively affecting participation. Compared to EU-13 respondents, respondents from associated countries are 10 percentage points less likely to identify limited resources as a deterring factor for participation.

Low success rates were also considered a further deterring factor to participation by 59% (830) of EU-15 respondents, 64% (115) of EU-13 respondents and 40% (54) of respondents from associated countries. Other deterring reasons mentioned by the respondents[129] are: difficulties in finding a project coordinator, difficulties in involving industrial partners, concerns about sharing valuable knowledge with partners (especially for businesses), lack of expertise to prepare a proposal and high costs for hiring external consultants for proposal preparation.

Figure 16: In your view, what are the main reasons that may have prevented potential beneficiaries from participating in Horizon 2020? Select maximum 3 answers. (N=1 781)



[129] Question: "if other, please specify".

The top four reasons selected by successful and unsuccessful applicants are the same, albeit with some variation:

Table 16: Top 4 for answers for 'In your view, what are the main reasons that may have prevented potential beneficiaries from participating in Horizon 2020? Select maximum 3 answers' (Successful applicants N= 1 622; Unsuccessful applicants N= 45)

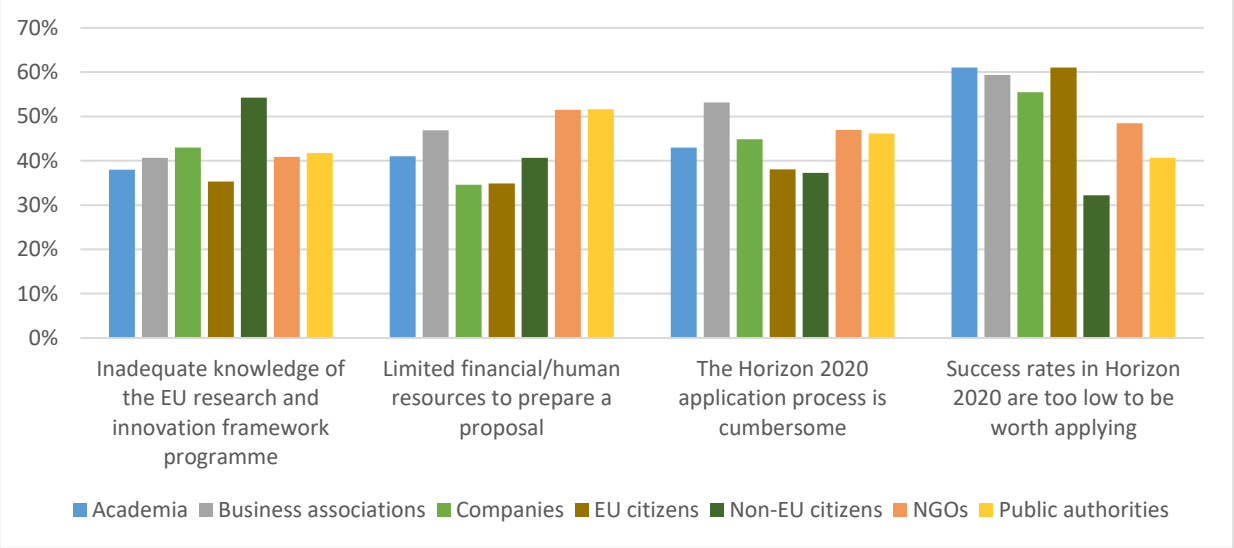
RESPONSE OPTION	HORIZON 2020 SUCCESSFUL APPLICANTS	HORIZON 2020 UNSUCCESSFUL APPLICANTS
Success rates in Horizon 2020 are too low to be worth applying	57.0%	68.9%
The Horizon 2020 application process is cumbersome	41.9%	53.3%
Limited financial/human resources to prepare a proposal	41.3%	26.7%
Inadequate knowledge of the EU research and innovation framework programme	39.3%	33.3%

Looking at disaggregation by country and stakeholder group for these top four reasons:

Table 17: Top 4 answers for 'In your view, what are the main reasons that may have prevented potential beneficiaries from participating in Horizon 2020? Select maximum 3 answers' (EU15 N= 1 407; EU13 N= 179; EU Associated Countries N= 136; Third Countries N= 59)

RESPONSE OPTION	EU15	EU13	EU ASSO. COUNTRIES	THIRD COUNTRIES
Success rates in Horizon 2020 are too low to be worth applying	59.1%	64.2%	40.4%	28.8%
The Horizon 2020 application process is cumbersome	44.2%	25.7%	50.0%	33.9%
Limited financial/human resources to prepare a proposal	40.2%	50.8%	39.0%	32.2%
Inadequate knowledge of the EU research and innovation framework programme	38.0%	36.3%	49.3%	54.2%

Figure 17: Stakeholder breakdown of top four reasons preventing participation in Horizon 2020
up to three responses allowed, environmental organisations and trade unions not represented due to low response rate (3 or fewer)

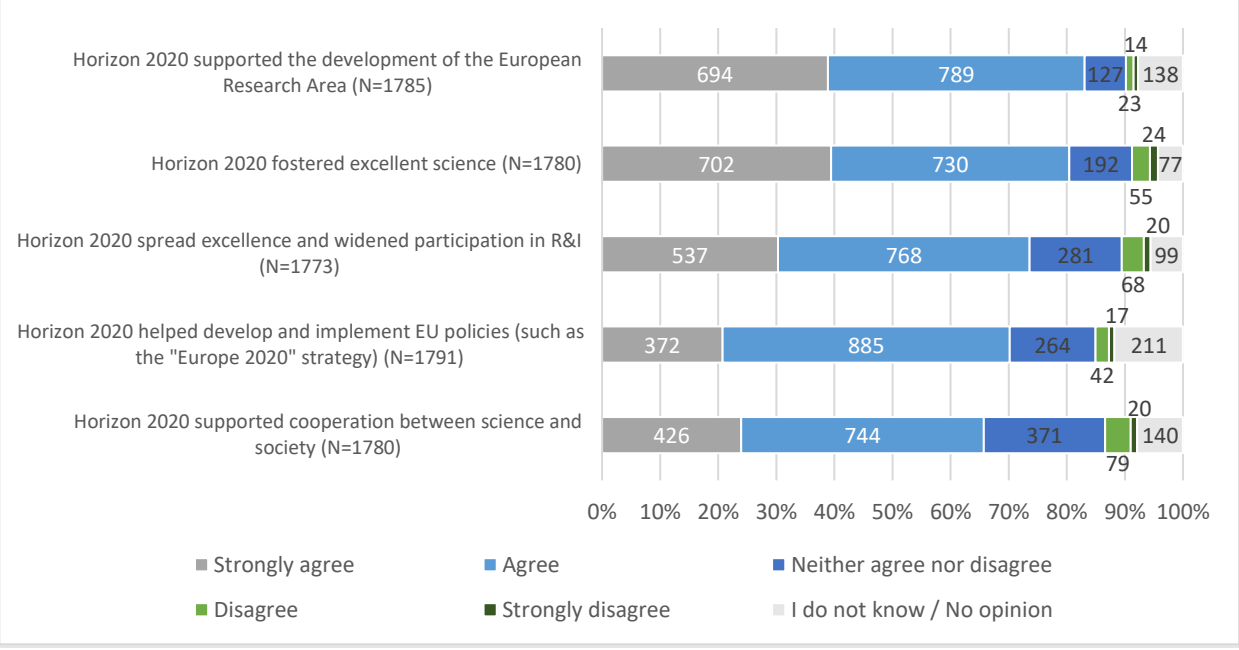


Priorities and objectives

Assessing the achievement of the Horizon 2020 objectives

Respondents generally expressed positive opinions concerning the achievement of the Horizon 2020 objectives. Most respondents agreed that 'Horizon 2020 supported the development of the European Research Area' (83%; 1 483), 'fostered excellence science' (80%; 1 432), 'spread excellence and widened participation in R&I' (74%; 1 305), and 'helped develop and implement EU policies' (70%; 1 257). The most controversial aspect was the ability of Horizon 2020 to 'support cooperation between science and society', with 6% (99) of respondents maintaining that the programme did not do enough to support such cooperation.

Figure 18: To what extent do you agree with the following statements concerning the objectives of Horizon 2020?



Development of the European Research Area

Similarly, EU citizens and respondents from academic and research organisations (both respectively 84%; 775, 184) either agreed or strongly agreed that Horizon 2020 supported the development of the European Research Area. Same as shown with regard to fostering excellent science, 88% (52) of non-EU respondents indicated that Horizon 2020 supported the development of the European Research Area, showing that the views regarding the scientific dimension of Horizon 2020 are coherent.

Excellent Science

Overall, 80% (1 432) of respondents to the consultation support the claim that Horizon 2020 encouraged excellent science: this view is held by 82% (760) of respondents from academic and research organisations and 65% (20) from business associations, 84% (175) of EU citizens and 88% (53) of non-EU citizens. Among all other stakeholder groups (including, among others, companies, public authorities, trade unions, NGOs and environmental organisations, 77% (424) agreed or strongly agreed with this view.

Spread excellence and widen participation

In total, 74% (1 305) of respondents agreed or strongly agreed in the stakeholder consultation with the notion that Horizon 2020 spread excellence and widened participation in R&I. This view was held by 81% (677) of respondents from business associations, 75% (26) of respondents replying on behalf of companies and businesses, 74% (677) of respondents from academia and 73% (48) of respondents replying on behalf of NGOs. At the same time, 73% of non-EU citizens agreed or strongly agreed (43), compared to 68% of EU citizens (148). Breaking down the responses of all respondents by countries, it becomes clear that 77% (138) of respondents from EU-13 countries, 74% (1 027) of EU-15 countries, 73% (99) of associated countries and 70% (41) of third countries agree or strongly agree with the notion that Horizon 2020 spread excellence and widened participation in R&I.

Develop and implement EU policies

Overall, 70% of respondents (1 483) in the stakeholder consultation conducted for this evaluation agreed or strongly agreed that **'Horizon 2020 helped develop and implement EU policies'** (such as the 'Europe 2020' strategy). The strongest support for this statement has been shown among public authorities (78%; 72), followed by business associations (75%; 24), companies (73%; 229) and academia (70%; 644). Only NGOs (66%; 44), EU citizens (66%; 145) and non-EU citizens (60%; 36) have indicated a lesser agreement with the statement, either agreeing or strongly agreeing that Horizon 2020 helped to develop and implement EU policies.

Overall, few respondents (2%; 37) across all stakeholder groups expressed unfavourable opinions regarding the capacity of Horizon 2020 to help develop and implement EU policies indicating that across all stakeholder groups are indeed overwhelmingly positive about the development and implementation of EU policies by means of Horizon 2020.

Building R&I capacity in EU countries lagging behind

Only 62% (1 097) of respondents believed that Horizon 2020 helped building R&I capacity in EU countries lagging behind: this view was primarily shared by non-EU citizens (70%; 41), environmental organisations (67%; 2), companies and businesses (64%; 199), academia / research organisations (62%; 566) followed by EU citizens (61%; 132). The views of business associations were less favourable, only having 55% (17) supporting the claim that the programme helped building R&I capacity in EU countries lagging behind, whereas 23% (199) of respondents replying on behalf of businesses indicated that the effect of Horizon 2020 in this endeavour was neutral. Nevertheless, other stakeholder groups held more favourable views, with less respondents deeming the effect neutral, e.g. 11% of academia (200) and 10% of companies (31). Overall, only a small fraction of respondents indicated that it had no effect at all: 3% of businesses (8) and companies and 1.5% of academia (14).

Supporting cooperation between science and society

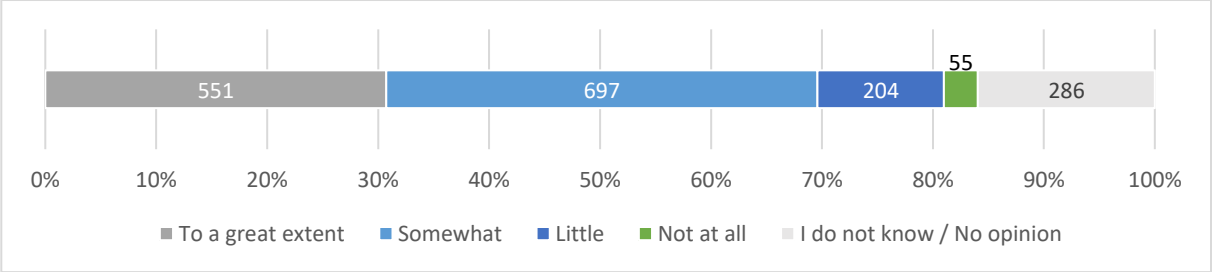
'Horizon 2020 supported cooperation between science and society': 6% of respondents (99) maintained that the programme did in fact not do enough to support said cooperation. Nevertheless, this constitutes only a small fraction of respondents within each stakeholder group. It is important to note that the majority of responses were rather favourable, suggesting an overall positive sentiment towards the support of cooperation between science and society.

Among the various stakeholder groups, favourable views were shared the most on behalf of NGOs 71% (47), whereas business associations (59%; 19) were the least favourable compared to other stakeholder groups indicating that they either agree or strongly agree with the fact that Horizon 2020 supported cooperation between science and society.

Flexibility to respond to unforeseen events

The majority of participants (70%; 1 248) stated that Horizon 2020 was flexible enough to respond to unforeseen emergencies such as the COVID-19 pandemic or Zika. Only 3% (55) expressed the opposite opinion. One position paper also appreciated the flexibility of Horizon 2020 in delivering a response to the COVID-19 pandemic.

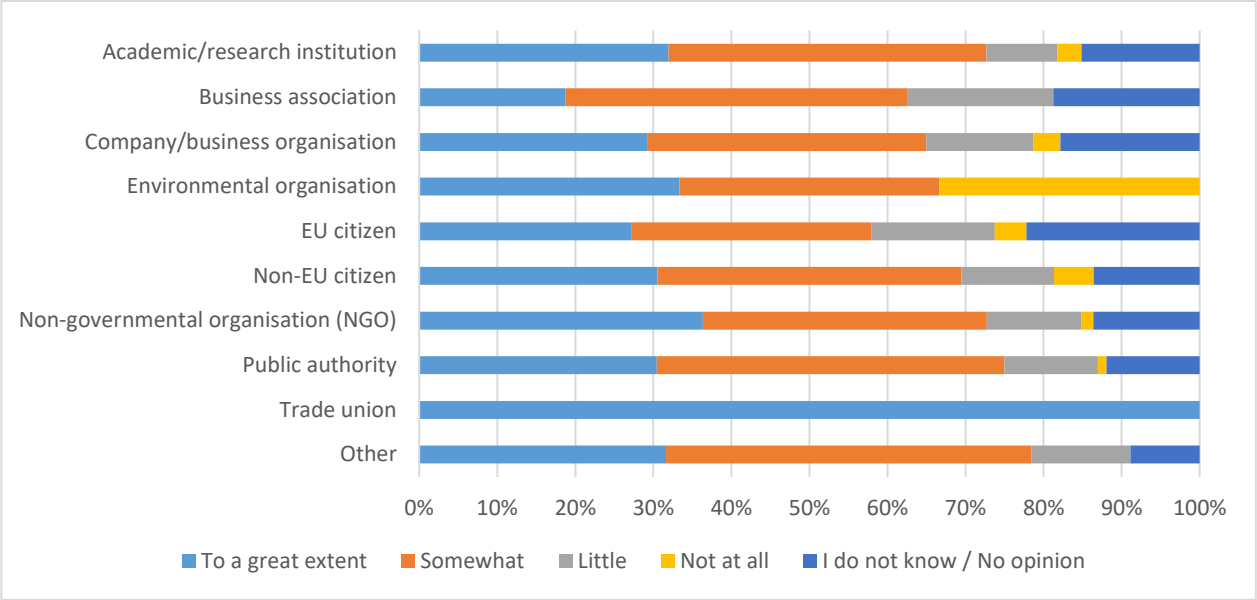
Figure 19: To what extent was Horizon 2020 flexible enough to respond to unforeseen emergencies such as the COVID-19 pandemic, Zika, etc. (N=1 793)



Overall, 70% (1 248) of respondents stated that 'Horizon 2020 is flexible enough to respond to unforeseen emergencies such as the COVID-19 pandemic, Zika and others'. Respondents that shared views on behalf of an institution or organisation agreed to a greater extent (76%; 435) with this statement compared to respondents that shared their views in an individual capacity (67%; 788).

Among the various stakeholder groups, respondents generally perceive Horizon 2020 as being flexible enough to respond to emergencies like the COVID-19 pandemic, Zika and others. Most respondents were positive about the flexibility of the programme with 32% of academia (296), 31% of non-EU citizens (18), 30% of public authorities (28), 29% of companies (92), 30% of public authorities (28) and 27% of EU citizens (60) strongly agreeing. The percentages of respondents sharing a more sceptical view on the matter were relatively low. Still, the 'I don't know / no opinion' option was chosen by 12% (public authorities, 11) to 18% (business associations, 6) of respondents.

Figure 20: Stakeholder breakdown - flexibility to respond to unforeseen emergencies (N= 1 793)

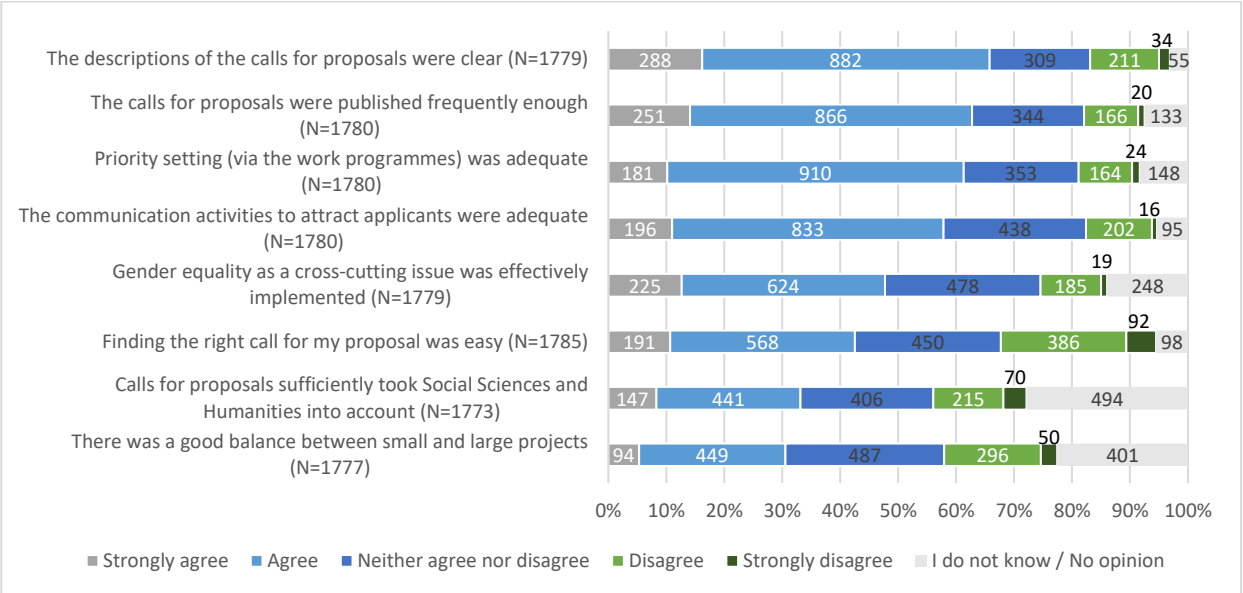


Implementation and administrative procedures

Design and implementation of the calls for proposals

Most respondents agreed that 'the descriptions of Horizon 2020 call for proposals were clear' (67%; 1 170) and frequent enough (63%; 1 117), that 'the priority setting via the work programmes was adequate' (61%; 1 091) and that 'the communication activities to attract applicants were adequate' (58%; 1 029). However, 27% (478) of respondents maintained that finding the right call for proposals was difficult.

Figure 21: To what extent do you agree with the following statements concerning the calls for proposals under Horizon 2020?



Among the different types of stakeholders, 31% (286) of research institutions as well as business associations **found it hard to find the right call**, whereas companies and business organisations indicated that they had slightly less difficulties (26%; 81). Likewise, 42% (384) among research institutions, 50% (16) among business associations and 47% among companies and business organisations found it easy to find the right call for their proposals, presenting a relatively even split between the views of whether calls were designed in a clear way.

Figure 22: Stakeholder breakdown - priority setting via the work programmes was adequate (N= 1 780)

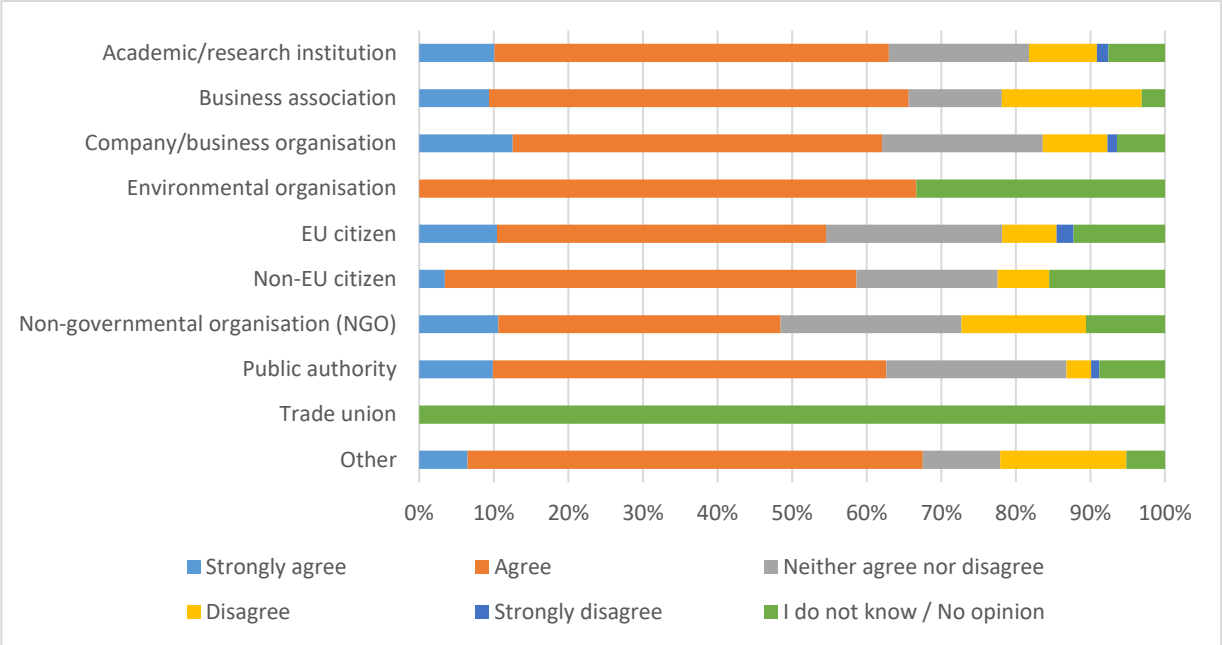
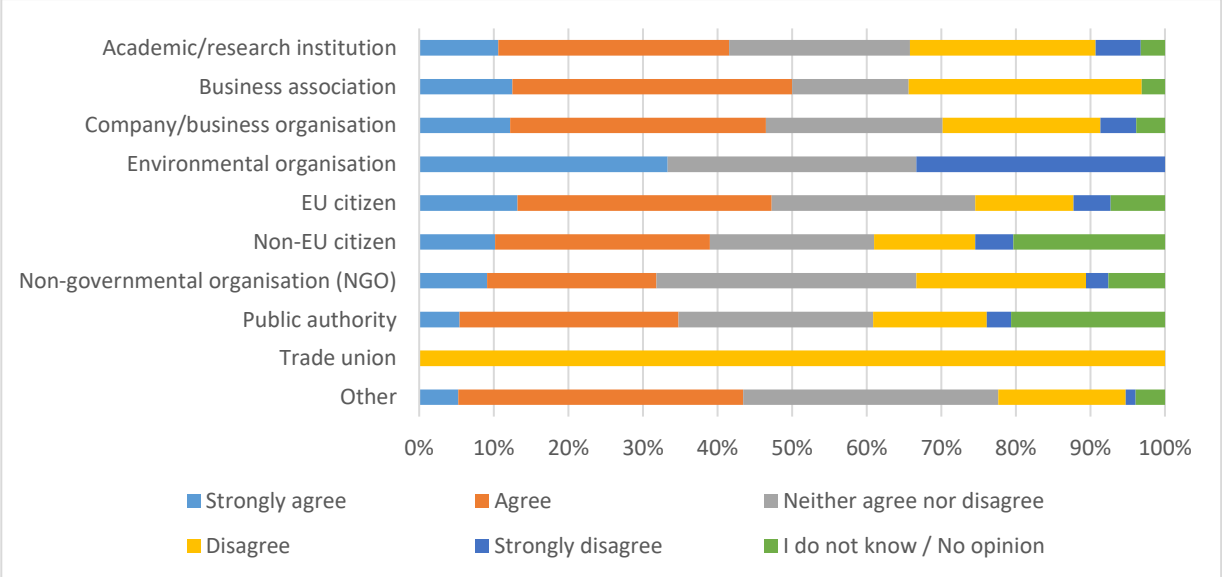


Figure 23: Stakeholder breakdown - finding the right call for my proposal was easy (N= 1 785)

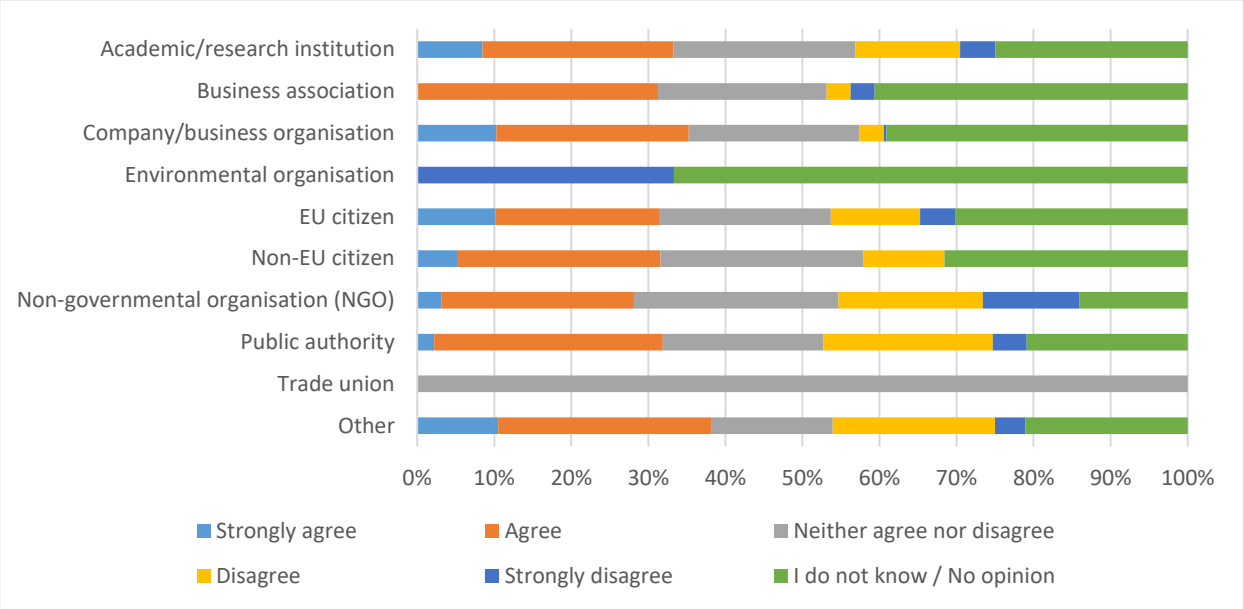


Social Sciences and Humanities

Overall, 37% (656) of respondents indicated in the public consultation that they either agree or strongly agree with the notion that calls for proposals sufficiently took Social Sciences and Humanities into account. It is important to mention that 29% (527) of respondents did not answer this survey question or indicated that they do not know or have no opinion. This indicates that a significant share of respondents has rather limited knowledge of the integration of Social Sciences and Humanities in the programme. Bearing this caveat in mind, 35% of respondents representing companies and businesses, 33% (110), 33% (306) of respondents from academia, 32% (29) of respondents from public authorities deemed that the calls for proposals did indeed sufficiently take Social Sciences and Humanities into account. Among both EU and non-EU citizens, 30% believe Social Sciences and Humanities were sufficiently taken into account (68 and 18 respectively). Still, respondents that neither agree nor disagree with the abovementioned statement include representatives from NGOs (26%; 17), research institutions (24%; 218), companies and business associations (both 22% 7 and 69 respectively). Notably NGOs (31%; 20)

and public authorities (26%; 24) either disagree or strongly disagree with the notion that Social Sciences and Humanities were sufficiently taken into account.

Figure 24: Stakeholder breakdown - calls for proposals sufficiently took Social Sciences and Humanities into account (N= 1 773)

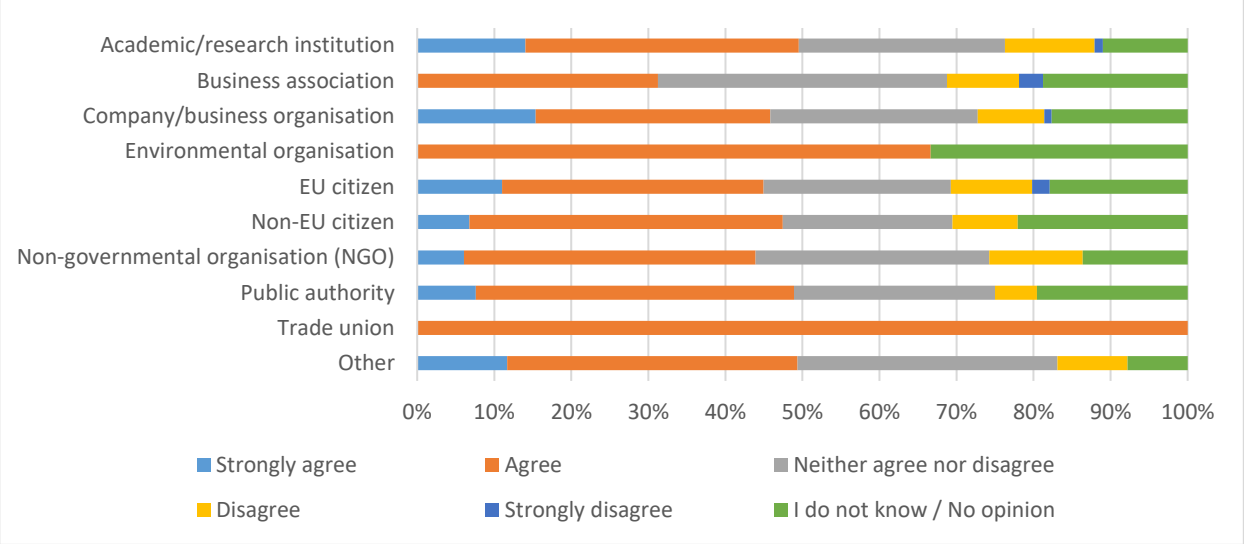


Gender equality

48% of respondents (849) either agreed or strongly agreed that gender equality as a cross-cutting issue has been effectively implemented. 27% (478) neither agreed nor disagreed, while 11% (204) disagreed or disagreed strongly. 14% (248) did not express an opinion.

The stakeholder groups that were most positive about the implementation of gender equality as a cross-cutting issue were academia (50%; 455), followed by public authorities (49%; 45), companies (47%; 143) and non-EU citizens (47%; 28). EU citizens (45%; 98), NGOs (44%; 29) and business associations (31%; 11) on the other hand were less positive: the difference between academia and business associations showed a 19 percentage point difference which might be rooted in the smaller variation within the stakeholder group – only 32 business associations replied to the related question overall whereas the figure was significantly higher for respondents from academia (919).

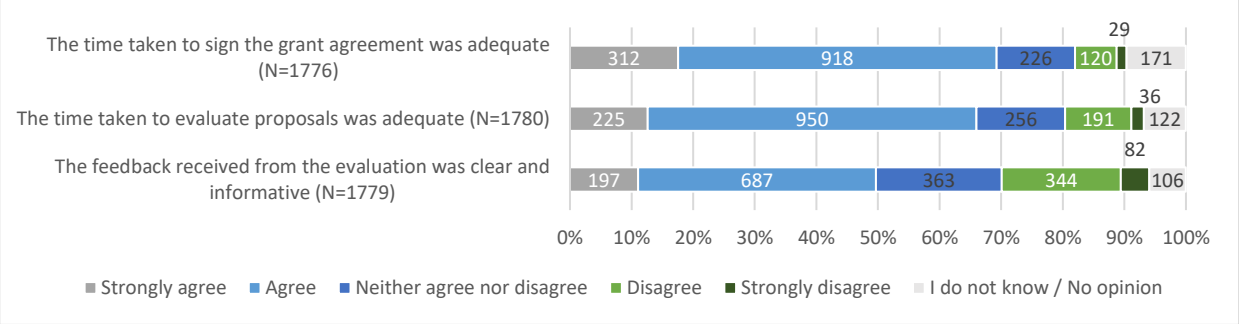
Figure 25: Stakeholder breakdown - gender equality has been effectively implemented as a cross-cutting issue (N= 1 779)



Evaluation of proposals

Most respondents agreed or strongly agreed that the 'time to evaluate the proposals' (66%; 1 175) and the 'time to sign the grant agreement' (69%; 1 230) was 'adequate'. Whilst 50% (884) of respondents think that the feedback received from the evaluation was 'clear and informative', 24% (426) of respondents disagreed or strongly disagreed with this statement.

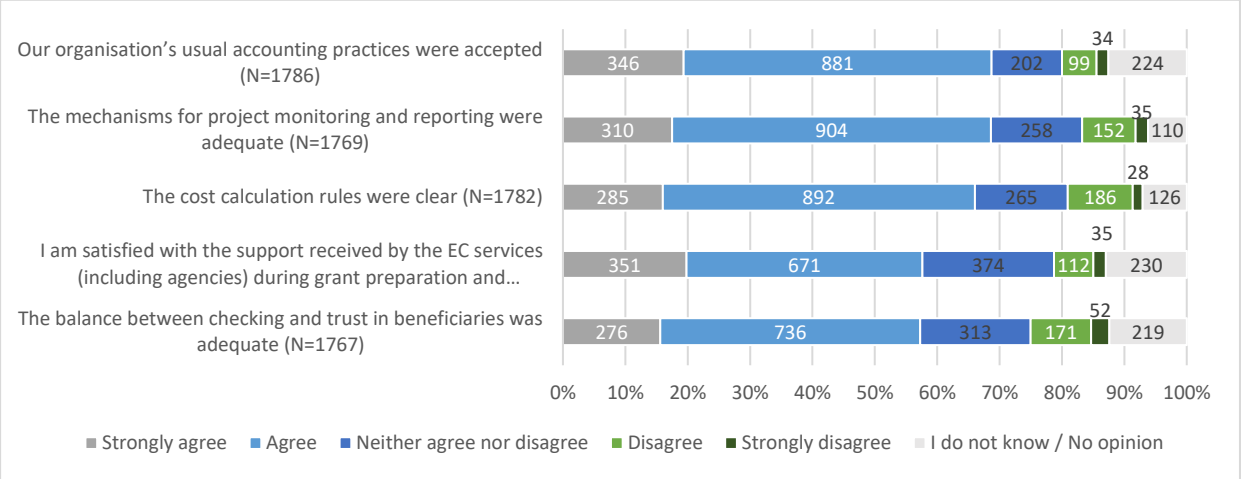
Figure 26. To what extent do you agree with the following statements concerning proposal evaluation under Horizon 2020?



Project implementation

Most respondents agreed or strongly agreed that their 'organisation's usual accounting practices were accepted' (69%: 1 227), that 'the mechanisms for project monitoring and reporting were adequate' (69%; 1 214), that 'the cost calculation rules were clear' (66%; 1 177). The majority of respondents were 'satisfied with the support received by the EC services (including agencies) during grant preparation and implementation' (58%; 1 022) and agreed or strongly agreed that 'the balance between checking and trust in beneficiaries was adequate' (57%; 1 012).

Figure 27. To what extent do you agree with the following statements concerning the project implementation under Horizon 2020?



A large majority of respondents 'agreed' or 'strongly agreed' that their 'organisation's **usual accounting practices** were accepted' (69%; 1 227). The agreement among respondents from NGOs and companies was even higher with both at 74% (49; 651) respectively. EU citizens (61%; 135) and non-EU citizens (51%; 30) agreed to a lesser extent. Only a small fraction of respondents found that their usual accounting practices were not accepted, namely public authorities (2%; 2), NGOs (8%; 3), companies (7%; 23), business associations (6%; 2) and academia (8%; 77).

Beyond that, stakeholders agreed that '**the mechanisms for project monitoring and reporting were adequate**' (69%; 1 214), showing the highest level of agreement among companies (74%; 226), followed by respondents from academia (70%; 634), business associations (68%; 21), EU citizens (66%; 143), non-EU citizens (60%; 35) and NGOs (58%; 38) and business associations (68%; 21). At the same time, another fraction of respondents from academia were of the opinion that the monitoring and reporting mechanisms were not adequate (10%; 93), followed by NGO-associated respondents (17%; 11), respondents on behalf of companies (9%; 28) and business associations (3%; 1).

Overall, respondents agreed with the statement that '**the cost calculation rules were clear**' (66%; 1 177). Nevertheless, there was some variation between the different stakeholder groups: business associations agreed to the greatest extent (74%; 23), followed by companies (72%; 224), academia (68%; 620), NGOs (62%; 41), EU citizens (61%; 120), public authorities (57%; 52) and non-EU citizens (54%; 37) respectively. At the same time, the level of dissatisfaction with the clarity of cost calculation rules varies to a smaller extent among the different types of stakeholders, ranging from 9% of companies (27), up to 13% for academia (118), public authorities (12) and business associations (4) respectively.

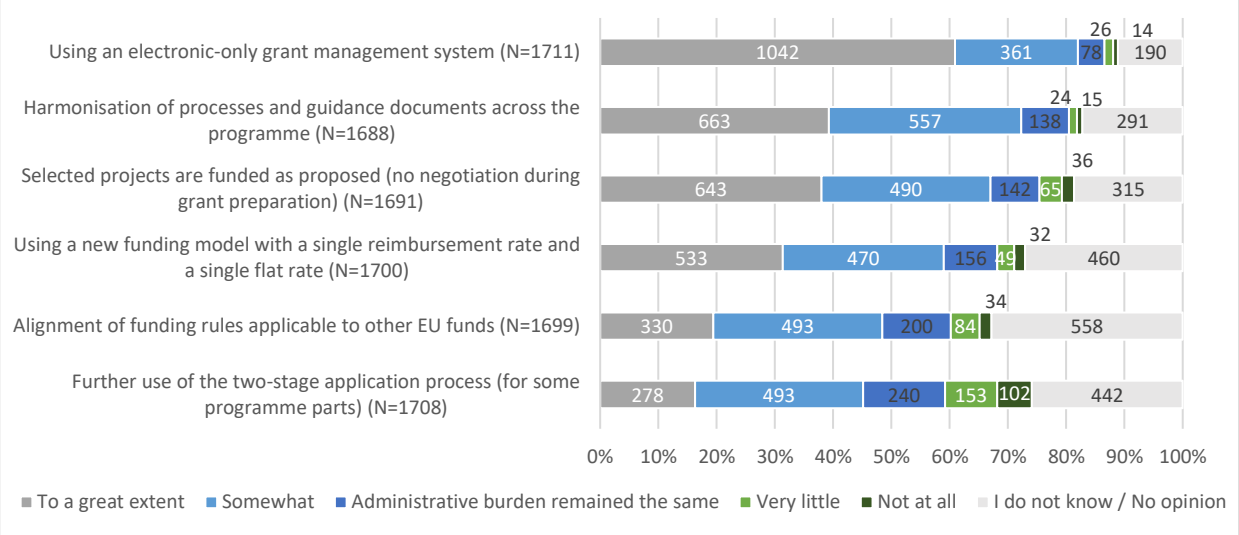
More than half of respondents were **'satisfied with the support received by the EC services (including agencies) during grant preparation and implementation**' (58%; 1 022): business associations are beyond the average of all respondents satisfied with the support received by the EC services (67%; 21), along with companies (64%; 199). At the same time, respondents from academia (57%; 524) and NGOs (48%; 32) were less satisfied. Interestingly, the level of satisfaction between EU citizens and non-EU citizens differs: **non-EU citizens** (64%; 27) **are less satisfied[401] with the support received by the EC services, compared to EU citizens** (55%; 122).

The effects of simplification measures

Most respondents stated that 'using an electronic-only management system' (82%; 1 403) and having 'harmonised processes and guidance documents across the framework programme' (72%; 1 220) reduced their administrative burden – somewhat or to a great extent. Likewise, most respondents think that removing the negotiation stage during grant preparation (67%; 1 133) and 'using a funding model with a single reimbursement rate and a single flat rate' (59%; 1 033) are effective simplification

measures. Although positive responses (771) outnumber negative ones (255), the simplification measures that received the highest number of negative responses is 'further use of the two-stage application process'.

Figure 28: Based on your experience, to what extent did the following simplification measures, introduced in Horizon 2020, help reduce your administrative burden?



Specifically regarding the implementation processes of the calls, stakeholders indicated that '**Using an electronic-only management system**' (82%; 1 403) and having '**harmonised processes and guidance documents across the framework programme**' (72%; 1 220) were understood to have reduced at least 'somewhat' the administrative burden for respondents. Likewise, most respondents think that **effective simplification measures** included: **removing the negotiation stage** during grant preparation (67%; 1 133) and '**using a funding model with a single reimbursement rate and a single flat rate**' (59%; 1 033)**.**

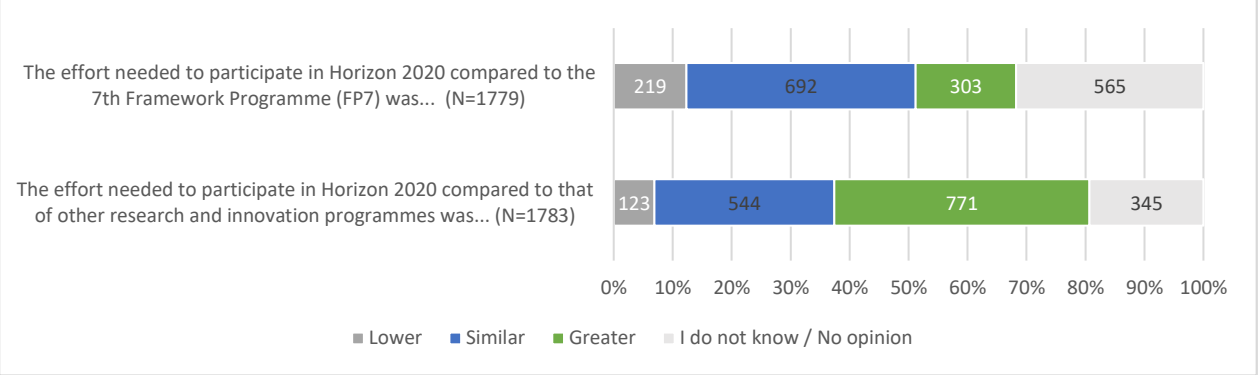
The simplification measure with the **highest number of negative views** was the 'further use of the **two-stage application process**'. Although positive responses (42%; 711) still outnumber the negative ones (15%; 255), the majority of respondents agrees with the notion of further expanding the two-stage application process for some programme parts. Notably respondents from academia (56%; 433), non-EU citizens (52%; 27), public authorities (49%; 36), business associations (48%; 11) and EU citizens (48%; 87) were in favour of furthering the use of the two-stage application process for some programme parts.

The effort to participate in Horizon 2020

Views on whether the effort needed to participate in Horizon 2020 was lower **compared to FP7** were not uniform: 39% (692) of respondents think that the effort was similar (the largest share across all country and stakeholder groups), 17% (303) that it was greater and 12% (219) that it was lower. One-third of respondents (565) do not have an opinion.

On the other hand, **relative to other research and innovation funding programmes**, the effort to participate in Horizon 2020 is deemed greater (43%; 771, particularly academic and research institutions) or similar (39%; 692) by most, across all stakeholder groups. Only a small minority of respondents (7%; 219) consider it lower.

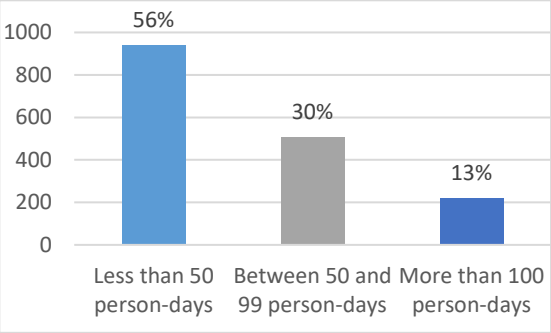
Figure 29: The effort needed to participate in Horizon 2020 compared to the 7th Framework Programme and other R&I programmes



Costs of proposal preparation

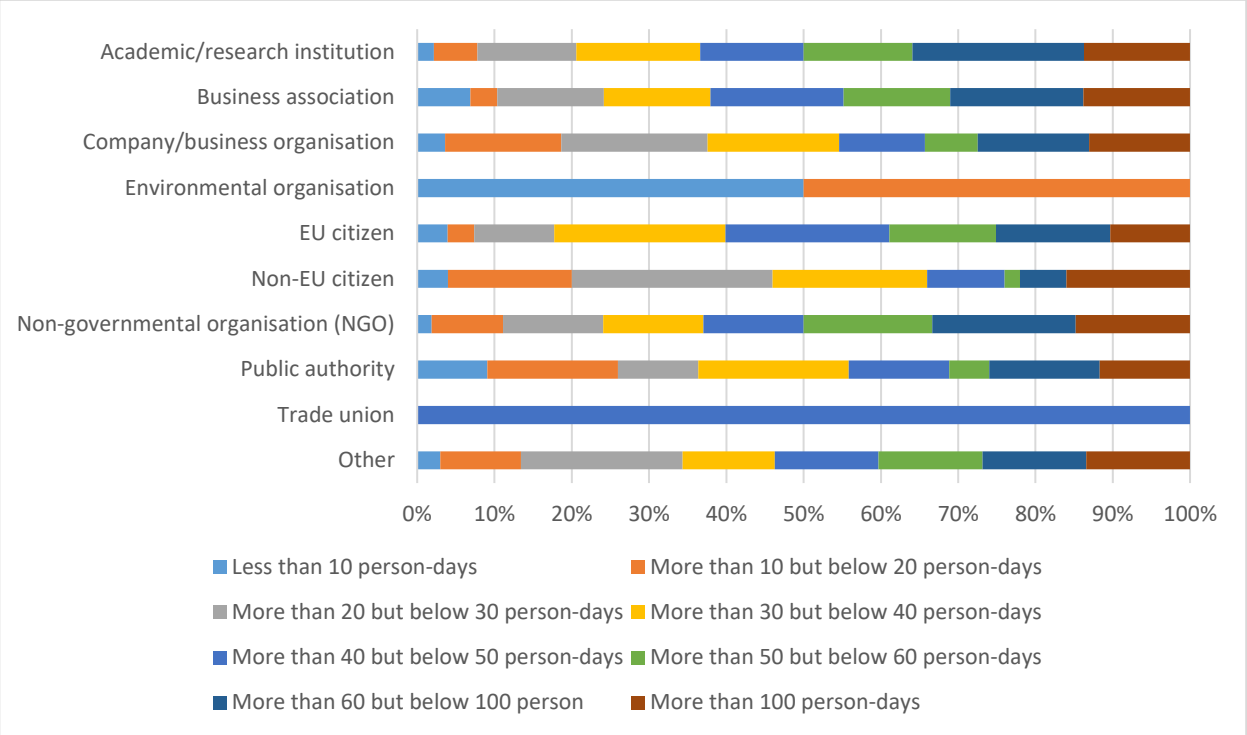
Most (56%; 939) of the consultation respondents declared that their 'proposal preparation for Horizon 2020' took overall less than 50 days (across all stakeholder groups, especially public authorities – 70% and companies – 65%). This is followed by 30% of respondents (505) who stated that the proposal preparation took 'more than 50 but less than 100 days' and 13% (219) who said 'more than 100 days'. Considering the different types of respondents, academic, research institutions and NGOs reported to spend more time preparing proposals than companies, business organisations or public authorities.[130]

Figure 30. Approximately, how much time did the proposal preparation for Horizon 2020 take overall? Please indicate the total number of person-days. (N= 1 663)



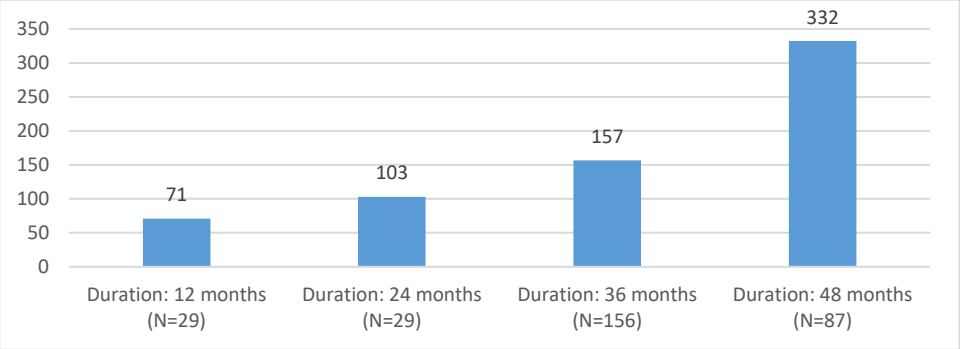
[130] The share of respondents spending less of 50 days for proposal preparation is 50% in the first group, whereas it is more than 65% for the second group.

Figure 31: Stakeholder breakdown – How much time did the proposal preparation for Horizon 2020 take overall? (N =1 663)



The consultation also asked participants about the 'time spent managing participation'. The analysis of responses cannot be conclusive because there is great variability in the responses in terms of who provided information or not, which programme parts the respondents were linked to and their specific role in the projects.[131] The chart below shows the information that was provided on 'average number of person-days spent during the entire project', by project duration.

Figure 32. Approximately, how much time does your project spend on managing participation in Horizon 2020? Total number of person-days spent overall on managing participation. Average estimate of person-days by project duration (N= 301)



The results to the open question 'Approximately, how much time does your project spend on managing participation in Horizon 2020?' can only be interpreted with caution because of the following:

- 332 responses could not be processed because respondents did not provide the required information (could not provide an estimate or when they did it was not in the required format).
- Comparability is difficult because respondents interpreted the question in different ways (e.g., some respondents included in the estimate the time spent for the internal project coordination, others provided an estimate of the time that it took for the whole project activities).

[131] For example, among projects with a duration of 36 months, the estimates range from 2 person-days to 1,500 person-days (after the outliers were removed).

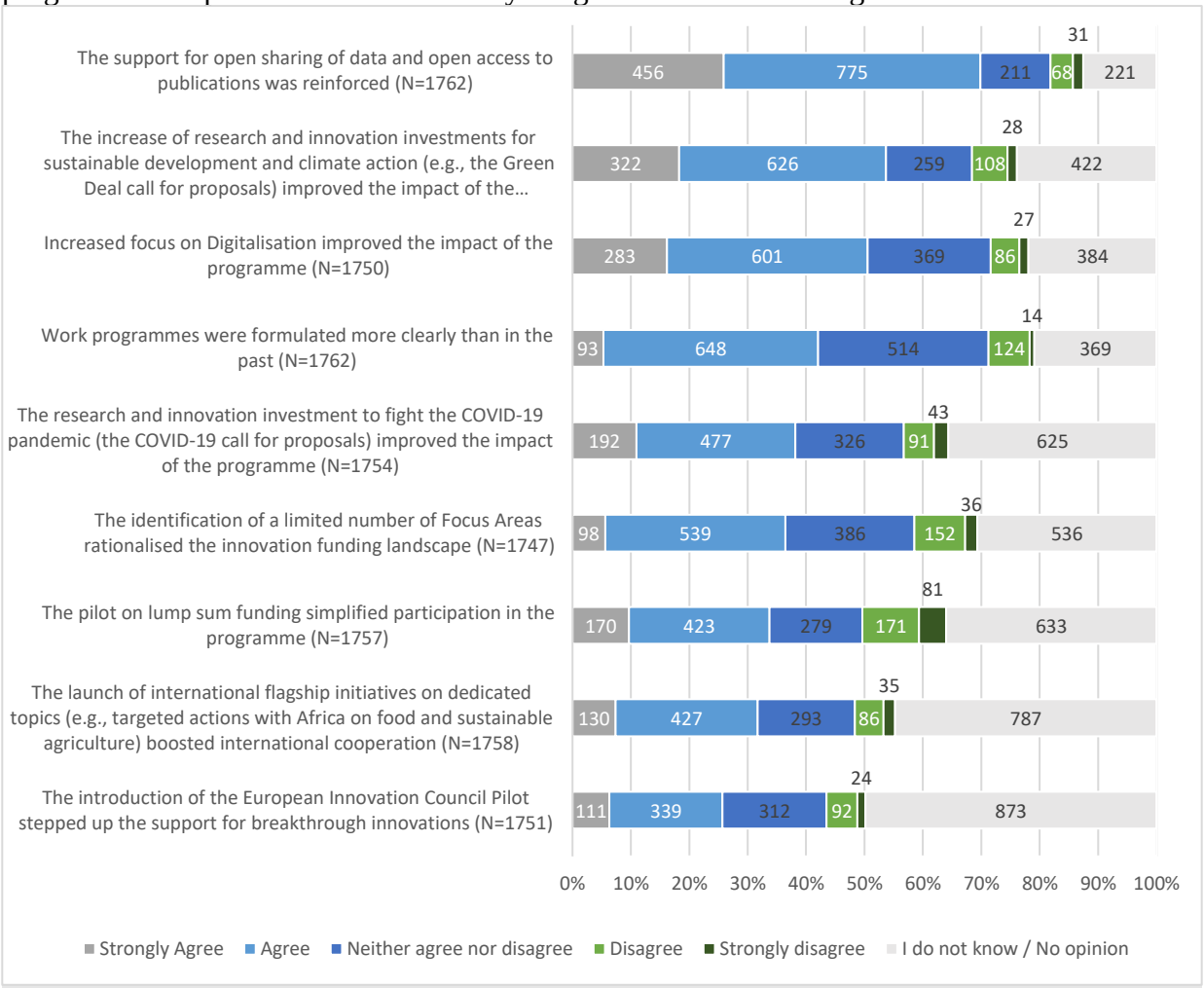
- The resources spent on managing participation largely depended on the type of action (i.e., Research & Innovation Action or Coordination and Support Action), the role of the respondent in the project (i.e., coordinator or partner), and the project size.

Effectiveness of the novelties introduced for the period 2018 – 2020

The consultation results show varying degrees of familiarity with the novelties introduced by the programme. 70% (1 231) of the respondents agreed or strongly agreed that reinforcing the 'support for open sharing of data and open access to publications' increased the framework programme's impact. Similarly, the majority of respondents see positive impacts from 'increasing the research and innovation investments for sustainable development and climate action' (54%; 948) and from 'increasing the focus on digitalisation' (50%; 884).

On the other hand, more than one-third of the respondents did not express an opinion on novelties such as the introduction of the European Innovation Council (EIC), the launch of international flagship initiatives, the introduction of the lump sum funding and the investments to fight COVID-19. The analysis by type of respondent does not highlight significant differences among the stakeholders' groups as the distribution of responses among the different options is similar.

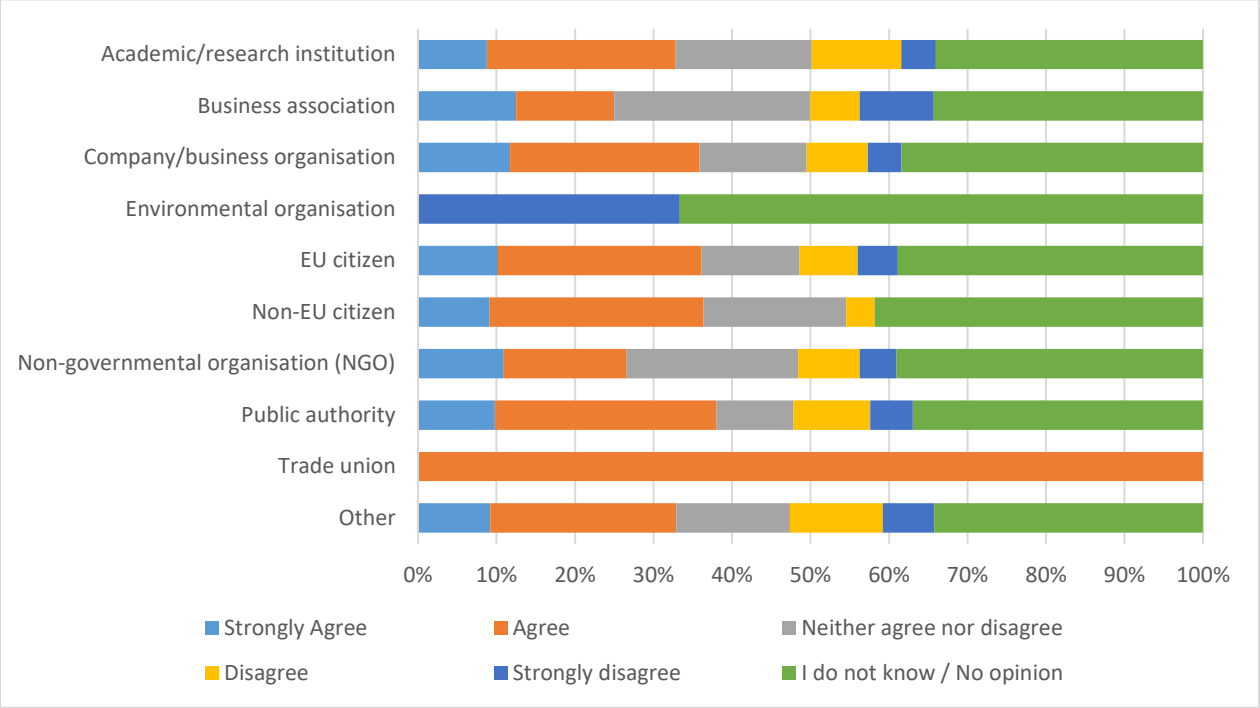
Figure 33. For the period 2018-2020, a number of novelties were introduced to increase the programme's impact. To what extent do you agree with the following statements?



Across all stakeholder groups, the support for the lump sum pilot is held the most with respondents associated with public authorities (38%; 35), which is followed by respondents from companies (36%; 110). Respondents from companies favour the introduction of the lump sum pilot to a greater extent compared to respondents from academia (33%; 299) however not significantly (only 3 percentage

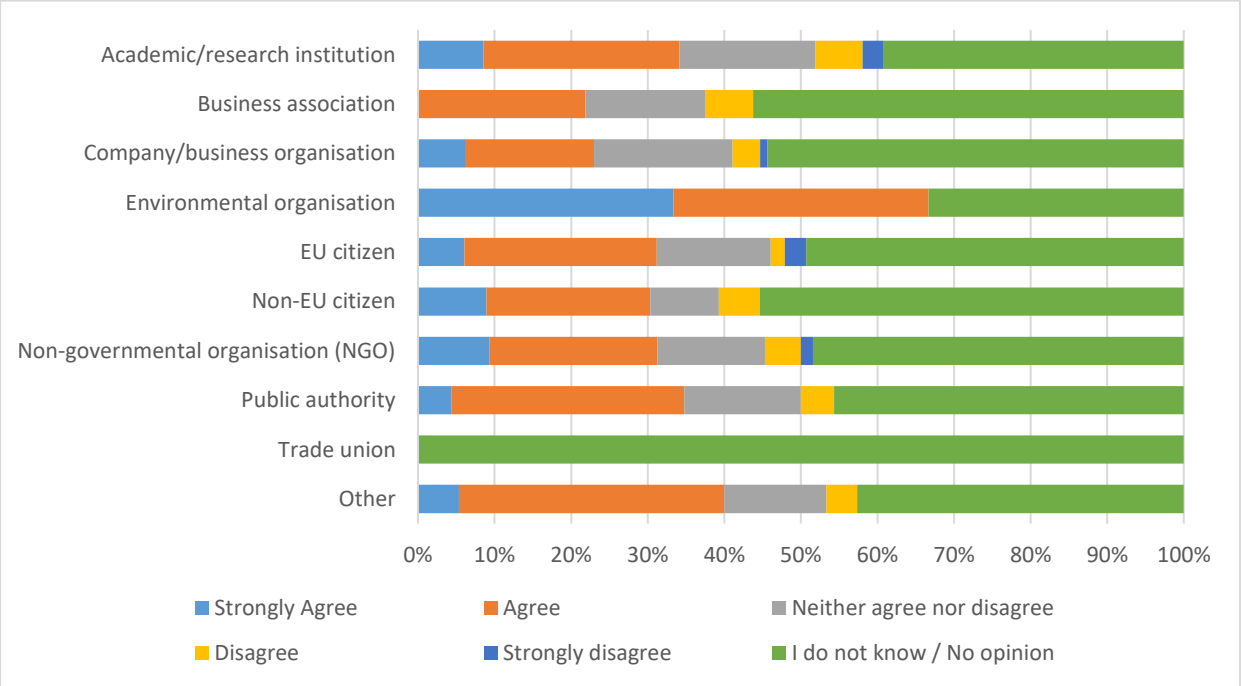
points). Similarly, 16% of respondents from academia (144) are negative about the introduction of the lump sum pilot, compared to 13% of respondents from companies (37) once again showing a difference of 3 percentage points.

Figure 34: Stakeholder breakdown - "The pilot on lump-sum funding simplified participation (N= 1 757)



According to 35% (32) of public authorities, 34% of academia (311), 31% of NGOs (20) and 23% of companies (71) deem that the **introduction of international flagship initiatives have boosted international cooperation**. However, around half of the respondents said that they do not know or do not have an opinion on this matter.

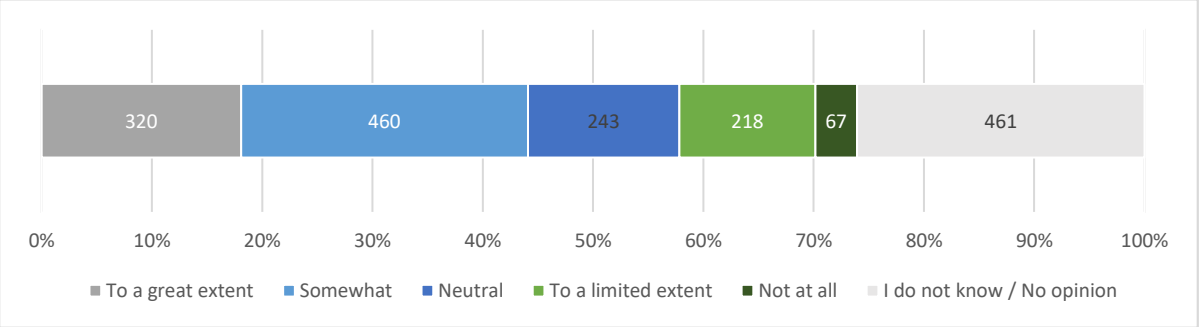
Figure 35: Stakeholder breakdown - launch of flagship initiatives boosted international cooperation (N= 1 758)



Effectiveness of the Horizon 2020 partnerships

44% (780) of respondents stated that the public-public or public-private partnerships were 'more effective than regular collaborative research in achieving impact for science, the economy and/or society'. Only 16% (285) of them selected that partnerships were not more effective, or they were more effective only 'to a limited extent'. However, more than 26% (461) of respondents did not express any opinion.

Figure 36: In your opinion, to what extent have public-private and public-public Partnerships supported by Horizon 2020 been more effective, compared to regular collaborative research in achieving impact for science, the economy and/or society? (N=1 769)

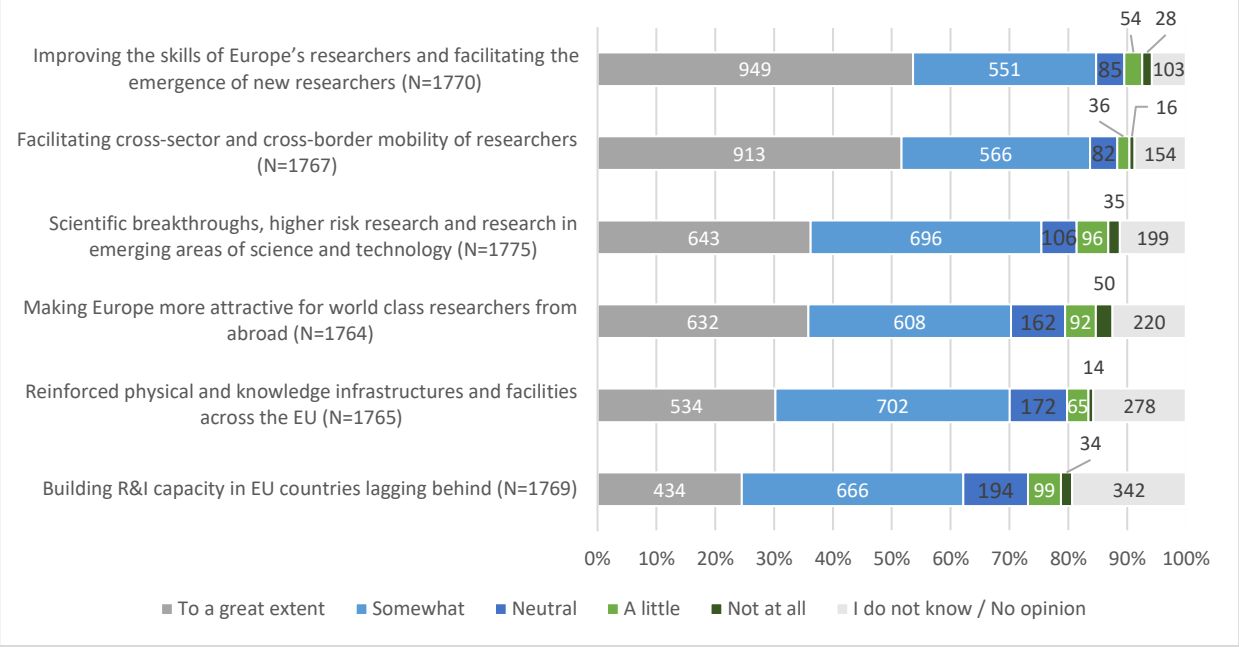


Among the different types of respondents, businesses and business organisations have a more positive opinion than academic / research institutions. 42.2% (386) of academic and research institutions answered 'to a great extent' or 'somewhat' compared to 63.6% (21) of business association respondents and 53.5% (167) of companies and business organisations.

Scientific effects

More than 60% of the respondents agree that Horizon 2020 produced the expected scientific effects listed in the consultation, for instance, by improving the skills of Europe's researchers and by facilitating the emergence of new researchers (85%; 1 500) or by making Europe more attractive for world-class researchers from abroad (70%; 1 240).

Figure 37. In your view, to what extent did Horizon 2020 produce the following scientific effects?



78% (711) of respondents from academic and research institutions, 75% (24) of business associations and 73% (226) of respondents from companies, Horizon 2020 fosters **scientific breakthroughs, higher**

risk research and research in emerging areas of science and technology. This claim was supported by EU citizens (76%; 163) and an even greater share of non-EU citizens (86%; 59).

More respondents agreed or strongly agreed that Horizon 2020 **improved the skills of Europe's researchers and facilitated the emergence of new researchers** (85%; 1 500): 92% of non-EU citizens (54), 88% of respondents from academia (803), 82% of respondents from NGOs (61) and 81% of respondents from business associations (26) supported this claim.

In terms of **facilitating cross-sector and cross-border mobility of researchers**, 88% of respondents from academia (804), 76% of respondents from companies (235) as well as 71% of business associations (22) agreed or strongly agreed that Horizon 2020 had a positive effect. Similarly, 73% of respondents from academia (666), 67% of respondents from business associations (20), as well as 60% of companies (90) deemed that the programme is **making Europe more attractive for world class researchers from abroad.** Still, this claim is only supported by 66% of non-EU citizens (52), contrasting 88% of EU citizens responding (164).

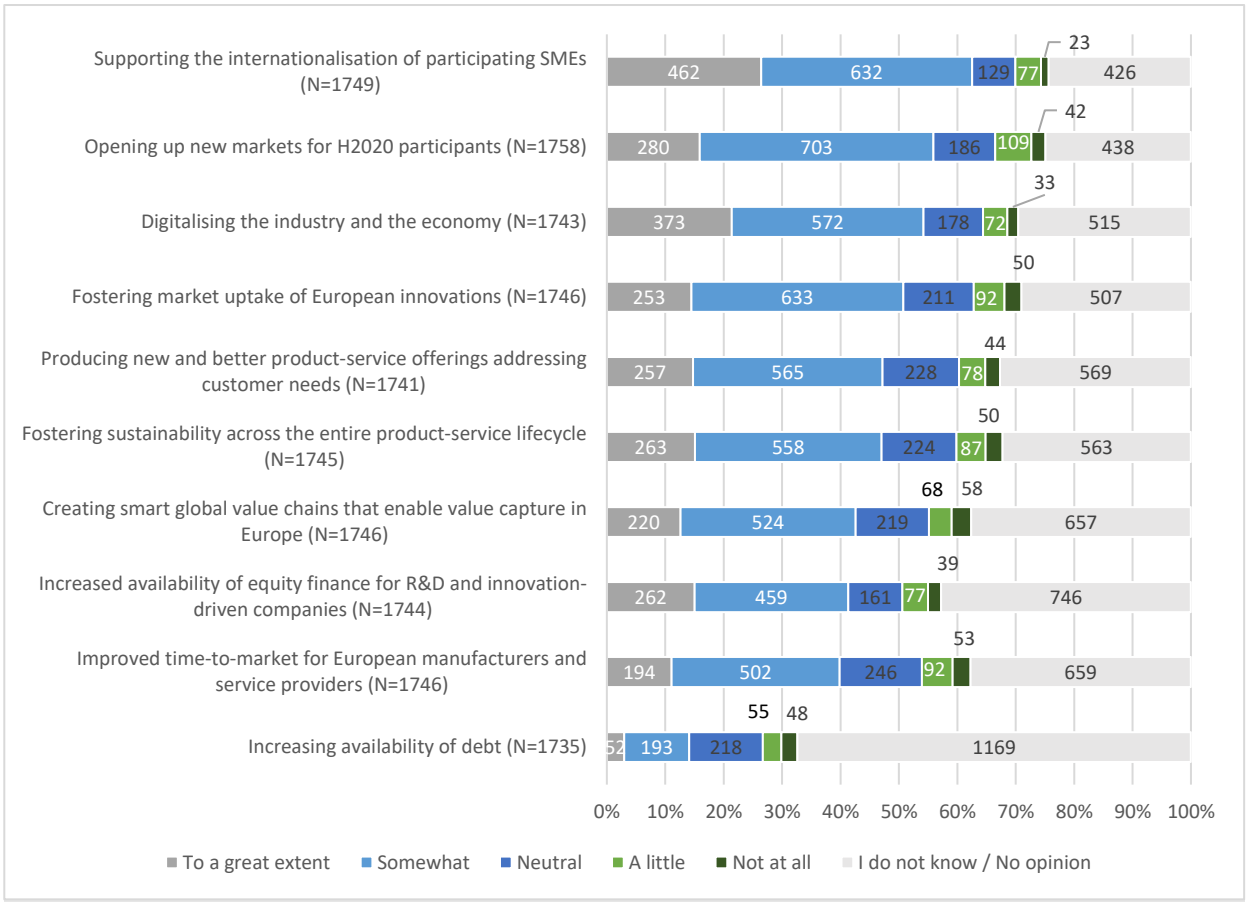
Among academia and research institutions, 30% (913) agreed to a great extent that Horizon 2020 **reinforced physical and knowledge infrastructures and facilities** across the EU which is similar to views of public authorities (32%; 91). Figures were lower for NGOs (28%; 65) and companies (27%; 309).

Only 62% (1 097) of respondents believed that Horizon 2020 **helped building R&I capacity in EU countries lagging behind**: this view was primarily shared by environmental organisations (67%; 2), companies and businesses (64%; 199) and academia / research organisations (62%; 566). The views of business associations were less favourable, only having 55% (17) supporting the claim that the programme helped building R&I capacity in EU countries lagging behind, whereas 23% (199) of respondents replying on behalf of businesses indicated that the effect of Horizon 2020 in this endeavour was neutral. Nevertheless, other stakeholder groups held more favourable views, with less respondents deeming the effect neutral (e.g. academia 11%; 200, companies 10%; 31). Overall, only a small fraction of respondents indicated that it had no effect at all (3%; 8 businesses and companies and 1.5%; 14 of academia).

Economic effects

Around one-third of respondents did not express any opinion on the economic effects produced by Horizon 2020. Nonetheless, most of the respondents stated that the programme fostered market uptake of European innovations (51%; 886), digitalised the industry and the economy (54%; 945), opened up new markets for participants (56%; 983) and supported the internationalisation of SMEs participating in Horizon 2020 (63%; 1 094). As for the other economic effects, the respondents with a positive opinion outnumber those with a negative opinion. Only 518 respondents expressed an opinion on whether Horizon 2020 increased the availability of debt financing.

Figure 38. In your view, to what extent did Horizon 2020 produce the following economic effects?



The following graphs provide a stakeholder breakdown for the top three effects identified by respondents:

Figure 39: Stakeholder breakdown – 'Horizon 2020 supported the internationalisation of participating SMEs' (N= 1 749)

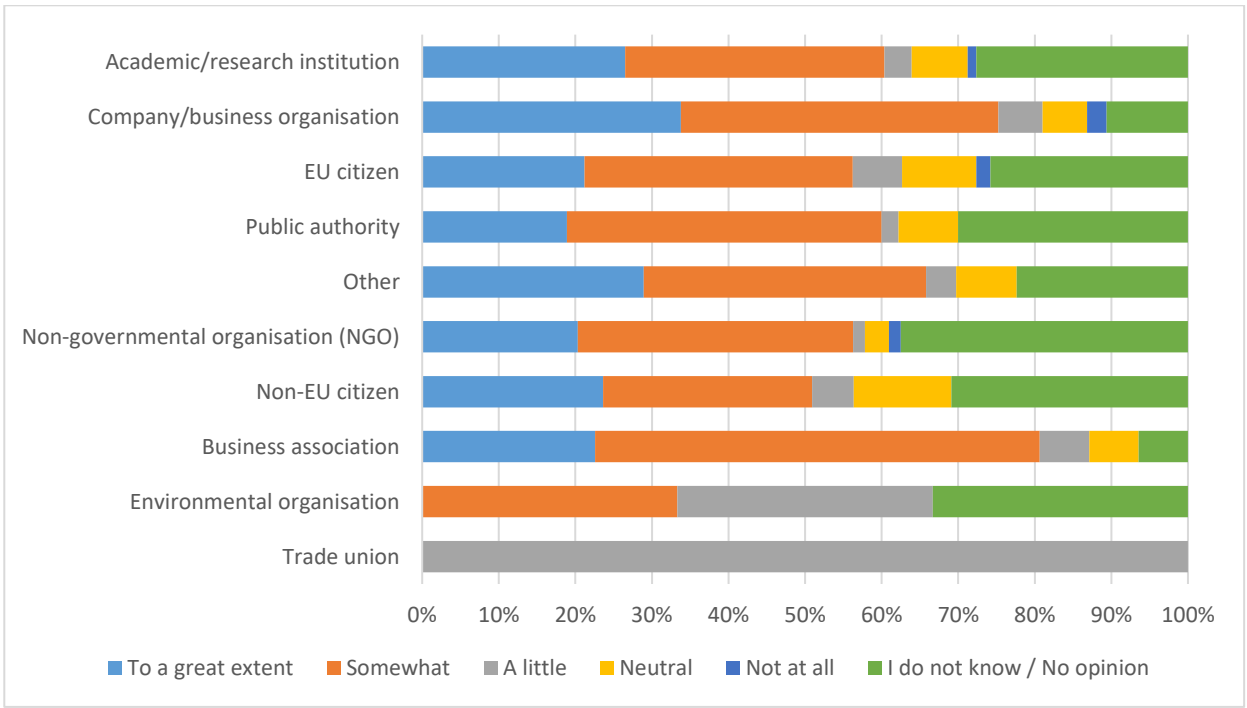


Figure 40: Stakeholder breakdown – 'Horizon 2020 opened up new markets for programme participants' (N = 1 758)

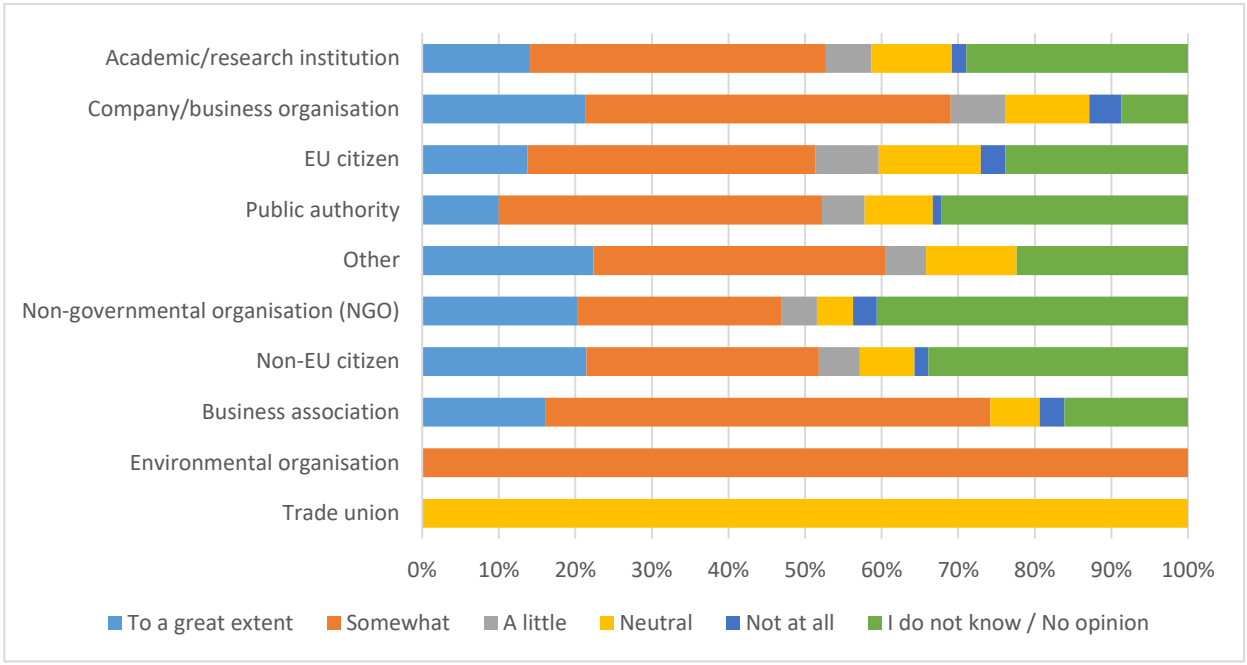
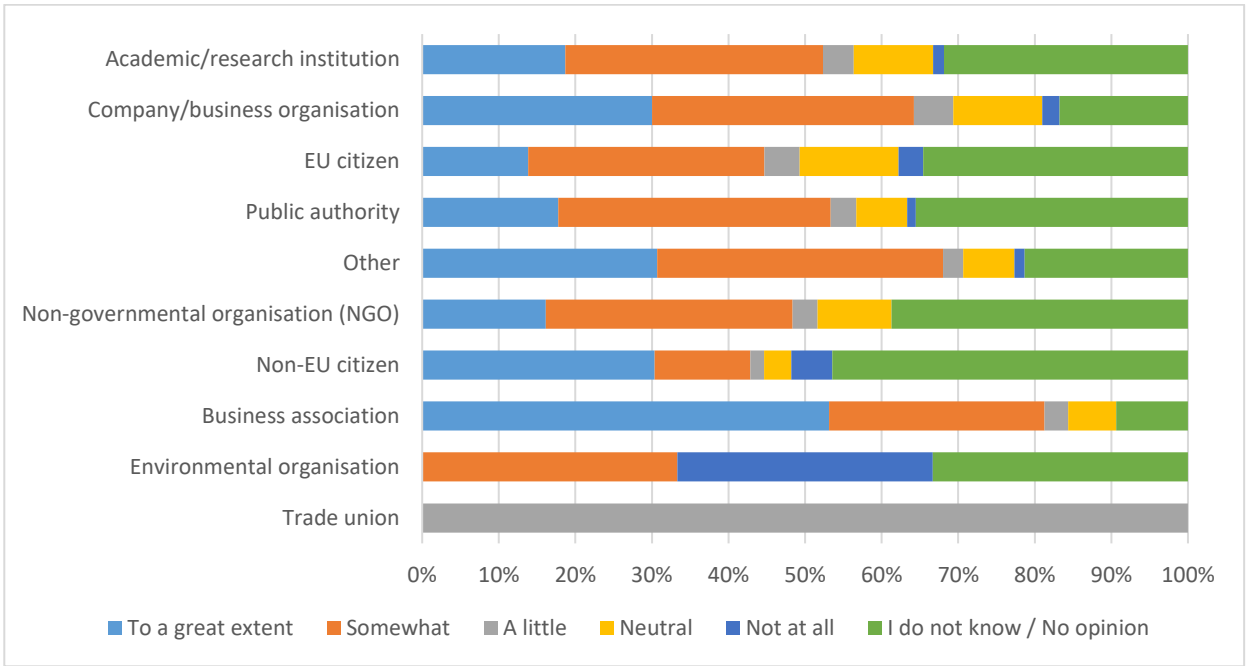


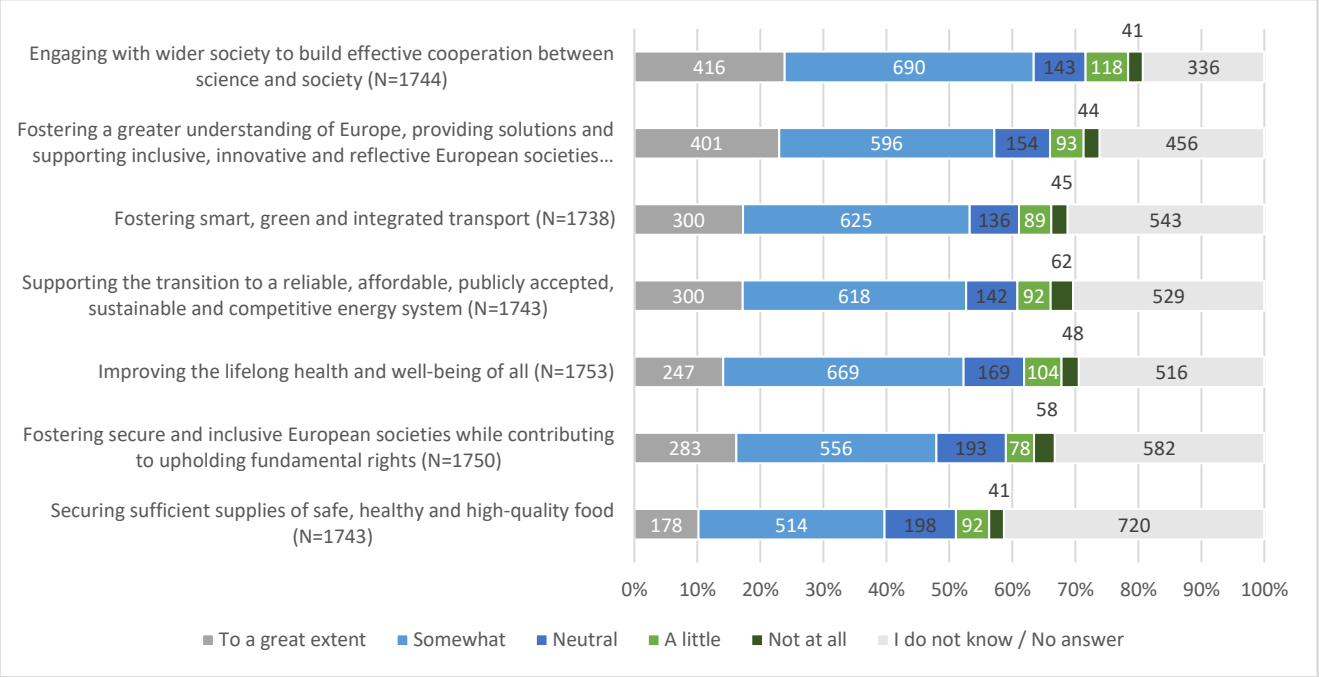
Figure 41: Stakeholder breakdown – 'Horizon 2020 digitalised the industry and the economy' (N = 1 743)



Societal effects

Respondents generally reported that Horizon 2020 produced positive societal effects. These effects included 'improving lifelong health and well-being of all' (52%; 916), 'supporting the transition to a reliable, affordable, publicly accepted, sustainable and competitive energy system' (53%; 918), 'fostering smart, green and integrated transport' (53%; 925), 'fostering a greater understanding of Europe' (57%; 997), and 'engaging with wider society to build effective cooperation between science and society' (63%; 1,106). More than 40% of respondents (720) did not express an opinion on whether Horizon 2020 contributed to 'securing sufficient supplies of safe, healthy and high-quality food'.

Figure 42: In your view, to what extent did Horizon 2020 produce the following societal effects?



66% (1 170) of respondents in the stakeholder consultation conducted for this evaluation agreed or strongly agreed that '**Horizon 2020 supported cooperation between science and society**'. 6% of respondents (99) maintained that the programme did *not* do enough to support said cooperation. Nevertheless, this constitutes only a small fraction of respondents within each stakeholder group. It is important to note that the majority of responses were rather favourable, suggesting an overall positive sentiment towards the support of cooperation between science and society. Among the various stakeholder groups, favourable views were shared the most on behalf of NGOs 71% (47), whereas business associations (59%; 19) were the least favourable compared to other stakeholder groups. Non-EU citizens found that Horizon 2020 supported cooperation between science and society to a greater extent (67%; 39) compared to EU citizens (60%; 129).

The following graphs provide a stakeholder breakdown for the top three effects identified by respondents:

Figure 43: Stakeholder breakdown – 'Horizon 2020 engaged with wider society to build effective cooperation between science and society' (N = 1744)

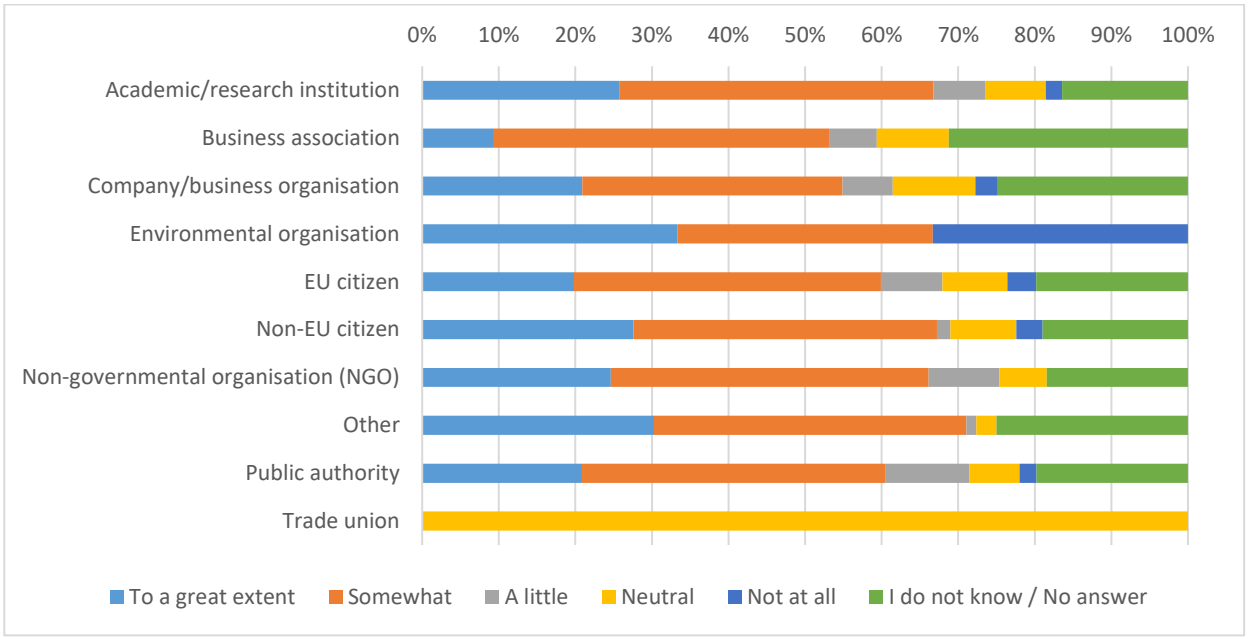


Figure 44: Stakeholder breakdown – 'Horizon 2020 fostered a greater understanding of Europe, providing solutions and supporting inclusive, innovative and reflective societies' (N= 1 744)

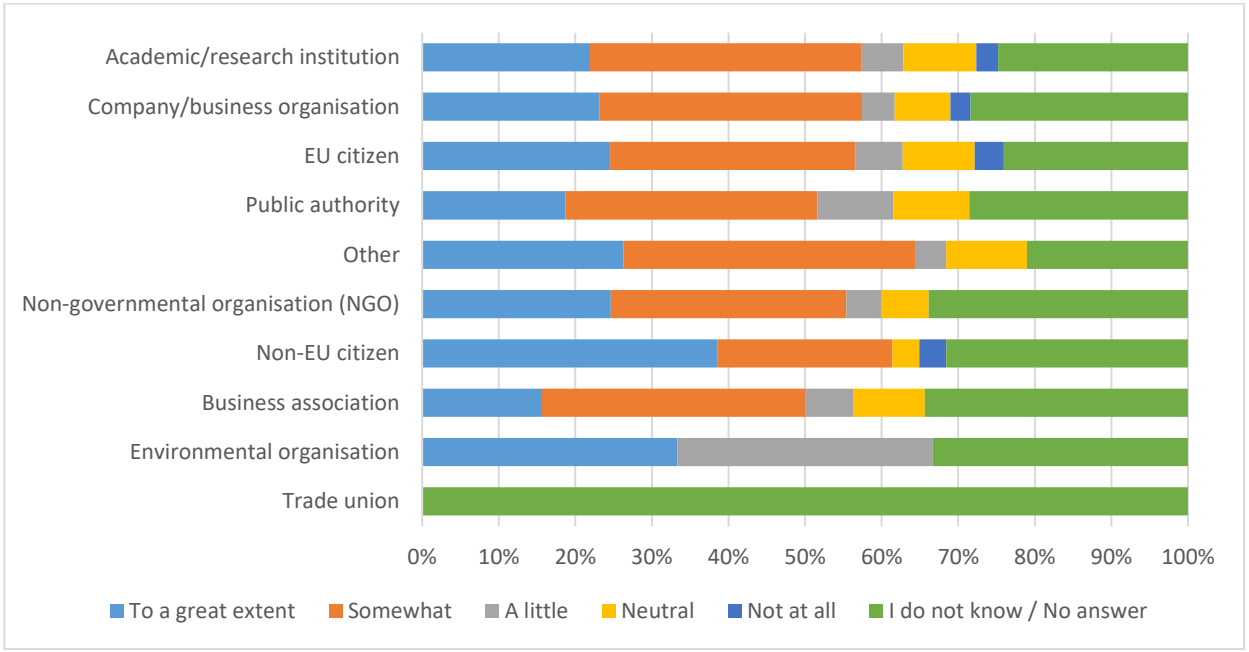
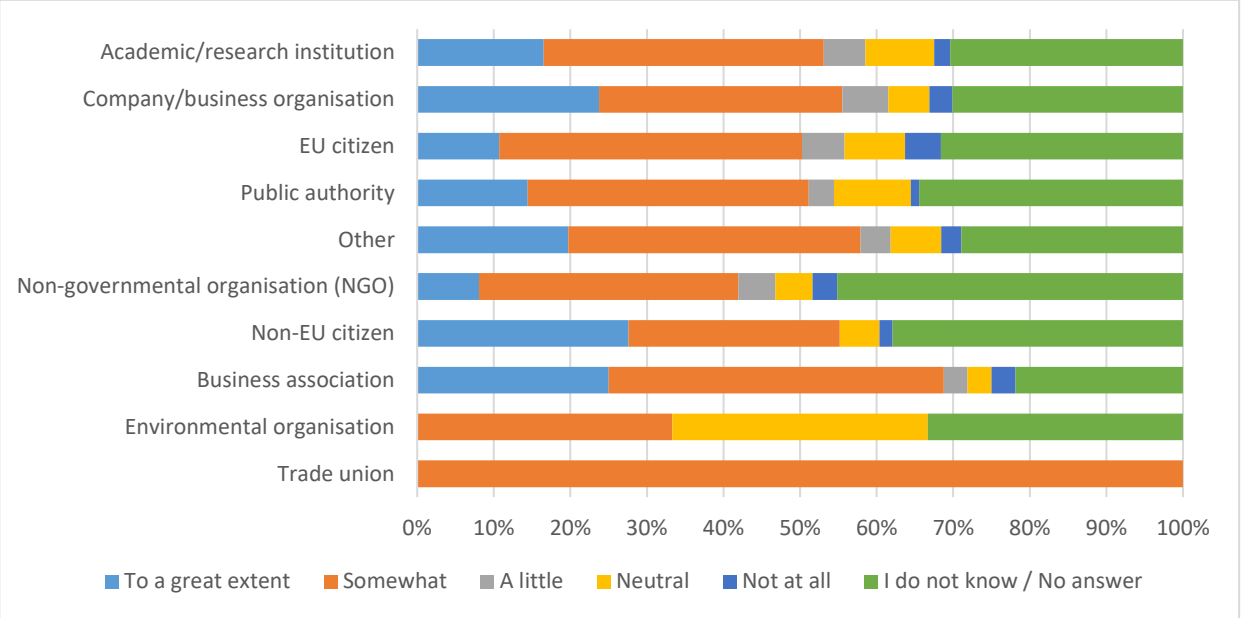


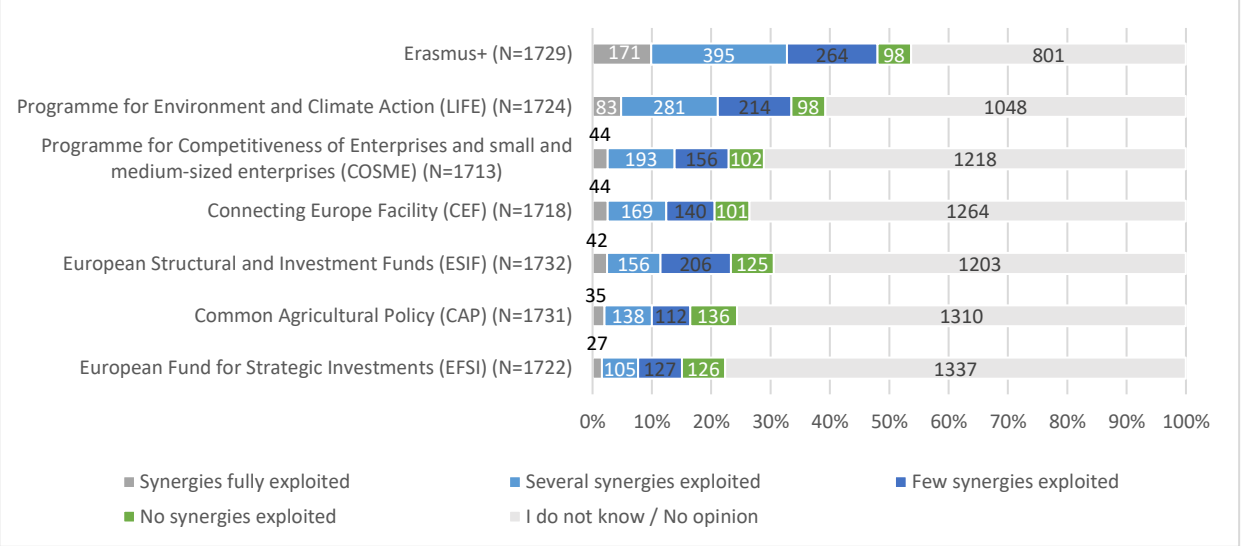
Figure 45: Stakeholder breakdown – 'Horizon 2020 fostered smart, green and integrated transport' (N = 1 738)



Synergies with other EU programmes

54% of respondents expressed an opinion on the synergies between Horizon 2020 and Erasmus+. Between 22% and 39% of all the respondents expressed an opinion on the synergies between Horizon 2020 and other EU programmes. The majority of respondents selected that 'synergies were exploited' or 'fully exploited' with Erasmus+ (61%; 566 out of 928) and the Programme for Environment and Climate Action (LIFE) (54%; 364 out of 676). Conversely, the majority of respondents selected that 'few' or 'no synergies were exploited' with the Programme for Competitiveness of Enterprises and Small and Medium-sized Enterprises, COSME (52%; 258 out of 495), Connecting Europe Facility (CEF) (53%; 241 out of 454), Common Agricultural Policy (CAP) (59%; 248 out of 421), the European Structural and Investment Funds (ESIF) (63%; 331 out of 529)[132], and the European Fund for Strategic Investments (EFSI) (66%; 253 out of 385).

Figure 46: How did the following EU programmes work in synergy (complement and reinforce) Horizon 2020?



[132] Respondents from EU13 countries have a more positive opinion on the synergies with the ESIF compared to respondents from EU15 countries.

As the Erasmus+ programme as well as LIFE stand out positively across all respondents, further analysis revealed that non-EU citizens (48%; 27) and respondents from the field of academia indicated that synergies with Erasmus+ were either fully or partly exploited (36%; 326), whereas the figure is lower among EU citizens (32%; 67), companies (21%; 65) and business associations (16%; 5). This leads to the assumption that the field of academia leaves greater room for synergies. This should not come as a surprise considering that the two programmes in view of academia have a strong link.

In view of LIFE, a similar trend can be seen: 22% of non-EU citizens (12), 21% of EU citizens (43) as well as 21% of respondents associated with academia (191), 18% of respondents associated with a company or business (56) and 13% of respondents associated with business associations (4) indicate that synergies were either fully or partly exploited. At the same time, 20% of respondents from academia (178), 22% of respondents from business associations (7) and 13% of respondents associated with a company or business (41) indicated that either few or no synergies were exploited.

Figure 47: Stakeholder breakdown - Synergies between Horizon 2020 and Erasmus+ (N= 1 729)

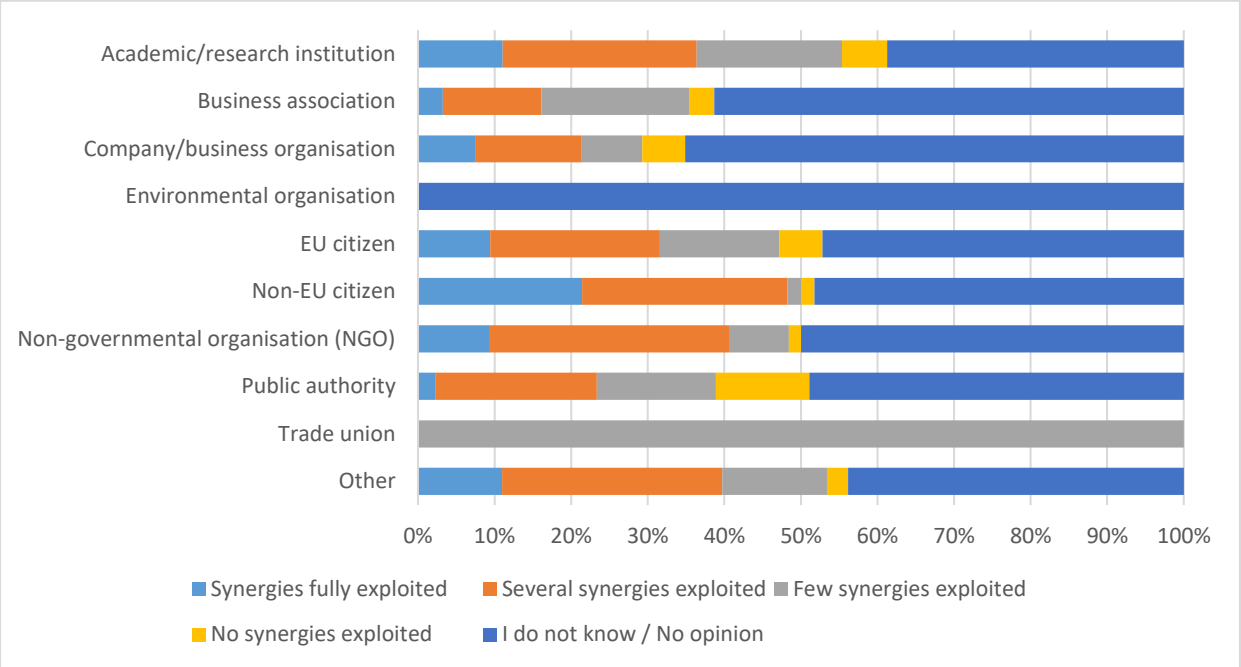
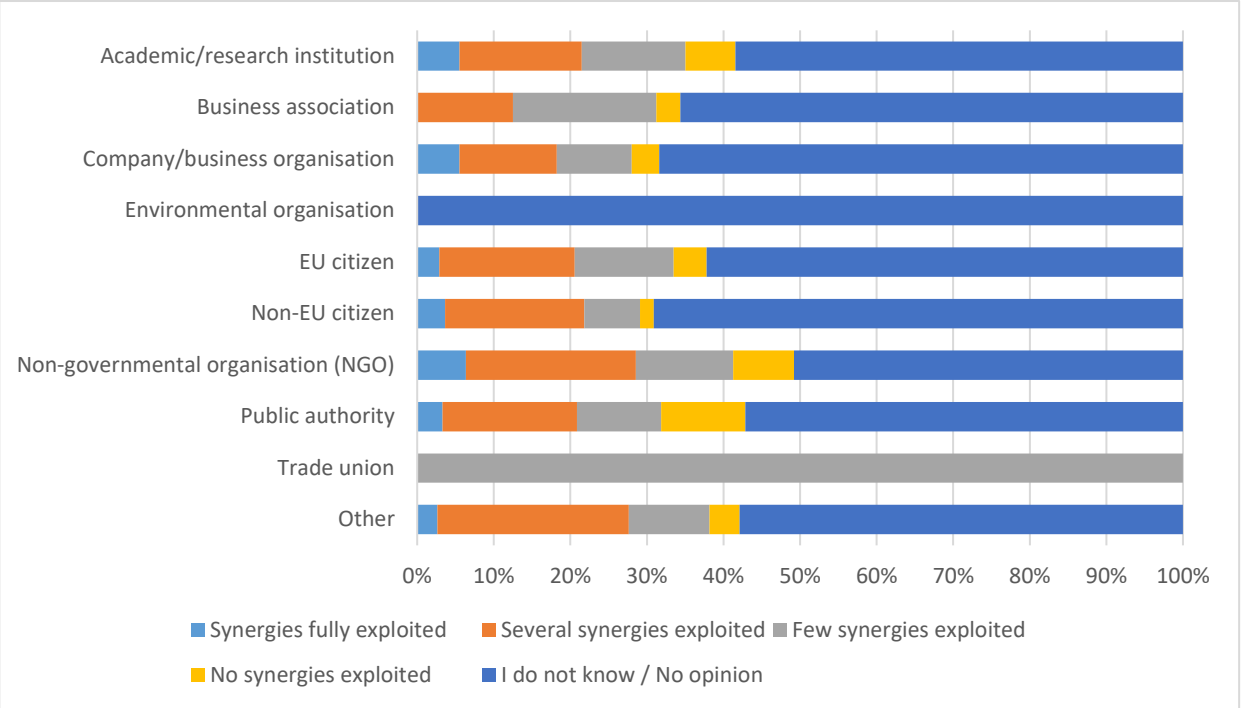


Figure 48: Stakeholder breakdown - Synergies between Horizon 2020 and LIFE (N = 1724)



Exploitation and dissemination of results

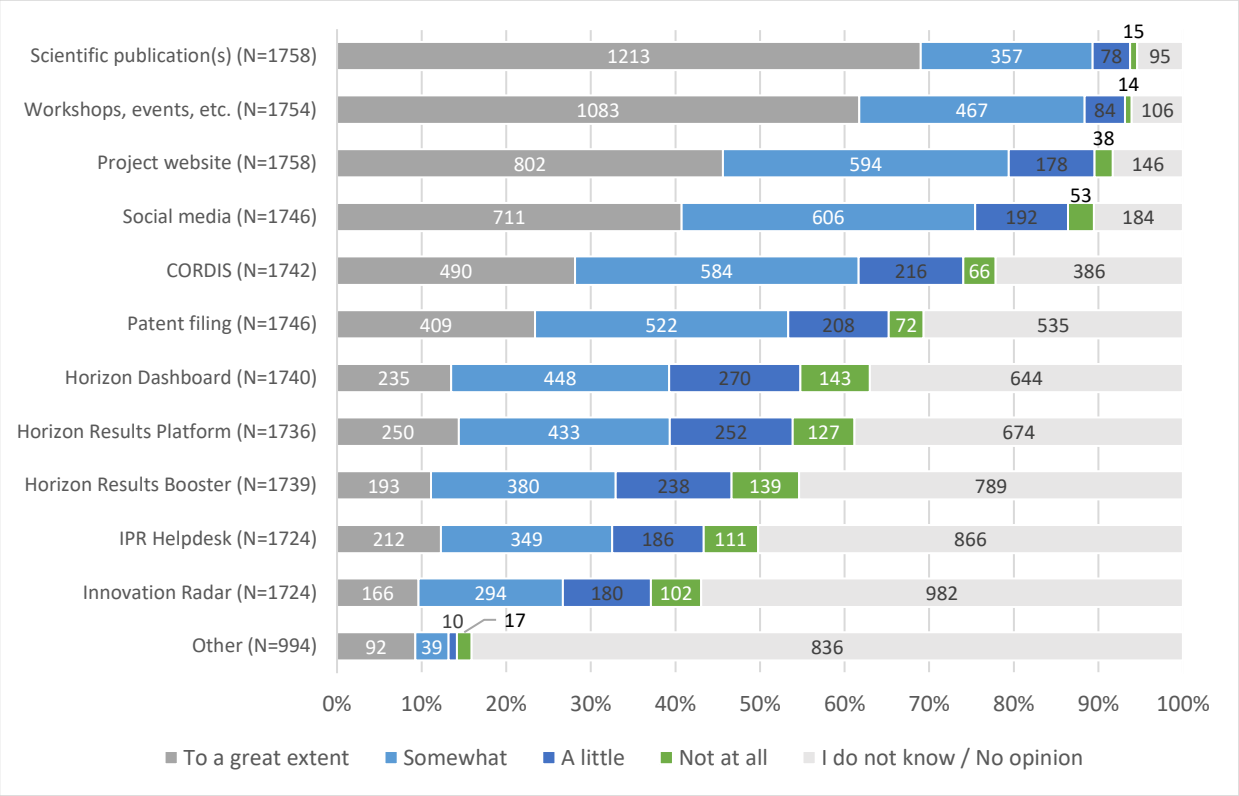
Respondents indicated scientific publication(s), workshops or other events, project website and social media (especially LinkedIn) as the initiatives of Horizon 2020 that mostly helped dissemination, exploitation and access to research and innovation results. In particular, 69% (1 213) and 62% (1 083) of respondents respectively stated that scientific publication(s) and workshops or other events[133] 'helped disseminate, exploit and access research and innovation results' to a great extent.

In the open comments to the question, participants mentioned 'personal contacts' and 'direct networking' as useful instruments to disseminate, exploit and access research and innovation results. Other comments highlighted the beneficial role of creating consortia under Horizon 2020 projects and the multi-actor approach that supports interaction between research providers and users within consortia. According to the comments, this approach helped find European innovation partners with similar long-term strategic goals, which was beneficial for cooperation beyond the duration of the supported project. Traditional media (TV, radio) and non-scientific publications (such as press releases, whitepapers, and books) were mentioned as other initiatives that strongly helped the dissemination, exploitation of R&I results and access to them.

Regarding the helpfulness of EU-wide dissemination and exploitation support services initiated by the Commission, a significant share of respondents did not have an opinion or did not know: over 50% for the Innovation Radar and IPR Helpdesk, 30-40% for the Horizon Dashboard, Horizon Results Platform and Horizon Results Booster, and 22% for CORDIS. For publications, the project website, social media and workshops, this share is 6-11%.

[133] Such as scientific conferences and congresses, events dedicated to sharing results such as the Road Transport Research Days and the Transport Research Arena, specific events organised by national contact points or agencies.

Figure 49: To what extent have the following initiatives helped disseminate, exploit and access research and innovation results?



Overall, this indicates that particularly in view of the **Innovation Radar** and the **IPR Helpdesk**, stakeholders are not sufficiently convinced of these tools' usefulness for dissemination and exploitation. Nevertheless, while EU citizens (15%; 31), non-EU citizens (14%; 8) and respondents from academia (12% 111) favour the IPR Helpdesk over the Innovation Radar (7%; 15, 11%; 6 and 9%; 80 respectively), only 16% of business associations (5) and 12% of companies (36) hold the belief that the IPR Helpdesk fosters dissemination and exploitation of results to a great extent.

Figure 50: Stakeholder breakdown - Extent to which the **IPR Helpdesk** helped to disseminate, exploit and access research and innovation results (N = 1 724)

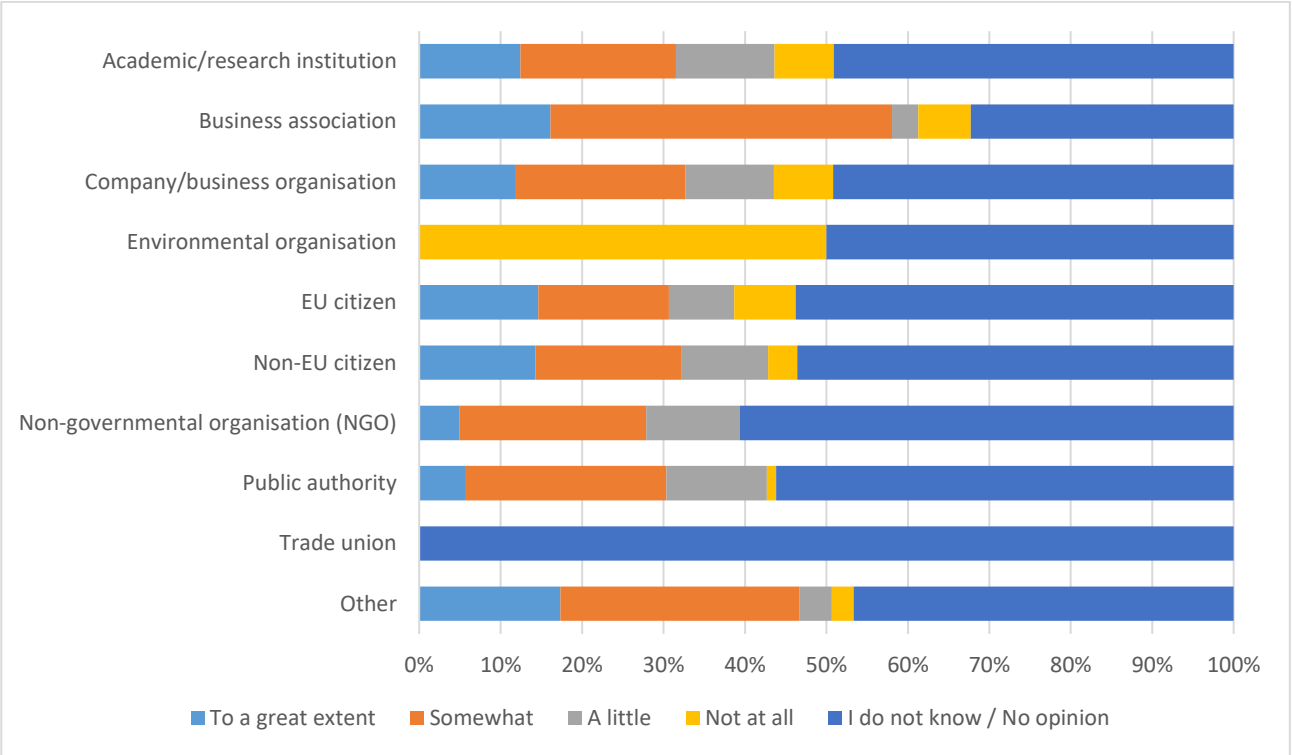
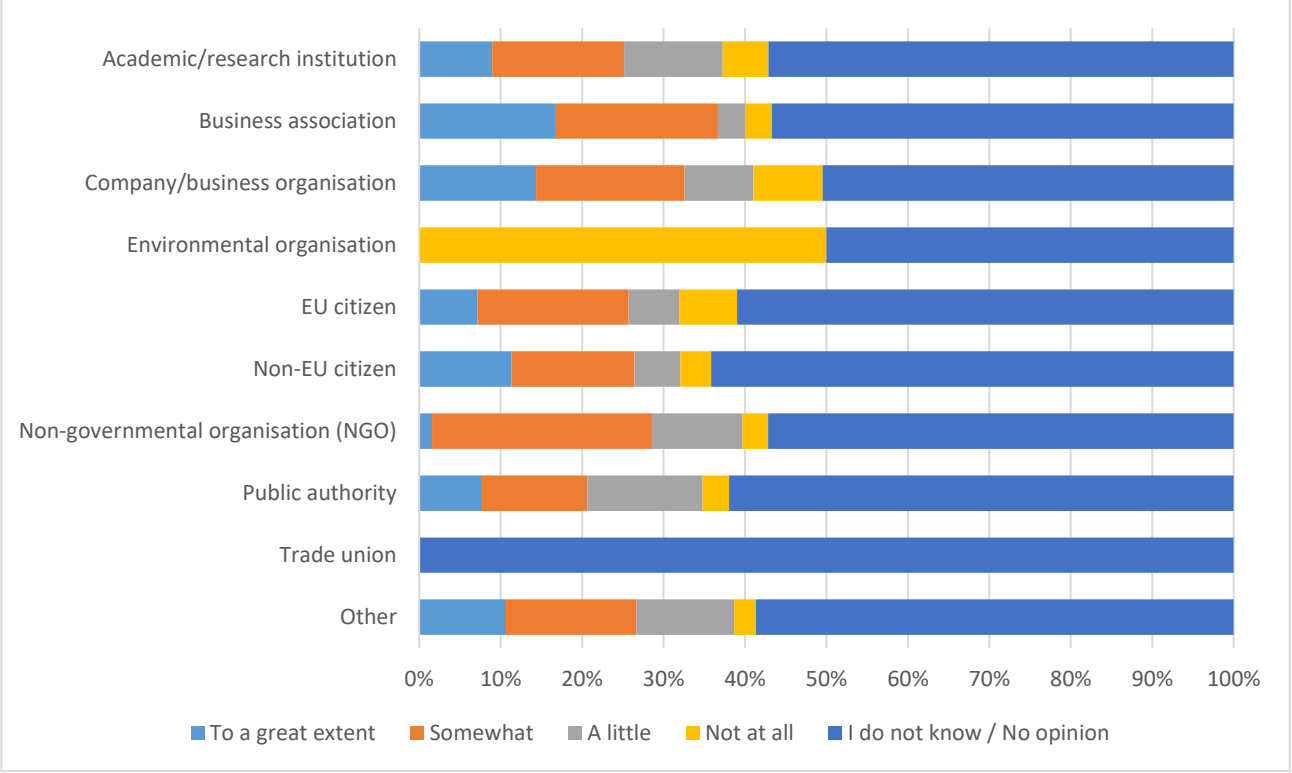
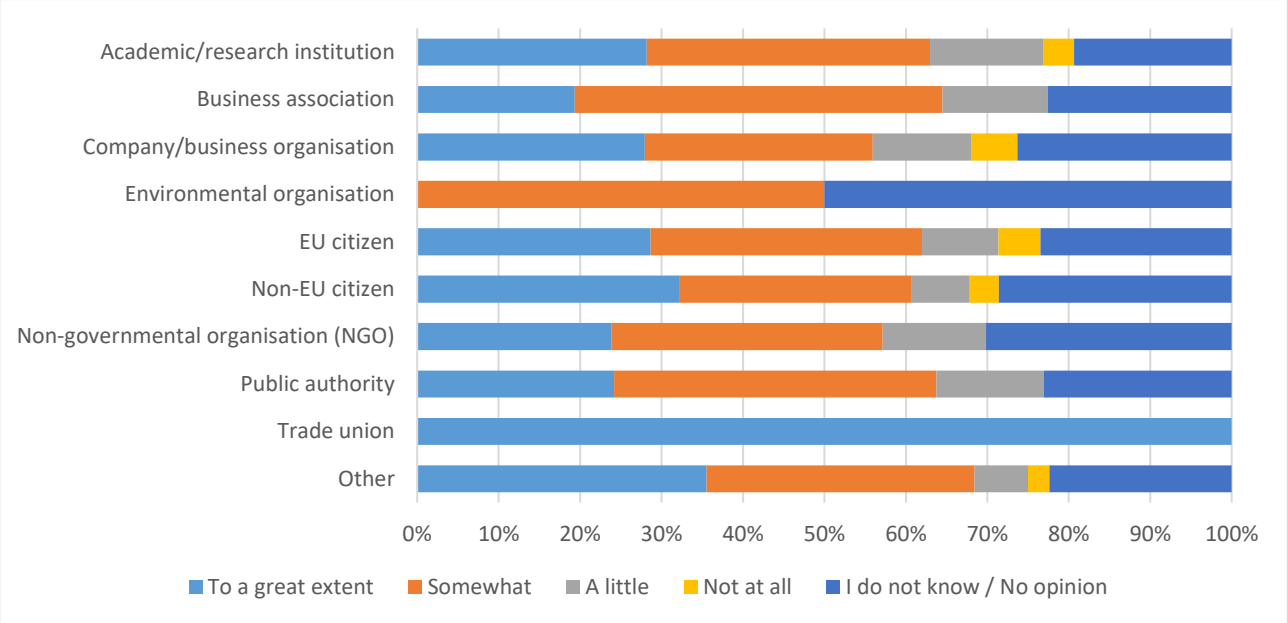


Figure 51: Stakeholder breakdown - Extent to which the **Innovation Radar** helped to disseminate, exploit and access research and innovation results (N = 1 724)



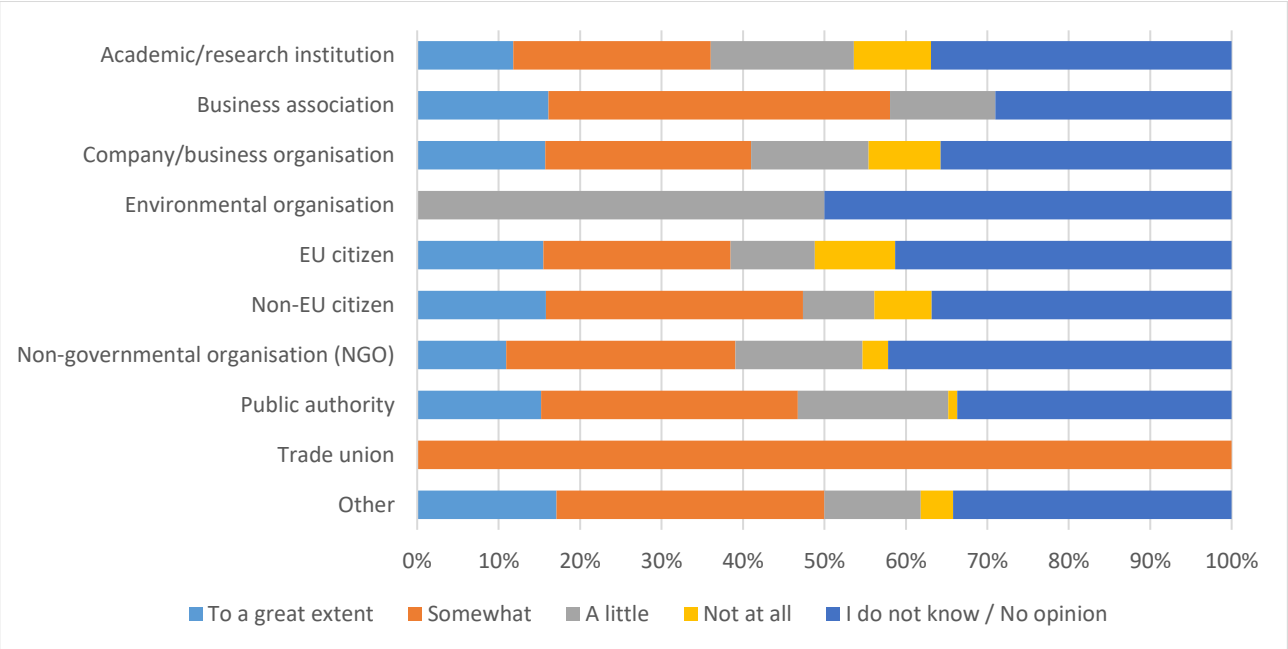
Among all stakeholder categories, **CORDIS** is deemed the most relevant EU-wide exploitation support service: 32% of non-EU citizens (18), 29% of EU citizens (61), 28% (255) of respondents from academia, 28% (85) from companies and 24% (22) from public authorities indicated that CORDIS helped disseminate and exploit results to a great extent.

Figure 52: Stakeholder breakdown - Extent to which **CORDIS** helped to disseminate, exploit and access research and innovation results (N = 1 724)



Following CORDIS, the **Horizon Dashboard** is most used among business associations (16%; 5), companies (16%; 48), non-EU citizens (16%; 9), EU citizens (15%; 33) and public authorities (15%; 14), similar to the **Horizon Results Booster** which was assessed by business associations (16%; 5), NGOs (14%; 9), non-EU citizens (14%; 8), companies (13%; 38) and EU citizens (12%; 25) as helpful to a great extent.

Figure 53: Stakeholder breakdown - Extent to which the **Horizon Dashboard** helped to disseminate, exploit and access research and innovation results (N = 1 740)



Although respondents from research or academia favoured the effectiveness of the Horizon Results Platform over the Horizon Results Booster (14%; 122) by 4 percentage points, which is a similar trend also pronounced in the responses of companies (16%; 48) by 3 percentage points.

Figure 54: Stakeholder breakdown - Extent to which the **Horizon Results Platform** helped to disseminate, exploit and access research and innovation results (N = 1 736)

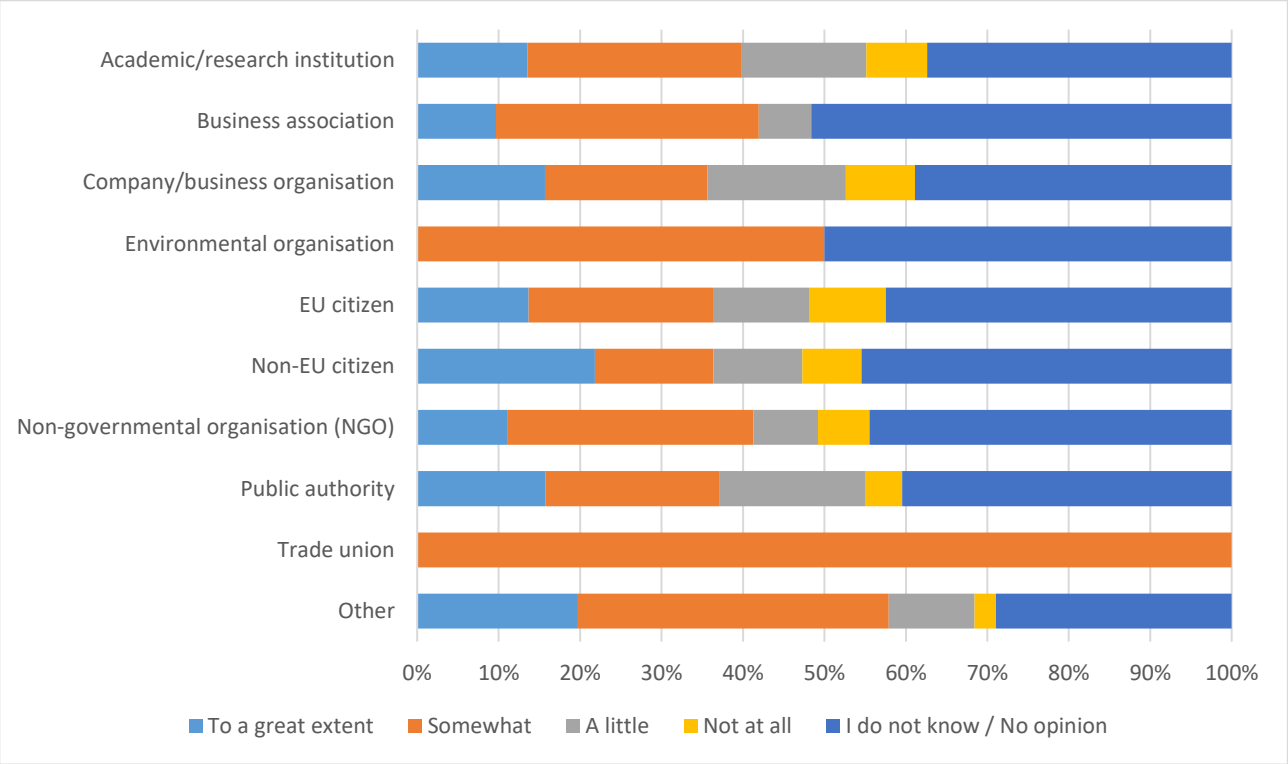
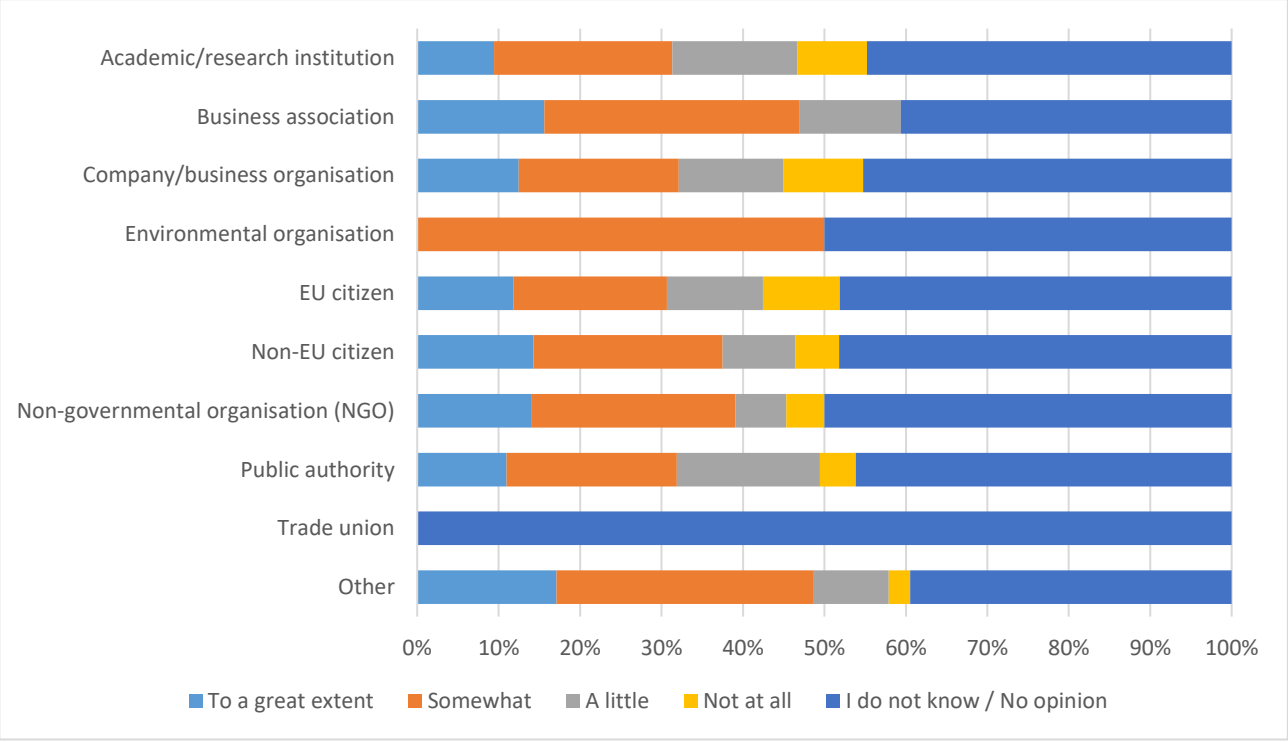


Figure 55: Stakeholder breakdown - Extent to which the **Horizon Results Booster** helped to disseminate, exploit and access research and innovation results (N = 1 739)



Design of Horizon 2020

General comments: Several comments from different stakeholder groups acknowledge that Horizon 2020 successfully contributed to stimulating research and innovation in the EU and provided the framework to enhance collaboration in R&I projects. However, some respondents also raised concerns about the changes to the Framework Programme's budget due to the annual inter-institutional negotiations as well as about the redistribution of the budget among different priorities during the programme's implementation. Another concern regarded the role of Horizon 2020 in facilitating complementarities and synergies among EU, Member States and international initiatives.

Type of funded R&I actions and Technology Readiness Levels (TRL) coverage: Respondents from NGOs, academia and research institutions perceived that Horizon 2020's project portfolio was not balanced in supporting projects at different TRLs, whereas focusing more on projects on technology deployment (TRL 7-9), rather than on projects on observations of basic principles, formulation of technology concepts, and experimental Proof of Concept (POC) (TRL 1-3). According to some respondents, this tendency was linked to the increasingly impact-oriented approach of Horizon 2020 that negatively affected the balance between Research and Innovation Actions (RIA) and Innovation Actions (IA). The Horizon 2020 Green Deal call was mentioned as an example of additional funding targeting projects with a high TRL, rather than basic research – although the issue should be addressed at all levels of research. At the same time, bigger and continuous support was suggested for technology validation and demonstration in relevant environments (TRL 4-6) to tackle the 'innovation valley of death' that sometimes threatens innovation uptake. Finally, one respondent from academia questioned the choice of funding incremental research in addition to breakthrough research through Horizon 2020.

Approach for topics / calls for proposals: Respondents from academia appreciated the bottom-up approach applied by the European Research Council, the Marie Skłodowska-Curie Action and the European Innovation Council Pathfinder. One respondent pointed out that narrow and restrictive calls limit the chances of developing research across different fields of science, reduce research creativity, and lead to limited innovation. Likewise, one SME stakeholder observed that targeted calls of proposals with a very narrow scope, limit the possibility for SMEs to participate as, compared to large companies, it is harder for SMEs to adjust their R&I activities to fit the specific topic. On the other hand, some stakeholders asked for more targeted calls on specific topics (e.g. research on paediatric cancer, Lyme disease).

Some stakeholders appreciated that the same or similar topics are addressed in several calls as it ensured coherence and strengthened the long-term vision of the work programme.

Horizon 2020 Key Performance Indicators: Some stakeholders are not convinced by the KPIs chosen to evaluate the impact of Horizon 2020 projects and consider them too focused on short-term, quantitative outputs (e.g., number of publications, number of patents, number of dissemination activities) and not on the broader societal impact or on the further exploitation of projects' results.

Horizon 2020 Implementation

Publication of the calls for proposal: There were concerns about the timing of the calls for proposals. According to various stakeholders, a large number of calls were announced too close to the deadline, which made it challenging to form a consortium and write a high-quality proposal. It was recommended to extend the call for proposal deadlines and to arrange them at regular intervals to facilitate long-term application planning, and to launch open calls for continuous submission over one year.

Proposal evaluation: Several respondents recommended to improve the scoring bandwidth in order to better reflect differences in the quality of the proposals. With the current system, respondents noted that there is very little variation in the final score between successful and unsuccessful, high-quality proposals. Some respondents expressed their frustration about proposals scoring very high but not being selected for funding. This could be tackled by increasing synergies with other EU-funded programmes (i.e. financing excellent but unsuccessful proposals through other programmes). Another recommendation was to offer lump sums to proposals reaching a certain threshold, instead of asking to improve and submit the proposal under another call. The review process of some programmes (e.g. the ERC) is appreciated more than that of others (e.g. SME instrument) – with respect to the different composition of evaluation panels.

Dissemination of projects' results: The dissemination of the projects' results was pointed out as a major area for improvement - some project beneficiaries required more support from the European Commission services in communicating the projects' results to attract additional funding for further development and, ultimately, for market uptake. Results and data sharing were considered important to advance research, especially in the scientific (e.g. medical) field.

Administrative burden for applicants and participants

Application process: Respondents appreciated the simplifications operated under Horizon 2020 for the preparation and submission of proposals compared to the Seventh Framework Programme (FP7). However, feedback suggests that respecting the page limit of the proposal template created some difficulties, especially when the projects did not focus on a single technology or product but were more complex and encompassed several aspects (e.g., for R&I infrastructures). Applicants found it difficult and time-consuming to describe in a short section the projects' activities and expected outcomes. According to one SME, the application process is particularly demanding for SMEs, which have limited resources for proposal writing and can leverage fewer connections to be part of large consortia. Respondents pointed out that the Funding and Tenders Portal required previous knowledge and experience with EU funding.

Grant agreement and project reporting: The preparation of Grant Agreement amendments was raised as particularly tedious for participants. Some respondents complained about an excessive, time-consuming request for administrative documents in this phase. There are contrasting views on whether the documentation effort for project reporting was reasonable. Finally, in some instances, project officers were reportedly too slow to respond to requests concerning project report amendment and validation, thus generating additional workload for project coordinators.

Audit procedures: Various respondents consider the period to receive feedback from auditors as too long, while the time allowed to comply with their demands was too short. A prompter publication of audit reports would contribute to improving the follow-up and would allow beneficiaries to quickly take auditors' comments into consideration. According to some stakeholders, financial reporting requirements were too complex. Overlaps between the different types of audits under Horizon 2020 were reported, pointing to a lack of coordination between the Commission and the contracted audit firms. According to one contribution, the rules and guidelines for Horizon 2020 financial reporting were interpreted in different ways by the auditing institutions, leading to inconsistencies and duplications. More consistency and better coordination between the different types of audits and the institutions involved (the European Commission, the European Court of Auditors, the European Anti-Fraud Office and external audit firms) could have avoided overlaps.

Widening participation

Access and participation from associated and non-associated third countries: It was recommended to increase access and participation from associated and non-associated third countries. This would lead to a wider dissemination of Horizon 2020 project results in these countries.

International collaboration: One respondent expressed disappointment about the lower level of support for international collaboration under Horizon 2020, in particular for Low and Medium Income Countries (LMICs), where funding decreased compared to the FP7 programming period. Participants perceived Horizon 2020 as primarily focused on strengthening the EU's competitiveness rather than tackling global challenges through international cooperation.

ANNEX VI: ADDITIONAL DATA ON HORIZON 2020 STATE OF PLAY

Applications to the programme

(Source: CORDA data – cut-off date: 1 January 2023)

Over **1 million applications** were submitted through over **285 000 eligible proposals**. Organisations located in EU28 Member States account for 88% of all applications, followed by associated countries (8.3%) and non-associated third countries (3.7%).

More detail is available on the tables that follow, on applications and success rates by country by organisation type and by pillar.

Table 18: Applications and success rates by type of organisation

Type of Organisation	Applications in eligible proposals	% of all applications	Applications in retained Proposals	Success rate of application	EU contribution requested in retained proposals (in million EUR)	%
Higher Education Institutions (HES)	357 364	35.6%	50 330	14.1%	24 950	38.6%
Research Organisations (REC)	171 199	17.0%	31 987	18.7%	16 405	25.4%
Private for-profit entities (PRC)	404 260	40.2%	55 684	13.8%	19 118	29.5%
Public bodies (PUB)	33 232	3.3%	8 234	24.8%	2 222	3.4%
Other (OTH)	38 544	3.8%	7 392	19.2%	2 007	3.1%
Total	**1 004 599**	**100%**	**153 627**	**15.3%**	**64 702**	**100%**

Table 19: Applications by country and type of participating organisation in Horizon 2020 *(Source: CORDA data – cut-off date: 1 January 2023)*

EU-28 Member State	Country code	Country group	Horizon 2020 applications in eligible proposals over 2014-2020	Excellent Science	Industrial Leadership	Societal challenges	Spreading excellence and widening participation	Other	Excellent Science	Industrial Leadership	Societal challenges	Spreading excellence and widening participation	Other	Excellent Science	Industrial Leadership	Societal challenges	Spreading excellence and widening participation	Other
				Number of applications					% of applications of the country by pillar					% of all applications per pillar				
Austria	AT	EU-15	25,663	8,577	5,770	9,795	300	1,221	33%	22%	38%	1%	5%	2%	3%	3%	3%	3%
Belgium	BE	EU-15	40,307	13,760	7,459	17,001	306	1,781	34%	19%	42%	1%	4%	4%	3%	5%	3%	4%
Bulgaria	BG	EU-13	6,695	963	1,644	3,452	166	470	14%	25%	52%	2%	7%	0%	1%	1%	2%	1%
Cyprus	CY	EU-13	6,654	1,474	1,432	3,020	322	406	22%	22%	45%	5%	6%	0%	1%	1%	3%	1%
Czechia	CZ	EU-13	10,441	3,515	2,399	3,588	302	637	34%	23%	34%	3%	6%	1%	1%	1%	3%	2%
Germany	DE	EU-15	108,127	44,214	24,892	33,683	1,214	4,124	41%	23%	31%	1%	4%	12%	11%	9%	12%	10%
Denmark	DK	EU-15	23,934	10,912	4,064	7,848	198	912	46%	17%	33%	1%	4%	3%	2%	2%	2%	2%
Estonia	EE	EU-13	5,754	1,192	1,418	2,636	198	310	21%	25%	46%	3%	5%	0%	1%	1%	2%	1%
Greece	EL	EU-15	34,570	7,037	9,392	16,259	207	1,675	20%	27%	47%	1%	5%	2%	4%	5%	2%	4%
Spain	ES	EU-15	110,661	34,922	28,703	41,953	496	4,587	32%	26%	38%	0%	4%	9%	13%	12%	5%	11%
Finland	FI	EU-15	22,055	7,039	6,118	7,901	200	797	32%	28%	36%	1%	4%	2%	3%	2%	2%	2%
France	FR	EU-15	77,950	34,598	16,716	23,500	527	2,609	44%	21%	30%	1%	3%	9%	8%	7%	5%	6%
Croatia	HR	EU-13	4,848	1,084	781	2,523	196	264	22%	16%	52%	4%	5%	0%	0%	1%	2%	1%
Hungary	HU	EU-13	10,580	2,620	2,571	4,643	154	592	25%	24%	44%	1%	6%	1%	1%	1%	1%	1%
Ireland	IE	EU-15	17,906	6,396	4,364	6,125	134	887	36%	24%	34%	1%	5%	2%	2%	2%	1%	2%
Italy	IT	EU-15	109,623	34,594	27,267	42,711	783	4,268	32%	25%	39%	1%	4%	9%	12%	12%	8%	11%
Lithuania	LT	EU-13	4,161	923	899	1,819	149	371	22%	22%	44%	4%	9%	0%	0%	1%	1%	1%
Luxembourg	LU	EU-15	3,271	797	1,011	1,287	47	129	24%	31%	39%	1%	4%	0%	0%	0%	0%	0%
Latvia	LV	EU-13	3,480	707	874	1,573	129	197	20%	25%	45%	4%	6%	0%	0%	0%	1%	0%
Malta	MT	EU-13	1,626	332	275	838	65	116	20%	17%	52%	4%	7%	0%	0%	0%	1%	0%
Netherlands	NL	EU-15	55,954	24,054	9,719	19,595	457	2,129	43%	17%	35%	1%	4%	6%	4%	5%	4%	5%
Poland	PL	EU-13	18,251	5,203	4,259	7,531	412	846	29%	23%	41%	2%	5%	1%	2%	2%	4%	2%
Portugal	PT	EU-15	25,382	8,279	5,691	9,804	561	1,047	33%	22%	39%	2%	4%	2%	3%	3%	5%	3%
Romania	RO	EU-13	10,640	1,852	2,422	5,389	311	666	17%	23%	51%	3%	6%	0%	1%	2%	3%	2%
Sweden	SE	EU-15	29,542	12,169	6,291	9,737	325	1,020	41%	21%	33%	1%	3%	3%	3%	3%	3%	3%
Slovenia	SI	EU-13	10,458	2,513	2,596	4,485	228	636	24%	25%	43%	2%	6%	1%	1%	1%	2%	2%
Slovakia	SK	EU-13	4,459	930	1,094	1,966	175	294	21%	25%	44%	4%	7%	0%	0%	1%	2%	1%
United Kingdom	UK	EU-15	100,607	53,560	16,175	27,198	684	2,990	53%	16%	27%	1%	3%	14%	7%	8%	7%	7%
Total EU-28			883,599	324,216	196,296	317,860	9,246	35,981	37%	22%	36%	1%	4%	86%	90%	88%	89%	89%
Total EU-13			*98,047*	*23,308*	*22,664*	*43,463*	*2,807*	*5,805*	24%	23%	44%	3%	6%	*6%*	*10%*	*12%*	*27%*	*14%*
Total EU-15			*785,552*	*300,908*	*173,632*	*274,397*	*6,439*	*30,176*	38%	22%	35%	1%	4%	*80%*	*79%*	*76%*	*62%*	*75%*
Associated countries			83,377	30,948	19,917	27,892	1,048	3,572	37%	24%	33%	1%	4%	8%	9%	8%	10%	9%
Thrid countries			37,623	20,774	2,592	13,474	48	735	55%	7%	36%	0%	2%	6%	1%	4%	0%	2%
Total Horizon 2020			**1,004,599**	**375,938**	**218,805**	**359,226**	**10,342**	**40,288**	**37%**	**22%**	**36%**	**1%**	**4%**	**100%**	**100%**	**100%**	**100%**	**100%**

Table 20: Applications by country and type of participating organisation in Horizon 2020 (*(Source: CORDA data – cut-off date: 1 January 2023)*

EU-28 Member State	Country code	Country group	Horizon 2020 applications in eligible proposals over 2014-2020	HES	PRC	PUB	REC	OTH	HES	PRC	PUB	REC	OTH	HES	PRC	PUB	REC	OTH
				Number of applications					% of all applications per country					% of all applications per organisation type				
Austria	AT	EU-15	25,663	8,686	10,000	513	5,348	1,116	34%	39%	2%	21%	4%	2%	2%	2%	3%	3%
Belgium	BE	EU-15	40,307	12,417	13,800	915	6,554	6,621	31%	34%	2%	16%	16%	3%	3%	3%	4%	17%
Bulgaria	BG	EU-13	6,695	1,077	3,239	416	1,278	685	16%	48%	6%	19%	10%	0%	1%	1%	1%	2%
Cyprus	CY	EU-13	6,654	2,153	3,474	364	317	346	32%	52%	5%	5%	5%	1%	1%	1%	0%	1%
Czechia	CZ	EU-13	10,441	4,101	3,940	290	1,656	454	39%	38%	3%	16%	4%	1%	1%	1%	1%	1%
Germany	DE	EU-15	108,127	36,497	42,313	1,864	24,553	2,900	34%	39%	2%	23%	3%	10%	10%	6%	14%	8%
Denmark	DK	EU-15	23,934	11,932	8,777	1,131	1,477	617	50%	37%	5%	6%	3%	3%	2%	3%	1%	2%
Estonia	EE	EU-13	5,754	2,032	2,665	299	332	426	35%	46%	5%	6%	7%	1%	1%	1%	0%	1%
Greece	EL	EU-15	34,570	9,473	13,676	1,262	9,012	1,147	27%	40%	4%	26%	3%	3%	3%	4%	5%	3%
Spain	ES	EU-15	110,661	26,164	47,704	4,932	27,929	3,932	24%	43%	4%	25%	4%	7%	12%	15%	16%	10%
Finland	FI	EU-15	22,055	8,940	8,442	600	3,534	539	41%	38%	3%	16%	2%	3%	2%	2%	2%	1%
France	FR	EU-15	77,950	16,468	32,738	1,816	23,822	3,106	21%	42%	2%	31%	4%	5%	8%	5%	14%	8%
Croatia	HR	EU-13	4,848	1,571	1,811	432	825	209	32%	37%	9%	17%	4%	0%	0%	1%	0%	1%
Hungary	HU	EU-13	10,580	2,525	5,679	497	1,447	432	24%	54%	5%	14%	4%	1%	1%	1%	1%	1%
Ireland	IE	EU-15	17,906	8,362	7,900	525	591	528	47%	44%	3%	3%	3%	2%	2%	2%	0%	1%
Italy	IT	EU-15	109,623	34,126	50,045	3,547	18,381	3,524	31%	46%	3%	17%	3%	10%	12%	11%	11%	9%
Lithuania	LT	EU-13	4,161	1,349	1,671	382	518	241	32%	40%	9%	12%	6%	0%	0%	1%	0%	1%
Luxembourg	LU	EU-15	3,271	641	1,838	82	535	175	20%	56%	3%	16%	5%	0%	0%	0%	0%	0%
Latvia	LV	EU-13	3,480	984	1,476	295	502	223	28%	42%	8%	14%	6%	0%	0%	1%	0%	1%
Malta	MT	EU-13	1,626	589	764	149	72	52	36%	47%	9%	4%	3%	0%	0%	0%	0%	0%
Netherlands	NL	EU-15	55,954	23,274	22,296	1,350	6,891	2,143	42%	40%	2%	12%	4%	7%	6%	4%	4%	6%
Poland	PL	EU-13	18,251	6,067	7,472	774	3,252	686	33%	41%	4%	18%	4%	2%	2%	2%	2%	2%
Portugal	PT	EU-15	25,382	6,631	9,898	1,248	6,477	1,128	26%	39%	5%	26%	4%	2%	2%	4%	4%	3%
Romania	RO	EU-13	10,640	2,713	4,626	935	1,627	739	25%	43%	9%	15%	7%	1%	1%	3%	1%	2%
Sweden	SE	EU-15	29,542	14,606	11,177	1,181	2,040	538	49%	38%	4%	7%	2%	4%	3%	4%	1%	1%
Slovenia	SI	EU-13	10,458	2,308	4,674	546	2,452	478	22%	45%	5%	23%	5%	1%	1%	2%	1%	1%
Slovakia	SK	EU-13	4,459	1,338	2,135	240	489	257	30%	48%	5%	11%	6%	0%	1%	1%	0%	1%
United Kingdom	UK	EU-15	100,607	58,910	32,045	2,246	5,196	2,210	59%	32%	2%	5%	2%	16%	8%	7%	3%	6%
Total EU-28			**883,599**	**305,934**	**356,275**	**28,831**	**157,107**	**35,452**	**34.6%**	**40.3%**	**3.3%**	**17.8%**	**4.0%**	**86%**	**88%**	**87%**	**92%**	**92%**
Total EU-13			*98,047*	*28,807*	*43,626*	*5,619*	*14,767*	*5,228*	*29.4%*	*44.5%*	*5.7%*	*15.1%*	*5.3%*	*8%*	*11%*	*17%*	*9%*	*14%*
Total EU-15			*785,552*	*277,127*	*312,649*	*23,212*	*142,340*	*30,224*	*35.3%*	*39.8%*	*3.0%*	*18.1%*	*3.8%*	*78%*	*77%*	*70%*	*83%*	*78%*
Associated countries			**83,377**	**32,017**	**36,462**	**3,172**	**9,678**	**2,048**	**38.4%**	**43.7%**	**3.8%**	**11.6%**	**2.5%**	**9%**	**9%**	**10%**	**6%**	**5%**
Thrid countries			**37,623**	**19,413**	**11,514**	**1,229**	**4,414**	**1,044**	**51.6%**	**30.6%**	**3.3%**	**11.7%**	**2.8%**	**5%**	**3%**	**4%**	**3%**	**3%**
Total Horizon 2020			**1,004,599**	**357,364**	**404,251**	**33,232**	**171,199**	**38,544**	**35.6%**	**40.2%**	**3.3%**	**17.0%**	**3.8%**	**100%**	**100%**	**100%**	**100%**	**100%**

Legend:

HES - Higher Education Institutions

REC- Research Organisations

PRC - Private-for-profit entities

PUB - Public bodies

OTH - Other

Table 21: Applications by country and success rates of application in Horizon 2020 *(Source: CORDA data – cut-off date: 1 January 2023)*

EU-28 Member State	Country code	Country group	Horizon 2020 applications in eligible proposals over 2014-2020	% of total	Horizon 2020 applications in eligible proposals per year	Horizon 2020 applications in high quality proposals	% of high quality applications	Retained Applications	Success rate of application in Horizon 2020	'000 of scientists and engineers per country*	Share of scientists and engineers in EU-28	Applications per '000 of scientists and engineers in the population	European Innovation Scoreboard Country Group (2014)	European Innovation Scoreboard Country Group (2020)
Austria	AT	EU-15	25,663	2.6%	3,666	15,440	60.2%	4,449	17.3%	329.22	1.9%	78	FOLLOWER	STRONG
Belgium	BE	EU-15	40,307	4.0%	5,758	26,097	64.7%	7,623	18.9%	466.96	2.7%	86	FOLLOWER	STRONG
Bulgaria	BG	EU-13	6,695	0.7%	956	2,673	39.9%	848	12.7%	191.5	1.1%	35	MODEST	MODEST
Cyprus	CY	EU-13	6,654	0.7%	951	3,608	54.2%	881	13.2%	26.18	0.2%	254	FOLLOWER	MODERATE
Czechia	CZ	EU-13	10,441	1.0%	1,492	5,704	54.6%	1,620	15.5%	331.22	1.9%	32	MODERATE	MODERATE
Germany	DE	EU-15	108,127	10.8%	15,447	66,661	61.7%	18,216	16.8%	3090.6	18.0%	35	LEADER	STRONG
Denmark	DK	EU-15	23,934	2.4%	3,419	15,069	63.0%	3,615	15.1%	282.94	1.6%	85	LEADER	LEADER
Estonia	EE	EU-13	5,754	0.6%	822	2,887	50.2%	791	13.7%	44.44	0.3%	129	FOLLOWER	STRONG
Greece	EL	EU-15	34,570	3.4%	4,939	19,267	55.7%	4,817	13.9%	250.76	1.5%	138	MODERATE	MODERATE
Spain	ES	EU-15	110,661	11.0%	15,809	61,970	56.0%	15,829	14.3%	1380.32	8.0%	80	MODERATE	MODERATE
Finland	FI	EU-15	22,055	2.2%	3,151	11,922	54.1%	3,122	14.2%	277.42	1.6%	80	LEADER	LEADER
France	FR	EU-15	77,950	7.8%	11,136	48,926	62.8%	13,622	17.5%	1739.62	10.1%	45	FOLLOWER	STRONG
Croatia	HR	EU-13	4,848	0.5%	693	2,282	47.1%	657	13.6%	96.66	0.6%	50	MODERATE	MODERATE
Hungary	HU	EU-13	10,580	1.1%	1,511	5,132	48.5%	1,353	12.8%	260.3	1.5%	41	MODERATE	MODERATE
Ireland	IE	EU-15	17,906	1.8%	2,558	10,546	58.9%	2,657	14.8%	231.44	1.3%	77	FOLLOWER	STRONG
Italy	IT	EU-15	109,623	10.9%	15,660	56,469	51.5%	14,245	13.0%	1043.38	6.1%	105	MODERATE	MODERATE
Lithuania	LT	EU-13	4,161	0.4%	594	1,976	47.5%	541	13.0%	97.28	0.6%	43	MODERATE	MODERATE
Luxembourg	LU	EU-15	3,271	0.3%	467	1,955	59.8%	541	16.5%	26.94	0.2%	121	FOLLOWER	LEADER
Latvia	LV	EU-13	3,480	0.3%	497	1,567	45.0%	477	13.7%	47.54	0.3%	73	MODEST	MODERATE
Malta	MT	EU-13	1,626	0.2%	232	812	49.9%	227	14.0%	16.02	0.1%	101	MODERATE	MODERATE
Netherlands	NL	EU-15	55,954	5.6%	7,993	35,717	63.8%	9,666	17.3%	834.52	4.9%	67	FOLLOWER	LEADER
Poland	PL	EU-13	18,251	1.8%	2,607	8,959	49.1%	2,483	13.6%	1169.98	6.8%	16	MODERATE	MODERATE
Portugal	PT	EU-15	25,382	2.5%	3,626	13,924	54.9%	3,296	13.0%	371.82	2.2%	68	MODERATE	STRONG
Romania	RO	EU-13	10,640	1.1%	1,520	4,868	45.8%	1,389	13.1%	534.36	3.1%	20	MODEST	MODEST
Sweden	SE	EU-15	29,542	2.9%	4,220	17,619	59.6%	4,538	15.4%	581.6	3.4%	51	LEADER	LEADER
Slovenia	SI	EU-13	10,458	1.0%	1,494	4,996	47.8%	1,248	11.9%	78.36	0.5%	133	FOLLOWER	MODERATE
Slovakia	SK	EU-13	4,459	0.4%	637	1,951	43.8%	593	13.3%	104.44	0.6%	43	MODERATE	MODERATE
United Kingdom	UK	EU-15	100,607	10.0%	14,372	61,534	61.2%	15,382	15.3%	3280.05	19.1%	31	FOLLOWER	STRONG
Total EU-28			**883,599**	88.0%	**126,228**	**510,531**	**57.8%**	**134,726**	**15.2%**	**17185.87**	**100.0%**	**51**	FOLLOWER	STRONG
Total EU-13			*98,047*	*9.8%*	*14,007*	*47,415*	*48.4%*	*13,108*	*13.4%*	*2998.28*	*17.4%*	*33*		
Total EU-15			*785,552*	*78.2%*	*112,222*	*463,116*	*59.0%*	*121,618*	*15.5%*	*14187.59*	*82.6%*	*55*		
Associated countries			83,377	8.3%	11,911	45,876	55.0%	12,139	14.6%					
Thrid countries			37,623	3.7%	5,375	25,376	67.4%	6,762	18.0%					
Total Horizon 2020			**1,004,599**	100.0%	**143,514**	**581,783**	**57.9%**	**153,627**	**15.3%**					

* Source = Eurostat

Funding allocation and participants in signed grants *(Source: CORDA data – cut-off date: 1 January 2023)*

EUR 68.3 billion were allocated through **35 426 grants**. In total, **41 575 different organisations** benefited from Horizon 2020 funding, some participating in several Horizon 2020 projects.

Figure 57: Funding per type of organisation

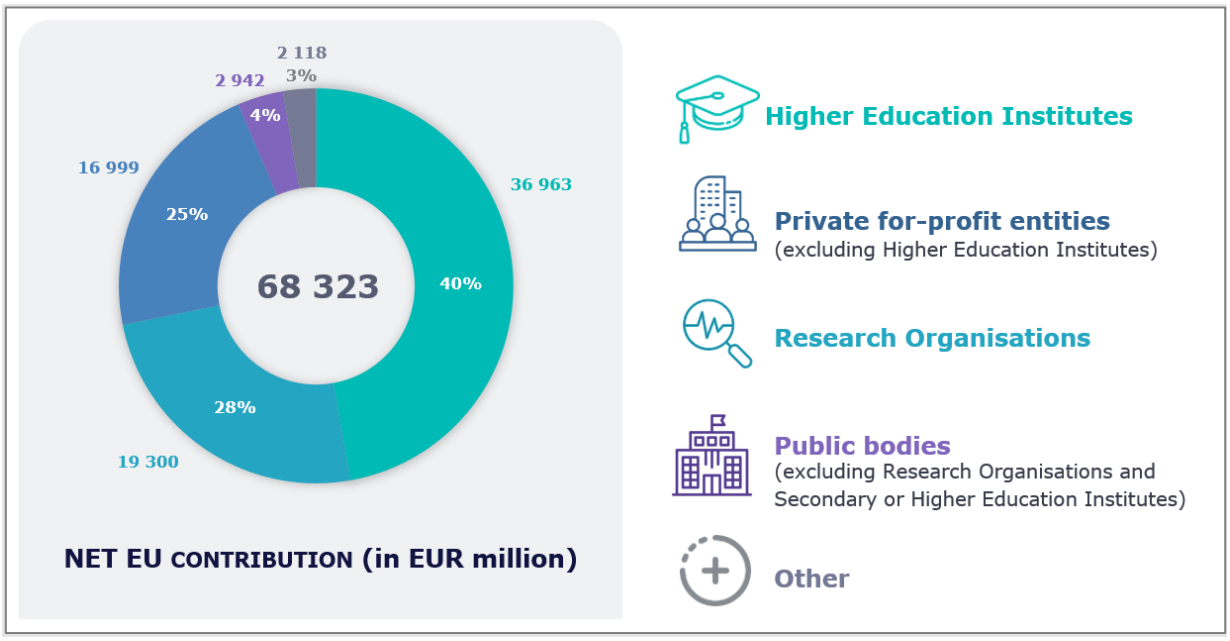


Figure 58: Funding by Member State (in EUR million)

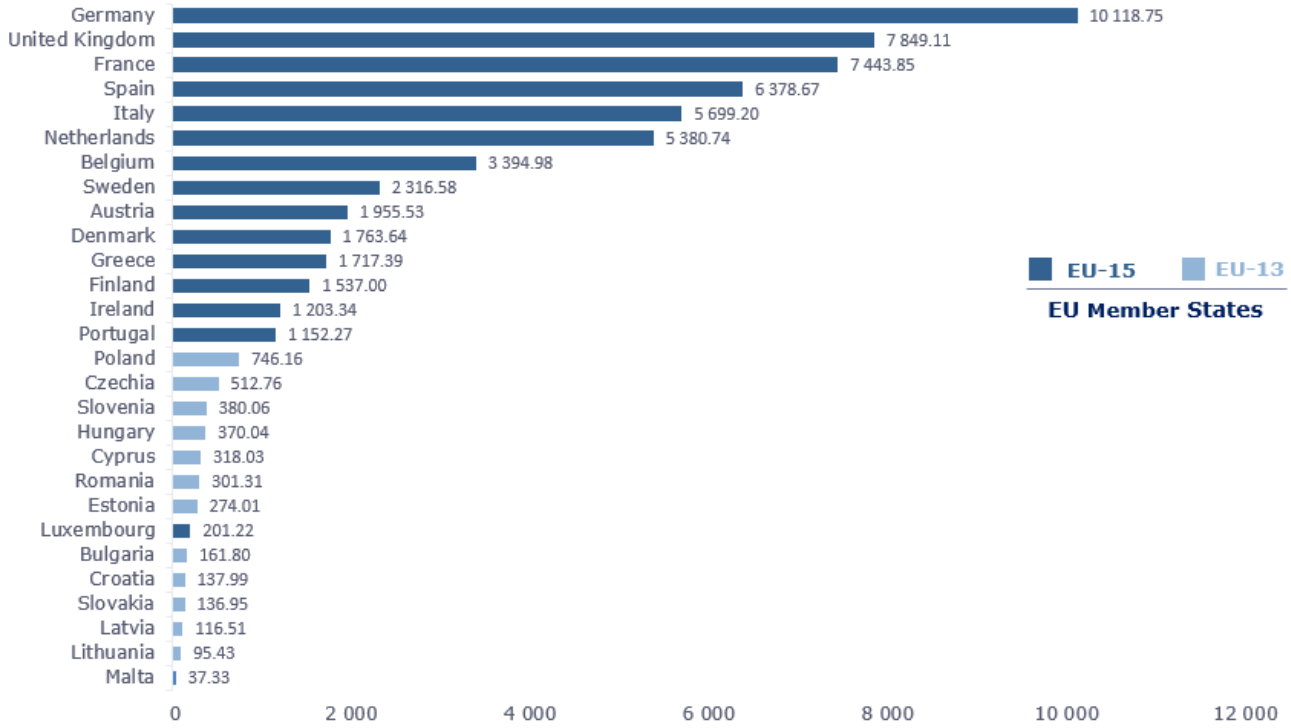


Figure 59: Funds received by Member States (by EUR million GERD)

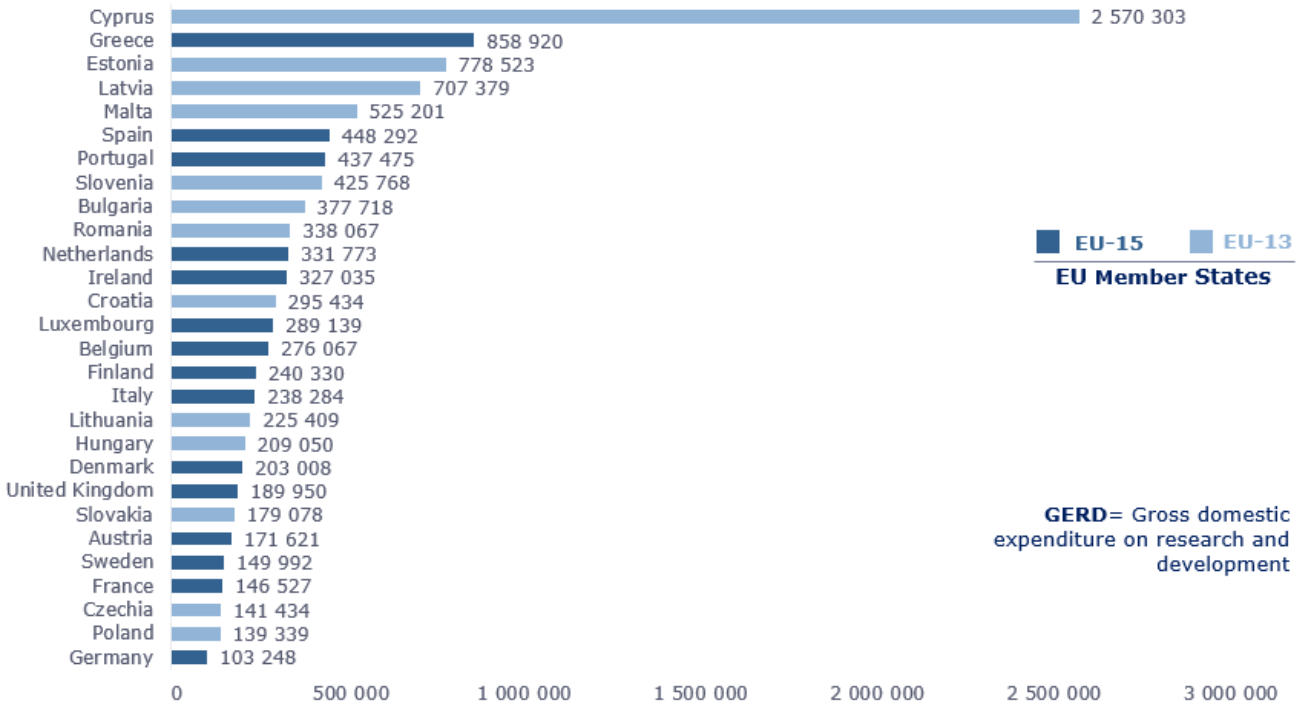


Figure 60: Funding allocation per pillar

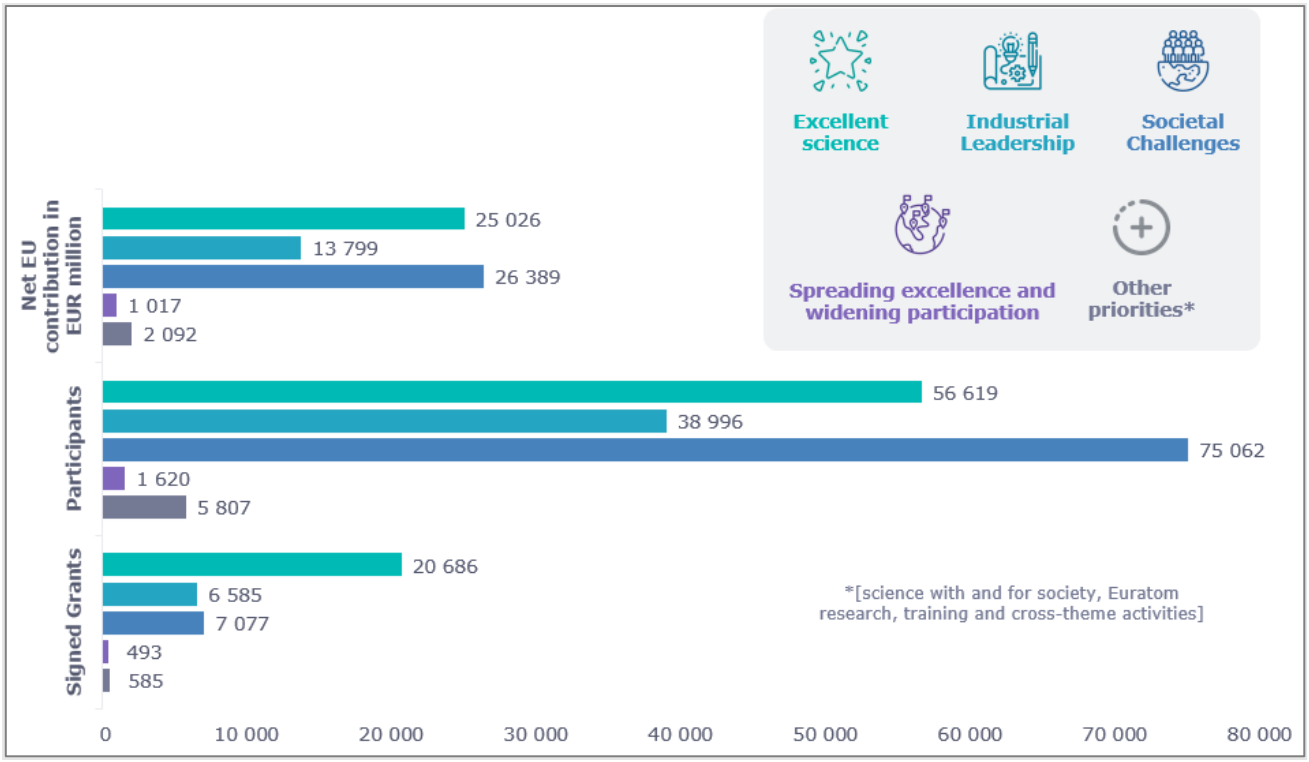
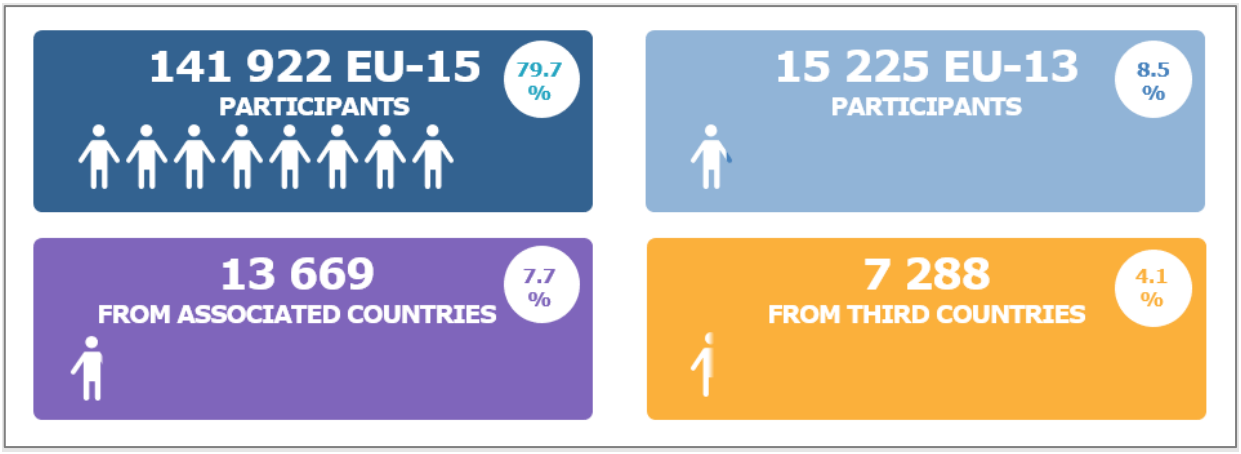


Figure 61: Participation by country group

178 104 participations were registered in Horizon 2020, a same organisation participating sometimes in several projects.



(Source: CORDA data – cut-off date: 1 January 2023)

More detail is available in the tables that follow on Horizon 2020 investment (a) by pillar, (b) by organisation type, and (c) by country.

Table 22: Horizon 2020 investments by country and by pillar of Horizon 2020 *(Source: CORDA data – cut-off date: 1 January 2023)*

EU-28 Member State	Country code	Country group	Horizon 2020 investments in signed grants (EUR million)	Excellent Science	Industrial Leadership	Societal challenges	Spreading excellence and widening participation	Other	Excellent Science	Industrial Leadership	Societal challenges	Spreading excellence and widening participation	Other	Excellent Science	Industrial Leadership	Societal challenges	Spreading excellence and widening participation	Other
				Investment by pillar					% of H2020 investments by country and by pillar					% of all investments in the same pillar				
Austria	AT	EU-15	1,956	706	448	742	12	48	36%	23%	38%	1%	2%	3%	3%	3%	1%	39%
Belgium	BE	EU-15	3,395	913	686	1,409	267	120	27%	20%	42%	8%	4%	4%	5%	5%	26%	97%
Bulgaria	BG	EU-13	162	22	25	76	30	9	14%	15%	47%	19%	6%	0%	0%	0%	3%	8%
Cyprus	CY	EU-13	318	60	55	107	88	8	19%	17%	34%	28%	3%	0%	0%	0%	9%	7%
Czechia	CZ	EU-13	513	162	91	177	50	32	32%	18%	35%	10%	6%	1%	1%	1%	5%	26%
Germany	DE	EU-15	10,119	3,942	2,178	3,558	44	396	39%	22%	35%	0%	4%	16%	16%	13%	4%	322%
Denmark	DK	EU-15	1,764	735	276	701	5	48	42%	16%	40%	0%	3%	3%	2%	3%	0%	39%
Estonia	EE	EU-13	274	38	49	128	53	6	14%	18%	47%	19%	2%	0%	0%	0%	5%	5%
Greece	EL	EU-15	1,717	289	560	829	6	34	17%	33%	48%	0%	2%	1%	4%	3%	1%	28%
Spain	ES	EU-15	6,379	1,767	1,625	2,797	9	181	28%	25%	44%	0%	3%	7%	12%	11%	1%	147%
Finland	FI	EU-15	1,537	457	413	601	15	52	30%	27%	39%	1%	3%	2%	3%	2%	1%	42%
France	FR	EU-15	7,444	2,763	1,569	2,856	16	239	37%	21%	38%	0%	3%	11%	11%	11%	2%	195%
Croatia	HR	EU-13	138	29	17	75	10	6	21%	12%	55%	7%	5%	0%	0%	0%	1%	5%
Hungary	HU	EU-13	370	116	70	139	25	20	31%	19%	38%	7%	5%	0%	1%	1%	2%	16%
Ireland	IE	EU-15	1,203	416	301	431	6	50	35%	25%	36%	0%	4%	2%	2%	2%	1%	40%
Italy	IT	EU-15	5,699	1,713	1,295	2,459	15	218	30%	23%	43%	0%	4%	7%	9%	9%	1%	177%
Lithuania	LT	EU-13	95	14	26	40	5	10	15%	27%	42%	6%	10%	0%	0%	0%	1%	8%
Luxembourg	LU	EU-15	201	46	64	84	5	2	23%	32%	42%	2%	1%	0%	0%	0%	0%	2%
Latvia	LV	EU-13	117	12	21	51	28	4	10%	18%	44%	24%	4%	0%	0%	0%	3%	3%
Malta	MT	EU-13	37	7	5	20	4	1	19%	14%	52%	11%	4%	0%	0%	0%	0%	1%
Netherlands	NL	EU-15	5,381	2,158	892	2,218	12	101	40%	17%	41%	0%	2%	9%	6%	8%	1%	82%
Poland	PL	EU-13	746	197	217	244	60	28	26%	29%	33%	8%	4%	1%	2%	1%	6%	23%
Portugal	PT	EU-15	1,152	316	245	454	102	34	27%	21%	39%	9%	3%	1%	2%	2%	10%	28%
Romania	RO	EU-13	301	46	49	183	11	12	15%	16%	61%	3%	4%	0%	0%	1%	1%	10%
Sweden	SE	EU-15	2,317	887	412	945	13	60	38%	18%	41%	1%	3%	4%	3%	4%	1%	49%
Slovenia	SI	EU-13	380	69	84	181	26	19	18%	22%	48%	7%	5%	0%	1%	1%	3%	16%
Slovakia	SK	EU-13	137	26	20	64	18	9	19%	15%	47%	13%	6%	0%	0%	0%	2%	7%
United Kingdom	UK	EU-15	7,849	4,106	965	2,542	35	201	52%	12%	32%	0%	3%	16%	7%	10%	3%	163%
Total EU-28			61,701	22,013	12,657	24,114	969	1,948	36%	21%	39%	2%	3%	88%	92%	91%	95%	1584%
Total EU-13			*3,589*	*800*	*729*	*1,486*	*409*	*165*	22%	20%	41%	11%	5%	*3%*	*5%*	*6%*	*40%*	*134%*
Total EU-15			*58,112*	*21,213*	*11,928*	*22,627*	*560*	*1,783*	37%	21%	39%	1%	3%	*85%*	*86%*	*86%*	*55%*	*1450%*
Associated countries			6,094	2908	1106	1893	48	139	48%	18%	31%	1%	2%	12%	8%	7%	5%	113%
Thrid countries			528	104	36	382.5	0	5.5	20%	7%	72%	0%	1%	0%	0%	1%	0%	4%
Total Horizon 2020			**68,323**	**25,025**	**13,799**	**26,389**	**1,017**	**123**	**37%**	**20%**	**39%**	**1%**	**0%**	**100%**	**100%**	**100%**	**100%**	**100%**

Table 23: Horizon 2020 investments by type of organisation *(Source: CORDA data – cut-off date: 1 January 2023)*

EU-28 Member State	Country code	Country group	Horizon 2020 investments in signed grants (EUR million)	HES	PRC	PUB	REC	OTH	HES	PRC	PUB	REC	OTH	HES	PRC	PUB	REC	OTH
				Investment by type of organisation					% of investments in a country by org. type					% of investments to an org. type, by country				
Austria	AT	EU-15	1,956	776	623	24	428	104	40%	32%	1%	22%	5%	3%	3%	1%	3%	4%
Belgium	BE	EU-15	3,395	1,097	736	69	790	704	32%	22%	2%	23%	21%	4%	4%	3%	5%	24%
Bulgaria	BG	EU-13	162	41	52	11	47	10	25%	32%	7%	29%	6%	0%	0%	1%	0%	0%
Cyprus	CY	EU-13	318	133	129	10	35	12	42%	41%	3%	11%	4%	0%	1%	0%	0%	0%
Czechia	CZ	EU-13	513	227	149	16	99	22	44%	29%	3%	19%	4%	1%	1%	1%	1%	1%
Germany	DE	EU-15	10,119	3,622	2,737	138	3,337	286	36%	27%	1%	33%	3%	13%	14%	6%	20%	10%
Denmark	DK	EU-15	1,764	1,048	444	103	106	62	59%	25%	6%	6%	4%	4%	2%	5%	1%	2%
Estonia	EE	EU-13	274	133	92	18	7	25	48%	34%	6%	2%	9%	0%	0%	1%	0%	1%
Greece	EL	EU-15	1,717	473	511	35	665	34	28%	30%	2%	39%	2%	2%	3%	2%	4%	1%
Spain	ES	EU-15	6,379	1,394	2,171	297	2,291	226	22%	34%	5%	36%	4%	5%	11%	14%	13%	8%
Finland	FI	EU-15	1,537	652	400	41	390	55	42%	26%	3%	25%	4%	2%	2%	2%	2%	2%
France	FR	EU-15	7,444	1,128	2,596	200	3,254	266	15%	35%	3%	44%	4%	4%	13%	9%	19%	9%
Croatia	HR	EU-13	138	45	39	13	35	7	32%	28%	9%	25%	5%	0%	0%	1%	0%	0%
Hungary	HU	EU-13	370	98	122	18	83	49	27%	33%	5%	22%	13%	0%	1%	1%	0%	2%
Ireland	IE	EU-15	1,203	689	416	46	32	21	57%	35%	4%	3%	2%	3%	2%	2%	0%	1%
Italy	IT	EU-15	5,699	1,901	2,108	169	1,363	157	33%	37%	3%	24%	3%	7%	11%	8%	8%	5%
Lithuania	LT	EU-13	95	28	32	11	13	12	29%	33%	11%	14%	12%	0%	0%	1%	0%	0%
Luxembourg	LU	EU-15	201	63	86	7	36	9	31%	43%	3%	18%	5%	0%	0%	0%	0%	0%
Latvia	LV	EU-13	117	47	33	12	17	7	40%	28%	11%	14%	6%	0%	0%	1%	0%	0%
Malta	MT	EU-13	37	18	9	7	2	1	48%	25%	19%	6%	3%	0%	0%	0%	0%	0%
Netherlands	NL	EU-15	5,381	2,666	1,313	111	1,000	291	50%	24%	2%	19%	5%	10%	7%	5%	6%	10%
Poland	PL	EU-13	746	206	190	49	211	90	28%	25%	7%	28%	12%	1%	1%	2%	1%	3%
Portugal	PT	EU-15	1,152	301	322	57	437	35	26%	28%	5%	38%	3%	1%	2%	3%	3%	1%
Romania	RO	EU-13	301	63	111	20	79	29	21%	37%	7%	26%	9%	0%	1%	1%	0%	1%
Sweden	SE	EU-15	2,317	1,324	600	165	192	34	57%	26%	7%	8%	1%	5%	3%	8%	1%	1%
Slovenia	SI	EU-13	380	72	135	25	139	9	19%	36%	7%	37%	2%	0%	1%	1%	1%	0%
Slovakia	SK	EU-13	137	48	54	7	19	10	35%	39%	5%	14%	7%	0%	0%	0%	0%	0%
United Kingd	UK	EU-15	7,849	5,420	1,464	178	632	156	69%	19%	2%	8%	2%	20%	8%	8%	4%	5%
		Total EU-28	**61,701**	**23,713**	**17,674**	**1,854**	**15,738**	**2,722**	38%	29%	3%	26%	4%	**88%**	**92%**	**88%**	**93%**	**93%**
		Total EU-13	*3,589*	*1,158*	*1,147*	*217*	*785*	*282*	32%	32%	6%	22%	8%	*4%*	*6%*	*10%*	*5%*	*10%*
		Total EU-15	*58,112*	*22,555*	*16,527*	*1,638*	*14,953*	*2,440*	39%	28%	3%	26%	4%	*84%*	*86%*	*77%*	*88%*	*83%*
		Associated countries	6,094	**3,030**	**1,558**	**222**	**1,134**	**150**	50%	26%	4%	19%	2%	**11%**	**8%**	**10%**	**7%**	**5%**
		Thrid countries	528	**221**	**68**	**41**	**127**	**70**	42%	13%	8%	24%	13%	**1%**	**0%**	**2%**	**1%**	**2%**
		Total Horizon 2020	**68,323**	**26,964**	**19,300**	**2,118**	**16,999**	**2,942**	39%	28%	3%	25%	4%	**100%**	**100%**	**100%**	**100%**	**100%**

Legend:

HES - Higher Education Institutions

REC- Research Organisations

PRC - Private-for-profit entities

PUB - Public bodies

OTH - Other

Table 24: Participation in Horizon 2020 by country *(Source: CORDA data – cut-off date: 1 January 2023)*

EU-28 Member State	Country code	Country group	Horizon 2020 participations in signed grants over 2014-2020	% of total	Horizon 2020 participations in signed grants per year	000 scientists and Engineers	Share of scientists and engineers in EU28	Participations per '000 scientists and engineers in the population	Number of Horizon 2020 projects with at least 1 participant from the countr	% of total
Austria	AT	EU-15	5,092	2.9%	727	329.22	1.9%	15.5	3,232	9.1%
Belgium	BE	EU-15	8,452	4.7%	1,207	466.96	2.7%	18.1	5,056	14.3%
Bulgaria	BG	EU-13	998	0.6%	143	191.5	1.1%	5.2	666	1.9%
Cyprus	CY	EU-13	986	0.6%	141	26.18	0.2%	37.7	736	2.1%
Czechia	CZ	EU-13	1,883	1.1%	269	331.22	1.9%	5.7	1,398	3.9%
Germany	DE	EU-15	20,787	11.7%	2,970	3090.6	18.0%	6.7	9,937	28.1%
Denmark	DK	EU-15	4,002	2.2%	572	282.94	1.6%	14.1	2,910	8.2%
Estonia	EE	EU-13	899	0.5%	128	44.44	0.3%	20.2	701	2.0%
Greece	EL	EU-15	5,502	3.1%	786	250.76	1.5%	21.9	2,901	8.2%
Spain	ES	EU-15	18,885	10.6%	2,698	1380.32	8.0%	13.7	8,808	24.9%
Finland	FI	EU-15	3,512	2.0%	502	277.42	1.6%	12.7	2,243	6.3%
France	FR	EU-15	17,155	9.6%	2,451	1739.62	10.1%	9.9	8,005	22.6%
Croatia	HR	EU-13	820	0.5%	117	96.66	0.6%	8.5	584	1.6%
Hungary	HU	EU-13	1,555	0.9%	222	260.3	1.5%	6.0	1,144	3.2%
Ireland	IE	EU-15	2,966	1.7%	424	231.44	1.3%	12.8	2,161	6.1%
Italy	IT	EU-15	17,176	9.6%	2,454	1043.38	6.1%	16.5	7,893	22.3%
Lithuania	LT	EU-13	619	0.3%	88	97.28	0.6%	6.4	504	1.4%
Luxembour	LU	EU-15	629	0.4%	90	26.94	0.2%	23.3	539	1.5%
Latvia	LV	EU-13	551	0.3%	79	47.54	0.3%	11.6	437	1.2%
Malta	MT	EU-13	263	0.1%	38	16.02	0.1%	16.4	192	0.5%
Netherlanc	NL	EU-15	11,131	6.2%	1,590	834.52	4.9%	13.3	6,178	17.4%
Poland	PL	EU-13	2,855	1.6%	408	1169.98	6.8%	2.4	1,959	5.5%
Portugal	PT	EU-15	3,961	2.2%	566	371.82	2.2%	10.7	2,447	6.9%
Romania	RO	EU-13	1,619	0.9%	231	534.36	3.1%	3.0	1,056	3.0%
Sweden	SE	EU-15	5,214	2.9%	745	581.6	3.4%	9.0	3,408	9.6%
Slovenia	SI	EU-13	1,480	0.8%	211	78.36	0.5%	18.9	1,016	2.9%
Slovakia	SK	EU-13	697	0.4%	100	104.44	0.6%	6.7	516	1.5%
United King	UK	EU-15	17,458	9.8%	2,494	3280.05	19.1%	5.3	10,517	29.7%
		Total EU-28	**157,147**	88.2%	**22,450**	**17185.87**	**100.0%**	**9.1**	**32,552**	91.9%
		Total EU-13	*15,225*	*8.5%*	*2,175*	*2998.28*	*17.4%*	*5.1*	*6,374*	*18.0%*
		Total EU-15	*141,922*	*79.7%*	*20,275*	*14187.59*	*82.6%*	*10.0*	*31,364*	*88.5%*
		Associated countries	13,669	7.7%	1,953				7,958	22.5%
		Thrid countries	7,288	4.1%	1,041				3,221	9.1%
		Total Horizon 2020	**178,104**	**100.0%**	**25,443**				**35,426**	**100.0%**

Table 25: Horizon 2020 investments by country *(Source: CORDA data – cut-off date: 1January 2023)*

EU-28 Member State	Country code	Country group	Horizon 2020 investments in signed grants (EUR million) over 2014-2020	% of total H2020 investment	% of H2020 investment in EU-28	Horizon 2020 investments in signed grants (EUR million) per year	GERD (in EUR million*	Horizon 2020 investment in EUR per EUR million of GERD	European Innovation Scoreboard Country Group (2014)	European Innovation Scoreboard Country Group (2020)
Austria	AT	EU-15	1,956	2.9%	3.2%	279	11394.48271	17,162	FOLLOWER	STRONG
Belgium	BE	EU-15	3,395	5.0%	5.5%	485	12297.66929	27,607	FOLLOWER	STRONG
Bulgaria	BG	EU-13	162	0.2%	0.3%	23	428.3682857	37,772	MODEST	MODEST
Cyprus	CY	EU-13	318	0.5%	0.5%	45	123.7331429	257,030	FOLLOWER	MODERATE
Czechia	CZ	EU-13	513	0.8%	0.8%	73	3625.455286	14,143	MODERATE	MODERATE
Germany	DE	EU-15	10,119	14.8%	16.4%	1,446	98004.74043	10,325	LEADER	STRONG
Denmark	DK	EU-15	1,764	2.6%	2.9%	252	8687.528429	20,301	LEADER	LEADER
Estonia	EE	EU-13	274	0.4%	0.4%	39	351.96	77,852	FOLLOWER	STRONG
Greece	EL	EU-15	1,717	2.5%	2.8%	245	1,999.48	85,892	MODERATE	MODERATE
Spain	ES	EU-15	6,379	9.3%	10.3%	911	14,228.82	44,829	MODERATE	MODERATE
Finland	FI	EU-15	1,537	2.2%	2.5%	220	6,395.40	24,033	LEADER	LEADER
France	FR	EU-15	7,444	10.9%	12.1%	1,063	50,802.01	14,653	FOLLOWER	STRONG
Croatia	HR	EU-13	138	0.2%	0.2%	20	467.09	29,543	MODERATE	MODERATE
Hungary	HU	EU-13	370	0.5%	0.6%	53	1,770.11	20,905	MODERATE	MODERATE
Ireland	IE	EU-15	1,203	1.8%	2.0%	172	3,679.56	32,703	FOLLOWER	STRONG
Italy	IT	EU-15	5,699	8.3%	9.2%	814	23,917.67	23,828	MODERATE	MODERATE
Lithuania	LT	EU-13	95	0.1%	0.2%	14	423.37	22,541	MODERATE	MODERATE
Luxembou	LU	EU-15	201	0.3%	0.3%	29	695.91	28,914	FOLLOWER	LEADER
Latvia	LV	EU-13	117	0.2%	0.2%	17	164.70	70,738	MODEST	MODERATE
Malta	MT	EU-13	37	0.1%	0.1%	5	71.08	52,520	MODERATE	MODERATE
Netherlanc	NL	EU-15	5,381	7.9%	8.7%	769	16,218.14	33,177	FOLLOWER	LEADER
Poland	PL	EU-13	746	1.1%	1.2%	107	5,355.02	13,934	MODERATE	MODERATE
Portugal	PT	EU-15	1,152	1.7%	1.9%	165	2,633.90	43,747	MODERATE	STRONG
Romania	RO	EU-13	301	0.4%	0.5%	43	891.27	33,807	MODEST	MODEST
Sweden	SE	EU-15	2,317	3.4%	3.8%	331	15,444.75	14,999	LEADER	LEADER
Slovenia	SI	EU-13	380	0.6%	0.6%	54	892.64	42,577	FOLLOWER	MODERATE
Slovakia	SK	EU-13	137	0.2%	0.2%	20	764.74	17,908	MODERATE	MODERATE
United Kin	UK	EU-15	7,849	11.5%	12.7%	1,121	41,322.07	18,995	FOLLOWER	STRONG
Total EU-28			**61,701**	**90.3%**	**100.0%**	**8,814**	**323,052**	**19,099**	FOLLOWER	STRONG
Total EU-13			*3,589*	*5.3%*		*8,535*	*15,330*	*23,412*		
Total EU-15			*58,112*	*85.1%*		*16,864*	*307,722*	*18,885*		
Associated countries			6,094	8.9%		25,376				
Thrid countries			528	0.8%		42,195				
Total Horizon 2020			**68,323**	**100.0%**		**67,498**				

* Source: Eurostat

Funding rates and leverage

Table 26: Horizon 2020 **funding rates and direct leverage factors**, by type of action

	Funding rate, in %[134]	**Direct leverage factor** (PRC), in EUR
Horizon 2020	varies	0.23 (0.57)
Horizon 2020 excluding fundamental research (ERC, MSCA) and CSA	varies	0.35 (0.63)
RIA	100	0.05 (0.08)
IA	70 (100 for non-profit)	0.24 (0.62)
SME Instrument	-	0.43
JTIs	varies	1.08
ERA-NET Cofund	33	2.2
EJP Cofund	70	0.92
KICs	-	0.23
Art. 185	varies	0.52

Notes: Definitions provided in glossary. Data is retrieved from e-CORDA (cut-off date 07/02/2023). For Art. 185 TFEU initiatives only 40% of the cost data is available.

Table 27: Horizon 2020 direct leverage factors for Innovation Actions (IA), by programme part

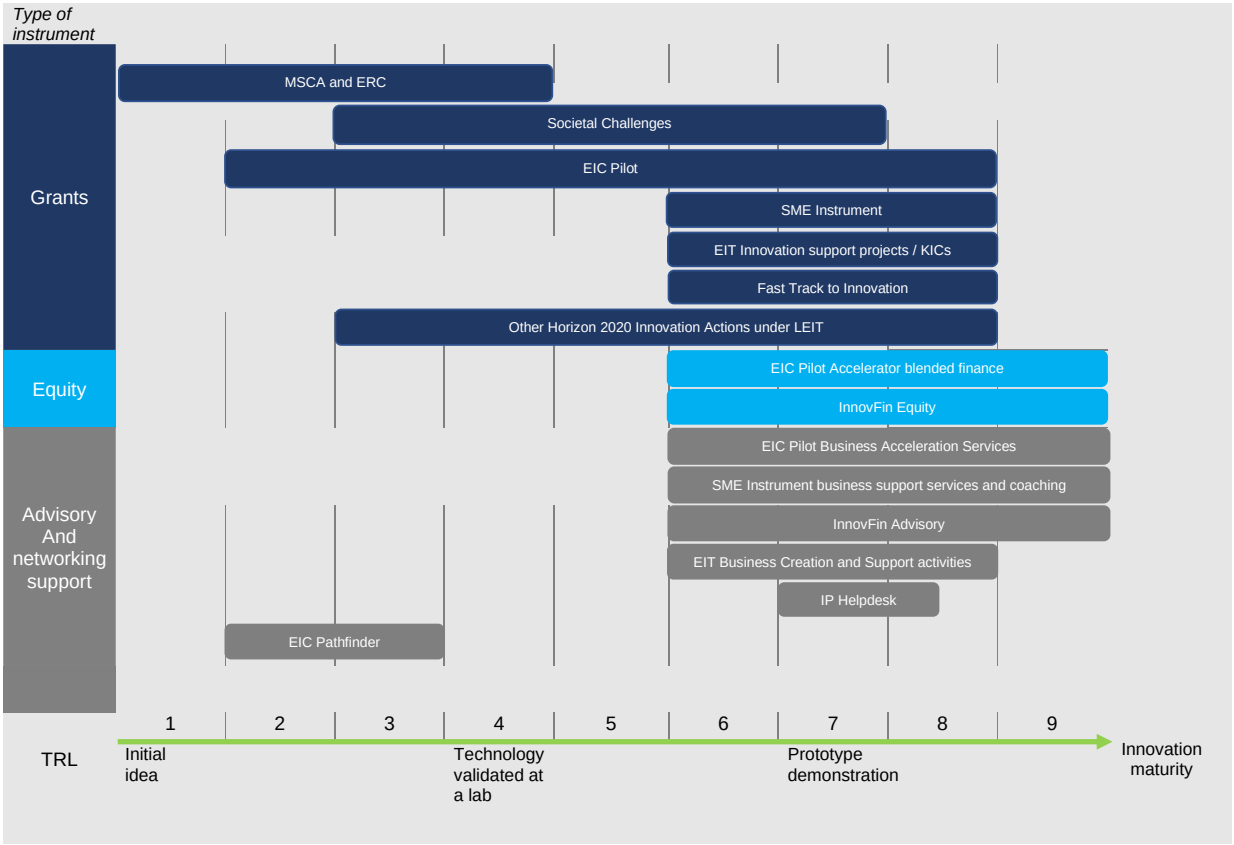
Programme part	**Direct leverage factor**, in EUR
Secure, clean and efficient energy	0.44
Smart, green and integrated transport	0.26
Secure societies - protecting the freedom and security of Europe and its citizens	0.21
Leadership in enabling and industrial technologies (LEIT)	0.2
Climate action, environment, resource efficiency and raw materials	0.15

Notes: Definitions provided in the glossary. Data from ECORDA (cut-off date 07/02/2023). Only the programme parts with the highest leverage (first five) are presented.

[134] Actual funding rate can be lower as applicants can request less funding than the maximum amount defined by the funding rate. The reasons some applicants request less funding than the maximum vary, but one is that they may receive funding from another source. Lower requested amount (lower funding rate) translates into higher direct leverage factor (see glossary for definitions and formal relationship among the two).

Level of TRLs

Figure 62: Selected features of Horizon 2020 support across the **TRL scale**



Source: European Commission, Directorate-General for Research and Innovation, Evaluation study on the European Innovation Council (EIC) pilot: final report, Publications Office of the European Union, 2022, p. 60, https://data.europa.eu/doi/10.2777/261324 - updated by PPMI for the Innovative Europe evaluation study (2023) and adapted by DG RTD in May 2023.