

TO THE COMMISSIONER
RESPONSIBLE FOR
RESEARCH AND
INNOVATION

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* The EU's science and innovation performance is mixed. Overall spending on science is still behind EU targets, with business R&D a particular contributor to the lag. However, the EU has caught up with the US in scientific quality terms.

Your main focus will be Horizon Europe funding. You should aim to make it as effective as possible in supporting socially and environmentally sustainable EU growth, including by addressing major challenges, including climate change.

You should ensure good mixes in Horizon Europe of top-down and bottom-up instruments, and of upstream science, pre-commercial research and downstream innovation. You should build on the success of the European Research Council and ensure the EU offers a high level of researcher mobility and is open to talent from around the world.

- * HORIZON EUROPE
- * BUSINESS RESEARCH AND DEVELOPMENT
- * EFFECTS-BASED APPROACH

1 STATE OF AFFAIRS

Science, research and innovation have the power to take Europe into a prosperous, clean, safe and healthy future for its citizens. But what progress is the European Union making? Table 1 shows some key data on its past research and innovation performance.

Depending on how optimistic you are, you can read the current state of affairs as encouraging or as a wake-up call.

*RESEARCH
SPENDING
GOAL

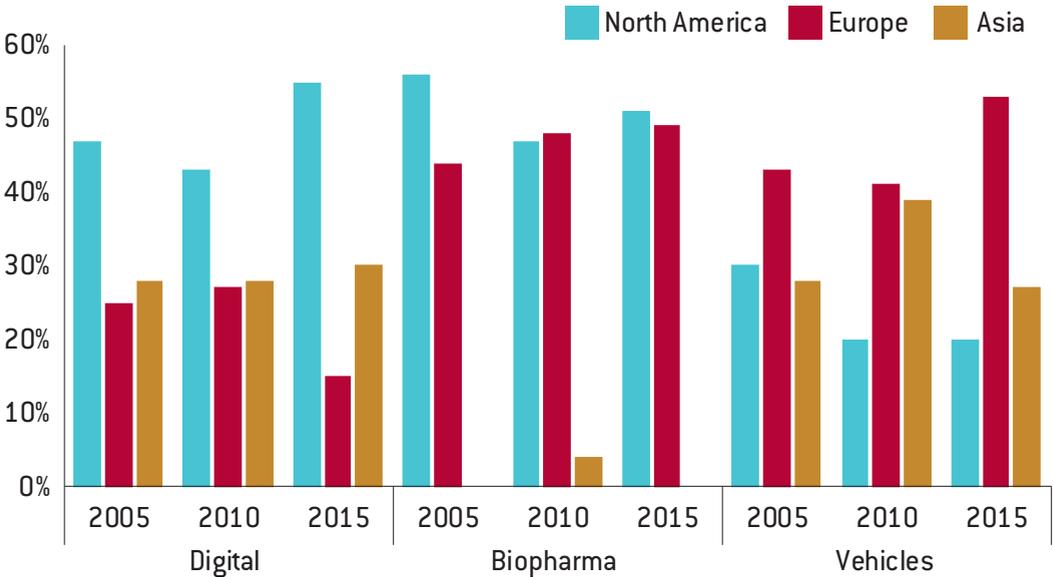
- On the share of GDP spent on research, the EU is, with less than 2 percent, still far away from the 3 percent target that was supposed to have been achieved by 2010¹. The EU continues to have a persistent R&D deficit compared to the US. There has been some progress, but this has been confined to some EU countries, most notably Germany, while others, such as Italy and Spain, have continued to lag behind or have even gone backwards. The business sector is responsible for most of the persistent EU deficit. In terms of public spending on R&D, the deficit relative to the US and China is less problematic. The EU has progressed slowly while China has moved rapidly, and has overtaken the EU in R&D-to-GDP numbers, including for corporate R&D.
- On science, quality matters. The key issue is whether the EU is producing high-quality science, as measured, for example, by the EU share of the world's top 1 percent of most cited scientific publications. Here, there is some cause for optimism, as the

Table 1: R&D comparative data, EU, US and China

		EU28	US	China
Research and development (% of GDP)	2010/2016	1.84%/1.93%	2.74%/2.74%	1.71%/2.11%
Business R&D (% of GDP)	2010/2016	1.12%/1.24%	1.86%/1.95%	1.26%/1.63%
Government-financed R&D (% of GDP)	2010/2015	0.65%/0.62%	0.89%/0.70%	0.41%/0.44%
Share of global corporate R&D spending	2014/2018	29%/27%	36%/36%	4%/10%
Share of top 1% most-cited science publications	2010/2014	35%/36%	41%/36%	10%/17%
Share of world top 100 universities	2012/2017	29%/30%	53%/48%	0/2%

Sources: OECD, Main Science and Technology Indicators; National Science Foundation; Academic Ranking of World Universities (Shanghai Ranking); EU Industrial R&D Investment Scoreboard of 2500 Largest Corporate R&D spenders in the world.

Figure 1: Regional R&D spending: shares of spending by top 10 percent largest R&D spenders in their sectors



Source: Bruegel, based on EU Industrial R&D Investment Scoreboard data. Note: numbers are calculated from a time-comparable sample of 202 biopharma companies, 466 digital companies and 99 automotive companies.

***SCIENTIFIC QUALITY**

EU has caught up with the US. China is a rising star in quality science, but still has some way to go before it catches up at the frontier of science. There has been catching up by continental EU countries, but about 30 percent of the EU’s top 1 percent publications originate in the UK, a scientific powerhouse the EU might soon lose. The EU’s science quality performance is thanks to pockets of excellence in specific sub-fields. Continental EU countries still do not have enough world-class universities that excel in a broad range of fields and are able to compete with their US counterparts in world university rankings, such as the Shanghai Ranking. Of the top 20 universities, only UK and Swiss institutions represent Europe.

***BUSINESS AND R&D**

- In terms of business-sector research and innovation, the EU’s persistent business R&D gap is not due to its incumbent innovators in classic sectors of strength – automobiles and pharmaceuticals – but because Europe is missing innovators who can assume world-leading positions in digital sectors (especially in

digital-services sectors). In these sectors, which are increasingly important parts of the corporate R&D landscape, the new leading firms are US or Chinese. And even in the EU stronghold of automobiles, firms are increasingly being challenged by the new wave of interconnected, autonomous and electric cars.

2 CHALLENGES

The challenges you face are many and various. EU science, technology and innovation (STI) policy should help to address the challenges of ensuring a prosperous EU economy that provides well-paid jobs, health, safety and a clean environment for all.

The challenges are not new. Up to now, the EU's STI approach has not been particularly successful in responding to these challenges. Unfortunately, the challenges have become more urgent and must be addressed in the context of a changing global environment in which China is becoming an STI powerhouse. The EU still needs to learn how to interact better with China's growing STI capacity in order to use it to accelerate the EU's catching up.

On climate change, the risks are increasing. The EU STI machine needs to be switched into higher gear to deliver faster. The longer this is delayed, the more difficult it will become, as delivery of research results cannot be easily speeded up.

While the challenges are sizeable and urgent, your powers to address them are being undermined. First, with Brexit, you run the risk of losing a pivotal part of the EU's STI capacity. The UK is a research powerhouse, and even a temporary pause in its participation in European research programmes and policies, and particularly an interruption of researchers' mobility, will be a loss.

But even within the EU27, there is an increasing divergence between countries on the importance of supporting STI. Scepticism is increasing on the value added of EU STI policy instruments.

Your major tool is the part of the 2021-27 EU budget that will go to research: Horizon Europe, the successor to the current Horizon 2020. Although a sizeable budget is proposed for Horizon Europe – about €100 billion at time of writing – and although this is set to

*SOCIETAL
CHALLENGES

*BREXIT



Stakeholders and member states mainly see the discussions on the Horizon Europe budget as a zero-sum exercise in which they ask “what’s in it for me?”

increase over time, reflecting the EU’s commitment to research, it represents only a small share of the total public budget for STI spent in the EU by member states. Even more problematic is that in the discussions on how to use the budget, it is mostly seen by stakeholders and member states as a zero-sum exercise in which they ask “*what’s in it for me?*”, rather than as an instrument that will enable the EU’s STI machine to address EU societal challenges to the benefit of all.

3 RECOMMENDATIONS

Most of the focus at the start of your term will be on how the Horizon Europe budget will be allocated to which pillars and instruments.

Your main aim should be to get the most out of Horizon Europe, making it as effective as possible in supporting socially and environmentally sustainable EU growth.

3.1 An effects-based approach

Taking an effects-based approach will require not only looking at how to best spend the €100 billion Horizon Europe budget, but also at how to best leverage that spending. It also means ensuring that Horizon Europe complements other public funding at EU level (eg structural and regional funding), European Investment Bank and European Fund for Strategic Investments funding, and the much bigger pots of national and regional funding for research and innovation. It also means ensuring that complementary policies are in place at EU and member-state level to address any

*HORIZON
EUROPE

*COMPLEMENTARY
FUNDING



Taking an effects-based approach requires a capacity to make micro and macro assessments of long- and short-run impacts from public science funding

*MONITORING
AND
EVALUATION

missing framework conditions necessary to leverage research and innovation investment into sustainable economic effects. Such conditions include open and competitive product and services markets and well-functioning capital and labour markets. You will have to coordinate closely with colleagues because the tools to shape the framework conditions, including competition policy, trade policy, regulations and standards, and carbon pricing, are mostly in their hands, or are the responsibility of member states or regions. You should therefore seek to influence the working of the many formal and informal bodies involved in EU STI policy.

Taking an effects-based approach requires a monitoring and evaluation capacity that encompasses *ex-ante* and *ex-post* micro and macro assessments of long- and short-run impacts from public STI funding. This cannot be done on the basis of *ad-hoc*, outsourced, confined exercises, but should involve a permanent in-house monitoring and evaluation capacity that will be able to combine internal and external expertise much more effectively. A pivotal tool for assessing impact beyond STI will be proper macroeconomic and environmental models that encompass the full potential of STI as a driver of sustainable growth, with all its direct and indirect effects. What makes STI particularly powerful as a driver of growth is its indirect spillover effects, which can only be assessed within a broader macro framework. Such macro models will enable better assessment of the overall short- and long-run impact of EU research and innovation policies, such as Horizon Europe, and also of other research and innovation funding at country and regional levels, and complementary policies affecting the functioning of product and labour markets and educational

systems. You should therefore invest in an in-house monitoring and evaluation capacity, with appropriate resources and expertise.

You will need this resource not only to improve your own major instrument, Horizon Europe, but also to support your pivotal role in coordinating with other EU and member-state policymakers, by providing evidence on what is needed to maximise the benefits from Horizon Europe. You will need the backing of quality analysis if you want to be in the driver's seat in the multitude of coordinating bodies you will have to participate in.

3.2 Horizon Europe

Cohesion and excellence

In the ongoing discussions with national stakeholders on Horizon Europe, you will need a convincing strategy to rebuild trust in EU instruments and move national stakeholders towards taking a positive-sum perspective, away from their zero-sum perspectives. This will require hard evidence of how Horizon Europe and an integrated EU area for innovation will provide benefits for member states beyond the euros that are directly allocated to them. You will need to instruct your monitoring and evaluation unit to identify which complementary national or regional policies are needed to get the most out of Horizon Europe in each member state.

Such evidence will help you switch the debate on 'excellence versus cohesion' to a debate on 'excellence for cohesion', showing that cohesion should not be seen simply in terms of equal distribution of inputs. What matters more for cohesion is the extent to which an excellence-based EU STI policy can generate greater impact for all, also in cohesion regions.

The sharing excellence pillar proposed under Horizon Europe, with 2 percent of its total budget, fits into this discussion. It can be used as an argument for the cohesion criterion to not be applied as a selection criterion for the other pillars, which should be solely based on excellence and/or impact. The sharing excellence pillar is also rightly targeted at supporting member states and regions in improving their national or regional capacities to absorb and benefit from excellent research and innovation created anywhere in the EU and beyond. You will need to instruct your monitoring

*SHARING
EXCELLENCE

and evaluation unit to assess whether this sharing excellence pillar will be effective.

Top-down versus bottom-up

Horizon Europe should have a good mix of bottom-up and top-down instruments. The trend in Horizon Europe compared to the past is to move more towards top-down instruments.

It is proposed that more than half the Horizon Europe budget will be allocated to ‘global challenges/missions’ (pillar 2), which is the top-down pillar. The bottom-up pillars, with investigator-driven proposals, are the open science and open innovation pillars (pillars 1 and 3). These take up respectively 25 percent and 14 percent of the proposed budget. Whether this is a good allocation or not should be analysed by your monitoring and evaluation unit. It is important to note that the bottom-up open science and open innovation pillars, even if their selection criterion is solely excellence and not impact, will also be important contributors to the addressing of global challenges/missions. You should ask, for example, the European Research Council to report to you how many climate-change projects they funded and their impacts. You will be pleasantly surprised. In the current political climate of asking for more immediate results from public funding, you should protect these bottom-up pillars from top-down pressures. These pillars will give you the option to address challenges that you might not have yet identified, but that the entrepreneurial scientists and innovators might have. Even under the global challenges pillar, the challenges are and should be sufficiently generally described so that there is room for bottom-up initiatives to identify how best to address them.

Horizon Europe’s top-down second pillar – challenges/missions – should be sufficiently openly specified to avoid capture – in other words, to avoid being suitable only for incumbent capacities. The missions, especially those in the new EU-wide research and innovation missions programme², will be co-designed with citizens, stakeholders, the European Parliament and member states. Such co-design and co-determination of missions risks leading to stakeholder-driven allocations and specifications

*OPEN
SCIENCE

*EUROPEAN
RESEARCH
COUNCIL



It will be important to ensure a good mix in Horizon Europe of upstream science, pre-commercial research and downstream innovation

*CLUSTERS

that best fit existing stakeholders. They should be open to new approaches and new participants. You should work to keep these missions open to all.

In line with the EU's overall priorities, the proposed allocations to clusters from the roughly €50 billion budget under the second pillar prioritise the climate and digital challenges (30 percent each to digital and industry, and to climate and energy). The urgency of the climate change challenge could easily justify even higher funding. The remaining allocations (food and natural resources, 20 percent; health, 15 percent; inclusive and safe societies, 5 percent), look very path-dependent. The inclusive and safe societies priority in particular arguably has too small a share in light of the current societal challenges.

From science to innovation

*OPEN
INNOVATION

A next important issue is to ensure a good mix in Horizon Europe of upstream science, pre-commercial research and downstream innovation. Horizon Europe takes a clear step forwards towards supporting innovation. This is most clear in the introduction of an Open Innovation pillar, with €13.5 billion of proposed funding and a new instrument: the European Innovation Council (EIC)³. You can easily justify increased support for innovation in relation to issues raised in section 1 of this memo. Europe produces great science, but typically succeeds less in turning this great science into great innovative successes. The EU's aspiring entrepreneurs, particularly young more-radical innovators, face obstacles in bringing their ideas to commercial fruition, particularly in relation to access risk finance. Public funding support could help to address this barrier.

This problem is well known and longstanding, and various support schemes already exist in member states and at EU level (for example, the European Investment Fund). The question is whether there is a role for a new instrument, as proposed in Horizon Europe. You can justify the value added of the EIC over other similar instruments by referring to its scope. Building on the success of the ERC, which has a selection process that has become a true seal of excellence, the EIC could likewise exploit applications and evaluating experts from across the EU and become a reputable label of excellence. Similarly to ERC grantees, being an EIC grantee could and should become a valuable certification for successful applicants, which will help them secure additional funding and other recognition. For the EIC to offer value added over and above national schemes, it is critical for to become a quality label, like the ERC. For this, it is critical that you install an EIC governance model like the ERC, based on a sufficiently autonomous council composed of recognised technology leaders, who can design the programme and select the evaluators. The potential for EIC value added is more obvious for the early stages of financing, when certification is much more critical, less so for later accelerator phases of financing. You should therefore prioritise the early-stage pathfinder EIC instrument over its accelerator instrument.

Back to science

The open science pillar, with about €25 billion of the proposed Horizon Europe budget, is perhaps the pillar that might be seen as less of a priority, simply because of its well-established instruments. But it would be wrong to take them for granted.

The ERC's success story might have been remarkable but its formula needs to be protected. A critical ingredient of its successful formula (to be replicated by the EIC) is the autonomy and independence its scientific council has in designing grants and selecting evaluators⁴. This autonomy is accompanied by accountability against clearly-defined targets aligned to the ERC mission of supporting frontier research, and there is no need for further oversight of the ERC. But you should protect the ERC autonomy-accountability model.

*MARIE CURIE ACTIONS

The excellent science pillar contains another instrument, Marie Skłodowska Curie Actions (MSCA). This programme is pivotal, but has not been recognised as such (see Box 1). It is pivotal because it is the EU's dedicated instrument for supporting the mobility of EU researchers between EU countries and to non-EU countries, the mobility of researchers who come to the EU from outside, and mobility between academia and industry. Researcher mobility is key for STI capacity. Mobile researchers bring their knowledge and the connections when crossing geographical or institutional boundaries. Researcher mobility is thus a critical pathway for knowledge networks, collaboration and spillovers. Mobility underpins better leverage of the full benefits of public investment in STI.

*RESEARCHER MOBILITY

Some time ago, for unclear reasons, this instrument left your portfolio and ended up with the commissioner responsible for education. It should be moved back into your portfolio, or you should at least work closely with your colleague. In any case, it needs to be revamped. Only a very small part of the current MSCA budget, itself already relatively small, is spent on individual fellowships for mobility and research-staff exchanges. Most of the MSCA budget is for doctoral training. The sums spent on mobility between academia and industry, and on fellowships for non-EU researchers and EU researchers outside the EU, are also minimal. Most of MSCA mobility is intra-EU and so far, exchanges involving the countries that joined the EU in 2004 and after have been limited.

MSCA should be expanded to cover more exchange between academia and industry. It should also introduce new fellowships involving academia and start-ups. Sending EU researchers across borders from academia to industry and from academia to start-ups will help bridge the gap between science and the commercialisation of innovative ideas.

*ACADEMIA- INDUSTRY EXCHANGE

There should be more individual fellowships and return fellowships aimed at helping lagging member states catch up. Enabling researchers to move from catching-up countries to excellent research destinations will help in building research excellence and will boost lagging countries when their researchers return home.

Box 2: Marie Skłodowska Curie Actions (MSCA) in Horizon 2020 (2014-20)

- 8 percent of the Horizon 2020 budget went to the MSCA programme, equivalent to about €6 billion, an increase from €4.7 billion in the previous seventh framework programme budget;
- Most MSCA funding goes to training of doctoral students: 54 percent of the MSCA budget is for Innovative Training Networks;
- Only 27 percent of the MSCA budget goes to individual fellowships for PhD holders. Another 9 percent goes to research staff exchanges;
- 80 percent of the budget for individual fellowships is for intra-EU mobility. Only 20 percent is for mobility to and from third countries;
- The US is the major third country, accounting for somewhat more than 40 percent of all third-country participants. China accounts for less than 5 percent;
- Countries that joined the EU in 2004 and after account for only 6 percent of all MSCA participants; the EU15 for 87 percent. The UK is the major beneficiary, accounting for about one quarter of all MSCA participants;
- Only 1 percent of the MSCA budget goes to the ‘Society and Enterprise’ panel, which funds individual fellowships in companies. Another 4 percent goes to European Industrial Doctorates. Of the research staff exchanges, less than half is for mobility between academia and non-academia;
- 2 percent of the MSCA budget goes to reintegration: fellowships to bring back EU researchers from outside the EU.

Source: Bruegel, based on Cordis and the European Commission’s interim evaluation of Horizon 2020 (https://ec.europa.eu/info/publications/interim-evaluation-horizon-2020_en).

There should be more individual fellowships and return fellowships linked to non-EU countries. Hosting top non-EU researchers and sending EU researchers to the best places outside the EU, and maintaining links with those places, will help the EU connect better to leading research countries. China, in particular, is significantly underrepresented currently in MSCA.

More targeting of MSCA to specific challenges/missions would help improve the knowledge spillover in key challenge areas. More

mobility between academia and industry in targeted areas, such as digital technologies, would help address the skills shortfalls that hold up industry from engaging in these new technologies.

This revamping could be done by reshuffling the MSCA budget, but in view of its small size, it would be better to find extra money to support MSCA fellowships by dedicating some of the other Horizon Europe funding (for example, from the sharing excellence pillar or the challenges pillar), or other parts of the EU budget (such as the structural funds).

Finally, the selection process for MSCA individual fellowships should be improved. The fellowships should become, like the ERC, a recognised seal of excellence.

Open to the world

It is important that the EU is connected to the other global centres of science excellence. Past and current framework programmes have not been very successful in establishing links with the best science countries. The EU's relationships with third countries that are at the frontier of science should be greatly intensified. Selection on the basis of excellence should become the priority for agreements with third countries, with the US and China being among the highest priorities. Links with China in particular should be strengthened.

You also need to consider the future relationship with the United Kingdom. The UK has been a major net recipient of framework programme funding and has also been a major contributor to EU STI excellence and impact. The UK has also been an important hub for incoming and outgoing EU talent and for intra-EU collaboration, and has been a major gateway to non-EU countries, collaborating with and attracting their talents. You should be concerned about the loss inflicted on the EU27 by separation from an important source of EU science and innovation excellence.

Minimising this loss should be your focus, rather than the money the EU27 would recover from the UK leaving or what price the UK should pay to join the European Research Area. Minimising the damage requires an integrated research area with the UK, with the opportunities for cross-border mobility of talent and collaboration

*THIRD-
COUNTRY
LINKS

*EUROPEAN
RESEARCH
AREA

safeguarded as much as possible. Your monitoring and evaluation unit should help you with the evidence on the win-win areas to be safeguarded. Such evidence will also allow you to quantify how much the EU27 would be willing to pay to keep the EU on board, and also what should be asked for from the UK for its continued participation.

Open science

The principle of maintaining open access to publications and data that result from EU-funded research should be applied to Horizon Europe. Scientific results from public funding should be available to everybody. But you could give the world of open science a big boost by using your power as an important funding agency to negotiate with publishers fair prices for providing open access. You can also ask your colleague responsible for competition to look into pricing behaviour in this sector. What should be ensured is that EU public funds designated for open research do not end up being transferred into excessive publishers' mark-ups.

*OPEN ACCESS

NOTES

- 1 See http://ec.europa.eu/invest-in-research/action/history_en.htm.
- 2 See https://ec.europa.eu/info/designing-next-framework-programme/mission-oriented-policy-next-research-and-innovation-framework-programme_en.
- 3 The EIC is not really new, but a revamping of the SME instrument from past framework programmes.
- 4 Between 2012 and 2016, the author of this memo was a member of the ERC Scientific Council.

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