

HEADING 1A: Competitiveness for growth and jobs**The Framework Programme for Research and Innovation (Horizon 2020)****Lead DG: RTD**

Associated DGs: EAC, CNECT, HOME, ENER, AGRI, GROW, MOVE, JRC, DEFSI

I. Overview***What the programme is about?***

Horizon 2020 is the biggest EU research and innovation programme ever. It aims at improving EU citizens' life through more breakthroughs, discoveries and world-firsts by taking great ideas from the lab to the market. Investment in research and innovation is essential for Europe's future and so they are at the heart of the Europe 2020 strategy for a smart, sustainable and inclusive growth. The goal is to ensure Europe produces world-class science and technology, removes barriers to innovation and makes it easier for the public and private sectors to work together in delivering solutions to big challenges facing the EU citizens and more globally our society.

Horizon 2020 is made up of three main pillars:

- Industrial leadership – boosting the EU's economic competitiveness;
- Excellent science – producing and promoting world-class science in Europe;
- Societal challenges – finding solutions to the big challenges facing our society.

It should be noted that research is an area where projects last several years, and the results often only emerge even after a project has been closed. Therefore, although some exciting results from Horizon 2020 have already been published, the vast bulk of them are expected to be delivered only after year 2020.

EU added value of the programme

In accordance with the principles of subsidiarity and proportionality set out in Article 5 of the Treaty on European Union, there is compelling evidence that Member States acting alone will not be able to make the required public intervention in the research domain in terms of achieving an appropriate, 'critical mass' level of investment and battling fragmentation.

Horizon 2020 plays a central role in the delivery of the Europe 2020 strategy for smart, sustainable and inclusive growth by providing a common strategic framework for the Union's research and innovation funding, thus acting as a vehicle for leveraging private investment, creating new job opportunities and ensuring Europe's long-term sustainable growth and competitiveness.

The added value of investing in Research & Innovation at EU level is very large. Research & Innovation are public goods with a strong European dimension (Reflection Paper on the Future of EU Finances.). EU investments in R&I leverage additional funds at the national level (without evidence of substitution).

Due to their scale, speed and scope, EU-funded projects would not have gone ahead with national funding alone (As shown in the Interim Evaluation of Horizon 2020, 83 % of projects would not have gone ahead without EU funding.). Below is a list of the benefits (The quantifications listed below come from a rigorous counterfactual analysis comparing R&I teams that received EU funding with those who did not. See PPMI study on EU added value of EU Framework Programmes, 2017) of investing at the EU level, compared to the national and regional level, together with concrete examples:

- boosting EU competitiveness through the creation of trans-national and multidisciplinary networks and markets, which lead to positive knowledge spillovers and technology transfers across the Union, and result in new products and services:
 - EU-funded R&I teams are 40 % more likely than non-EU funded teams to be granted patents;
- pooling public and private resources / knowledge to achieve the critical mass needed to tackle global challenges:
 - the work of the UN's IPCC on climate change relied extensively on EU-funded research;
 - only EU-level action can overcome the thin distribution of patients affected by rare diseases (6 000 rare diseases, taken together, affect ~20 million EU citizens);
- strengthening scientific excellence through EU-wide competition and cooperation:
 - in the world's top 1 % most cited publications, four times more publications derive from Horizon 2020 projects than from any other source of funding (in relative terms);
 - EU-funded peer-reviewed publications are cited more than twice as often as the world average;
- increasing the EU's attractiveness as a place for education, research, innovation and business:
 - EU funding supports over 300 000 researchers and innovators;
 - the research impact of internationally mobile researchers supported by Marie Skłodowska Curie Actions is up to 20 % higher than for non-mobile researchers;
 - EU-funded teams grow faster and attract twice as many collaborations from outside the EU;

- leveraging private investment:
 - EU R&I projects give the impetus to the private sector to invest more of their own funds than they do under national funding schemes – Horizon 2020 has leveraged EUR 13 billion in private funds and mobilised EUR 29.6 billion via debt financing;
- having a positive structuring effect on the national R&I ecosystems:
 - the European Research Council has become a global beacon of excellence. This has in turn encouraged the national research institutions to evolve and improve in order to attract and retain grantees.

Implementation mode

Funding opportunities under Horizon 2020 are set out in multiannual work programmes, which cover the large majority of support available. The work programmes are prepared by the European Commission within the framework provided by the Horizon 2020 legislation and through a strategic programming process which integrates EU policy objectives in the priority setting. The main Horizon 2020 work programme is complemented by the separate work programmes for the European Research Council, Euratom, the Joint Research Centre and the Strategic Innovation Agenda for the European Institute of Innovation and technology (EIT).

Horizon 2020 supports indirect actions through one or several of the forms of funding, in particular grants, prizes, procurement and financial instruments. Financial instruments are the main form of funding for activities close to market under Horizon 2020. These instruments help companies and other types of organizations engaged in R&I to gain easier access to financing, in the form of risk-sharing (for loans and guarantees) and by providing risk finance (equity). The aim is to stimulate more investment in research and innovation, notably by the private sector.

Horizon 2020 also supports direct actions, which are undertaken by the JRC.

Management and implementation of the Horizon 2020 programme is undertaken by 29 different bodies:

- Ten Commission DGs: RTD, CNECT, GROW, DEFIS, MOVE, ENER, HOME, EAC, JRC, AGRI;
- Four executive agencies: European Research Council Executive Agency (ERCEA), Research Executive Agency (REA), Executive Agency for SMEs (EASME), Innovation & Networks Executive Agency (INEA);
- Five public-public partnerships (Art. 185 TFEU bodies): Active and Assisted Living (AAL), European & Developing Countries Clinical Trials Partnership (EDCTP 2), European Metrology Research Programme (EMPIR), Research and Development Programme aimed at supporting research performing small and medium-sized enterprises (Eurostars 2), Partnership for Research and Innovation in the Mediterranean Area (PRIMA);
- Eight public-private partnerships, (Art. 187 TFEU bodies or Joint Undertakings): Bio-based industries (BBI), Clean Sky 2, ECSEL, Fuel Cells and Hydrogen (FCH 2), the new High Performance Computing (HPC), Innovative Medicines Initiative (IMI 2), SESAR and Shift2Rail; complemented by ten contractual Public-Private Partnerships (cPPP); Factories of the Future; Energy-efficient Buildings; European Green Vehicles Initiative; Sustainable Process Industry; Photonics; Robotics; High Performance Computing; Advanced 5G networks for the Future Internet; Cybersecurity and Big Data Value.
- The European Institute of Innovation and Technology (EIT);
- The European Investment Bank (EIB) and the European Investment Fund (EIF).

The Commission has taken a number of measures to ensure a consistent and harmonized approach amongst the different implementing services. Thus, there is a range of strategic coordination mechanisms, including the strategic programming exercise that leads to the development of the Work Programme. For grant management, a Common Support Centre has been established, which provides common services to all members of the ‘research family’. There are also common rules for participation, with very few derogations, replacing the multitude of rules of the past.

II. Programme Implementation Update

Implementation status (2017-2019)

The **2016-2017 Work Programme** was flexible and capable of addressing the topical issues that matter most to the European citizens. Important novelties were introduced:

- A new boost to **competitiveness** by accelerating innovation and collaboration, and by improving transparency and openness when it comes to research data, thus avoiding duplication of efforts. The current Open Research Data Pilot programme was extended to cover all the thematic areas of Horizon 2020, **making open research data the default setting**.
- In response to the **migration crisis**, funding was made available to help coordinate research communities and to make policy recommendations to facilitate migrants’ integration into the labour market.
- Key actions **supporting a forward-looking climate change policy**, such as the new ‘**Closing the water gap**’ topic with a budget of EUR 10 million in the ‘Greening the economy’ call. This will reduce the fragmentation of water research and innovation efforts across Europe and contribute to the implementation of the Sustainable Development Goals (SDGs), as well as to the conclusions of the COP21 Paris Agreement on climate change.

By the February 2020, 228 411 eligible proposals were submitted, requesting a total EU financial contribution of EUR 363.9 billion. Out of these, 27 488 proposals had been retained for funding, bringing the overall success rate of eligible full proposals in the first five years to 12.03 %. These retained proposals resulted in a total of 27 190 signed grant agreements, with a total budget allocation of EUR 50.5 billion in EU funding. This amount is expected to grow even further, as some of the grants from the 2018 call planning will be signed only in 2019.

Key achievements

The Research and Innovation projects funded by Horizon 2020 have already produced many results. Due to the large volume of results, it is impossible to present all 2019 key achievements. Therefore, only a few of them with limited information are presented in this section. The results of all funded projects including all the European Commission's information such as the grant, the funding and participants, the projects' summaries, and links to specific publications and other documents are available on http://cordis.europa.eu/projects/home_en.html. Furthermore, we would like to emphasise that most of the following key results belong to EU projects funded before 2019. Indeed, it takes a number of months or even many years after the launch of the project to get a reliable result. You will find in this section an extract of the 2019 key achievements sorted by the order of the funding domain.

The European Research Council (ERC) selects and funds the very best, creative researchers of any nationality and age, to run projects in Europe. For example, on a remote island at the edge of the Aegean Sea, a climate change superstation has been constructed with the support of the ERC, the National Observatory of Athens (NOA) and the Greek government. This remote Ionian island is increasingly coming into the limelight as a main reference point for climate, energy and weather research in the Eastern Mediterranean.

The 2019 Nobel Prize in Physiology or Medicine has been awarded to Professors William G. Kaelin Jr, Sir Peter J. Ratcliffe and Gregg L. Semenza 'for their discoveries of how cells sense and adapt to oxygen availability'. Sir Peter J. Ratcliffe is **the seventh ERC-funded researcher to be awarded a Nobel Prize** to date. The project succeeded in providing a detailed structural and chemical characterisation of human hydroxylase enzymes, and also led to the development of inhibitors of these enzymes. Modulating how cells respond to hypoxia could in the future be of therapeutic use in ischaemic disease and cancer.

The Marie Skłodowska-Curie Actions (MSCA) has created an extensive network of researchers from all scientific fields, and intersectoral partnerships, which are able to contribute to the implementation of different EU policies. This is notably the case for the European Green Deal, as **MSCA has been funding about 600 research projects related to climate-change** for a total budget of EUR 310 million since 2014. MSCA is also greatly contributing to the implementation of the EU strategy for international cooperation in research and innovation, accounting alone for more than half of the total third countries' participations to Horizon 2020, while 38 % of the MSCA fellows are nationals from non-EU countries.

Each year on the last Friday in September, **the European Researchers' Night** brings research and researchers closer to the public at large, to boost public recognition of science and research education and show the impact of research on daily life. It has become the largest research communication and promotion event in Europe. In 2019, the European Researchers' Night (27 September) was implemented in more than 400 cities across Europe and beyond. The events involved more than **36,000 researchers** and attracted **1.65 million visitors**, and stimulated, especially among young people, interest in research and related careers.

The 10th April 2019, the Commission revealed **the first ever image of a black hole** taken by Event Horizon Telescope, a global scientific collaboration involving EU-funded scientists. This major discovery provides visual evidence for the existence of black holes and pushes the boundaries of modern science. The crucial observation was possible because of the state-of-the-art technique was in place. The EU has supporting the upgrade to the technologies needed for some of these research infrastructures, in the past 15 years, through various grants to RadioNet for a total amount of about EUR 30 million, including EUR 10 million from Horizon 2020.

The Euro-ARGO ERIC, (European Research Infrastructure Consortium), has been established to develop a long term European contribution to Argo Programme that uses profiling floats to observe temperature, salinity, currents, and, recently, bio-optical properties in the Earth's oceans. EURO-ARGO project has already deployed **279 new floats that represent more than 25 % of the global contribution**.

Horizon 2020 supports the European Earth Observation Programme, Copernicus, with **five research projects dealing explicitly with climate change and CO₂ monitoring**. Research organisations and public bodies from throughout Europe are working together to provide comprehensive, detailed and reliable climate information. This will not reduce CO₂ or stop climate change per se, but it will give Europe an independent monitoring tool in support of political measures. It is available to all interested parties for free. An innovative use of these services can be found in application projects in various domains: The agricultural sector represents about two thirds of all Horizon 2020 Copernicus downstream projects in the private commercial domain. Many of them aim to solve problems related to climate change, such as the need for irrigation and managing ground water supplies. Another example is applications fostering urban sustainability combining climate change related infrastructure adaptations, energy management and social measures. This can serve both the private and public sector.

EU-funded projects will help transform our economy and society and decouple industrial growth from environmental impacts. Currently, on average, every citizen generates around 5 tonnes of waste per year, of which only a limited amount is recycled, most of the remainder is landfilled or incinerated. Six projects propose innovative solutions that promote waste reduction and improved resource efficiency in the textile, construction, photovoltaic, steel industry, bulky and urban waste sectors. The

initiatives focused on Industrial Symbiosis, which is key driver for enabling the next step in a circular economy with a significant reduction in Green House Gas emissions, as well as its contribution to reaching a climate neutral economy by 2050 (zero emissions/zero waste). BAMB, reduces construction and demolition waste through a new standardised circular way of designing buildings, enabling the construction sector to recover, repair and reuse building materials. Meanwhile, CABRISS developed a circular economy for not only the photovoltaic (PV), but also the electronic and glass industries to form new business opportunities through the recovery of high-value materials found in End-of-Life PV panels. URBANREC designed an innovative bulky waste management system to enhance waste prevention and encourage new forms of waste treatment to obtain high benefit recycled products.

The European Innovation Council, (EIC) can help innovators from the stage of idea and invention to investments in various domains such as the environment. The TAPP Water, has received a phase 2 grant from the EIC SME Instrument Program to further **enhance tap quality and reduce plastic bottle waste** with 2 billion bottles per year.

New tools and new solutions to reduce Breast cancer. Breast cancer claims the lives of more European women than any other cancer: one in eight women in the EU will develop breast cancer before the age of 85. Data from the European Cancer Information System (ECIS) indicate more than 400 000 new cases were diagnosed in 2018. By improving the quality of breast cancer services in Europe, the European Commission Initiative on Breast Cancer (ECIBC) aims to help reduce the burden of cancer and decrease the avoidable differences in breast cancer incidence, prevalence, mortality and survival. The European Union is exploring all avenues to save lives. By understanding the molecular characteristics of stem cells, the BRECASTEM project hopes to advance new treatments and more targeted therapies. EpiPredict has mapped systems behaviour of breast cancer cells after hormone treatment. Findings show how tumours change their ‘appearance’ to evade cancer treatments using epigenetic mechanisms. Meanwhile, the INTHER project developed an innovative device to deliver minimally invasive immunostimulating Interstitial Laser Thermotherapy (imILT). The therapy works by attacking the tumour directly and stimulating the patient’s own immune system to attack other (same-type cancer) tumours. Traditionally, breast cancer treatment decisions made by physicians rely on clinical pathology such as the tumour’s hormone receptor status, age, tumour size, grade and lymph node involvement. However, this approach doesn’t determine the risk of cancer recurrence with patients being over- or under-treated. The MammaPrint project, following on from two previous FP6 and FP7 projects, set out to analyse the entire genome of patients and further validate a molecular signature that could be associated with cancer recurrence. The MATADOR project is dedicated to developing a new cell-based test for drug screening capable of identifying the compounds that best interfere with epithelial-to-mesenchymal transition. Finally, ONCOscanner is an innovative solution that enables intra-operative recognition of collected tissues during surgical removal of cancerous breast tissue. By doing so, the scanner can detect breast cancer tissue during an operation, leading to an improved rate of retention of healthy tissue and local treatment outcome.

But still a way to go. The breast cancer mortality rate has dropped by nearly 12 % across the EU over the past decade, the study notes, with 13.36 women per 100 000 expected to succumb to the disease in 2019, down from 16.44 women per 100 000 in the 2005-2009 period. Researchers found that six of the biggest countries in the bloc now have averages hovering from 13-14 deaths per 100 000 women. Cancer is an important priority of the next phase of the EU’s research and innovation programme, Horizon Europe. The programme includes a proposal to establish a ‘Mission on Cancer’ to boost the impact of EU-funded research and innovation by mobilising investment and EU-wide efforts around measurable and time-bound goals around issues that affect citizens’ daily lives.’

Horizon 2020 projects related to ‘Food’ highlight **how our ecosystems contribute to sustainable production, food security, safety and healthy and sustainable nutrition in the EU (and globally) and how they deliver on the main EU policies.** A number of projects have analysed the production dimension from different angles. AquaSpace’s goal is to provide greater space for aquaculture so as to allow increased production while DIVERSIFOOD has evaluated and enriched the diversity of cultivated plants within diverse agroecosystems to increase their performance, resilience, quality and use by studying underutilized and forgotten plant species for organic and low-input agriculture. SUFISA has identified sustainable practices and policies in the agricultural, fish and food sectors that support the sustainability of primary producers in a context of multi-dimensional policy requirements, market uncertainties and globalisation.

Horizon 2020 projects **address technology development, market barriers and accelerate the uptake of renewable energy technologies.** On a regional basis, CoolHeating supported the implementation of small modular heating and cooling grids in south eastern Europe using improved business strategy and innovative financing schemes. The BestRES project explored aggregation of various distributed renewable energy sources. Development of ‘bioenergy villages’ requires bioenergy concepts to be at the investment stage. BioVill developed these villages in Croatia, Serbia, Slovenia, North Macedonia and Romania to a point where they could cooperate with established markets in Austria and Germany. LIFES 50plus has delivered two optimized, innovative substructure designs for very large floating offshore wind turbines (10 MW) that have been qualified to TRL (Technology Readiness Level) of 5 through experimental validation in relevant environment. The two Selected Designs have also undergone an industrialization process to guarantee their MRL (Manufacturing Readiness Level). Assuming that this replaces generation from conventional coal fired power plants in the long terms, emissions will be reduced with some several million tonnes of CO₂ for every TWh of offshore wind generation. In a climate-neutral Europe, power generation should be fully decarbonised by 2050, more than 80 % of the EU’s electricity will be produced by RESs (Renewable Energy Sources). *Efforts are still required to meet these targets.* The Commission proposed in the next R&I programme Horizon Europe a **mission ‘Climate neutral and Smart Cities’** to help the EU to meet the goals and targets set out by international policy frameworks such as the COP21 Paris Agreement, the UN’s Sustainable Development Goals (notably SDG11), the Urban Agenda for the EU and the Habitat III New Urban Agenda as cities play a key role in all of them.

Europe enjoys a rich diversity of flora and fauna, many of which are unique. This natural wealth provides us with clean air and water, productive soils as well as energy and natural resources for economic and social development. Such healthy ecosystems help mitigate the impacts of climate change, while supporting a green economy, creating job opportunities and enhancing biodiversity. Many animal and plant species are seriously threatened by urban sprawl, intensive agriculture, pollution, invasive species and climate change resulting from human activities. The International Union for Conservation of Nature estimates that up to 25 % of European animal species are now threatened with extinction. In full awareness of the situation, Horizon 2020 contributes significant financial resources to the conservation of biodiversity. **ECOPOTENTIAL developed tools to connect Earth observation techniques with field measurements to study ecosystems and better manage protected areas** such as National Parks, Unesco World Heritage and Natura2000 sites, and marine ecosystems. **AQUACROSS advanced knowledge on ecosystem management to enhance the resilience of aquatic ecosystems and arrest biodiversity loss.** Wetlands are the ecosystems with the highest rate of loss around the world.

Co-creating innovative public services for citizens and businesses. The TOOP project is piloting solutions to help administrators implement the ‘once-only principle’ by developing a federated technical architecture to connect national registries at the EU level, while SCOOP4C is aiming at simplifying administrative procedures for citizens. RECAP helps both administrators and farmers alike adhere to the technical demands of the Common Agricultural Policy, saving both time and money, while OpenGovIntelligence pilots the use of Linked Open Statistical Data and the active participation of society and businesses in data sharing.

The security of 5G telecommunications networks has become a pressing political issue. An EU toolbox of mitigating measures was published on 29 January 2020, designed to address effectively major risks to 5G networks, such as criminal hacking, espionage and sabotage, in a coordinated way. The project SPIDER (cyberSecurity Platform for vRtualised 5G cybErRange services) aims at providing an innovative cyber range platform with the latest 5G virtualisation, infrastructure management and orchestration technologies. Furthermore, it seeks to utilize state-of-the-art AI/Machine Learning-based technologies capable of assessing the security of critical virtualised communication infrastructures and to integrate improved risk analysis and econometric models that can support organisations in making optimal cybersecurity investment decisions. The SPIDER virtual environment will be also used for training information security professionals to deal with real-world 5G security incidents.

Enhanced situational awareness improves decision-making during extreme weather events – The intensity, frequency and economic costs of extreme weather events are increasing with global climate change. As a result, flooding, droughts, heatwaves and wildfires are expected to be more common and more severe in the future. Currently, emergency management of severe weather events is largely decentralised, leaving local communities responsible to prepare for and deal with disasters. Innovative crisis management tools and technology should enable a fast and effective response, significantly decreasing loss of life and property. The EU-funded beAWARE project developed a comprehensive communications and analysis platform to help decision-makers, first responders and citizens. It includes multilingual verbal and written communication analyses, multilingual report generation and emergency multimedia-enriched communication. Widespread implementation of the beAWARE platform at the local level should enable communities to take charge of crisis management. Community leaders, first responders and citizens alike will be able to address increasingly severe weather events more quickly and effectively, saving lives and livelihoods.

The Emissions Database for Global Atmospheric Research (EDGAR) provides **global past and present day anthropogenic emissions of greenhouse gases and air pollutants by country and on a spatial grid**. The EDGAR 2019 report produced by JRC shows that global CO₂ emissions from fossil fuels combustion and processes further increased by 1.9 % in 2018 compared to the previous year. The world’s largest CO₂ emitters in 2018 remain China, the United States, India, the EU28, Russia and Japan. However, **the EU28 and Japan reduced their fossil CO₂ emissions by -1.9 % and -1.7 % respectively.**

In order to achieve the ambition transition to a low carbon economy meeting the 2 % target, global greenhouse gas emissions need to drop to net zero in the second half of the century. The Global Energy and Climate Outlook (GECO) produced by JRC analyses the role of electrification in global transition pathways to a low Greenhouse Gas (GHG) emissions economy. The 2 °C target could be achieved by simultaneously transforming various elements of the energy system: This report further shows that the 2 °C target is technically possible at relatively low cost for the overall economy (global GDP reduction below 1 % across all sensitivities compared to Reference in 2050). This would also bring along co-benefits for air quality. The role of electricity is examined by large sector (industry, transport, buildings, power generation), with a particular regional focus on the EU and China and a sectoral focus on road transport electrification.

. In addition, in support to EU Directives, research activities are carried out at the Vehicle Emissions Laboratory (VELA) testing facilities on a variety of **vehicles’ emissions including the measurement of evaporative emissions.**

The EIT has established a trusted network of around 1 650 partners across Europe, making it one of the largest networked innovation communities in the world. Overall, the EIT has supported over 1 250 start-ups and scale-ups (more than EUR 890 million in investments), and creating more than 6 100 high-skilled jobs and also bringing over 600 new products and services to the market. More than 2 300 students have already graduated from EIT-labelled education programmes at Master and PhD level. These accomplishments are proof that the EIT is an up-and-running innovation engine that delivers tangible results. Some of the companies supported by the EIT at an early stage have now grown into major players in their markets and attracted substantial private sector investments, for example Tado, Konux, Skeleton Technologies, Navya and Lilium Aviation. Among the innovative solutions supported by the EIT KICs that contributing to tackle the climate and environmental-related challenges are unique wave energy converter to efficiently and sustainably harvest energy from oceans, hyperloop – an energy-efficient new mode of tube transportation for large volume of passengers and cargo or robotics technology in waste management to improve the quality of

recycled materials and facilitate their reintroduction into the value chain.

Evaluation /studies conducted

The Horizon 2020 interim evaluation was completed and published in May 2017 – see: https://ec.europa.eu/info/research-and-innovation/strategy/support-policy-making/support-eu-research-and-innovation-policy-making/evaluation-impact-assessment-and-monitoring/horizon-2020_en

Forthcoming implementation

The 2018-2020 Work Programme was built on the success of Horizon 2020 so far and lessons learned from the interim evaluation from the programme. For this 2020 work programme five major priorities were identified, themselves founded on the overall policy priorities for the EU, and a significant proportion of the budget of EUR 7.6 billion has been focused on these. Also, the 2018-2020 Work Programme invests **EUR 2.7 billion to kick-start the new European Innovation Council**, which will support break-through innovation in the EU.

The five priorities are the following:

- Increased investment in sustainable development and climate related R&I
- Integrating digitisation in all industrial technologies and societal challenges
- Strengthening international R&I cooperation
- Societal Resilience
- Market creating innovation

Attention is drawn in particular to initiatives in key areas like the Digital Single Market, (High Performance Computing, ICT, SMEs), Energy Union, Mobility (batteries) Space and the Circular Economy including work on plastics.

This new content revitalises and resets the programme in the light of emerging priorities and, very importantly, ***connecting with the forthcoming Horizon Europe programme***. This work programme of Horizon 2020 also includes actions, which in terms of their content and structure will help to prepare for the possible research and innovation agendas and structures in Horizon Europe, although not prejudging the outcome of the negotiations on this new programme. These actions have been described as ‘bridging’ towards Horizon Europe. Two pilot topics in the Research Infrastructures work programme part will test some possible Horizon Europe features relating to the opening, integrating and interconnecting of research infrastructures. Relevant also in this context is the piloting of new approaches which are foreseen to be further developed in Horizon Europe, such as the enhanced EIC Pilot (Pathfinder and Accelerator).

Furthermore, this final update of the work programme contains ***measures to increase simplification***, e.g. lump sum pilots for funding, which have been extended to the FET-open, LEIT-NMBP, Dissemination, Exploitation and Evaluation and the Societal Challenges 1-6 work programme parts.

Overall, the final Horizon 2020 Work Programme has the potential to make a real and sustainable difference to the quality of life in the EU, as well as the EU’s position in the world, through the implementation of the Sustainable Development Goals (SDGs).

In line with and in order to prepare for Horizon Europe which emphasises ***support to synergies with other Union funding programmes and Union policies***, this work programme for Horizon 2020 will seek to support the issue. Project proposers should consider and actively seek synergies with, and where appropriate possibilities for further funding from, other relevant EU, national or regional research and innovation programmes (including ERDF/ESF+ or the Instrument for Pre-accession Assistance [IPA II]), private funds or financial instruments (including EFSI).

Building on the additional funding allocated to climate objectives under Horizon 2020 in 2020, a total budget of around EUR 1 billion will be dedicated to ‘Green Deal’ related calls. This amount is over and above the EUR 1,3 billion already foreseen for 2020, providing a total of around EUR 2,3 billion of Horizon 2020 funding allocated to clean-technology research and innovation in 2020. In addition, Horizon 2020 has shown its ability to react quickly to major events. In response to the current COVID19 pandemic, Horizon has in total mobilised in total more than 1 billion EUR (EUR 307 million on-going projects and EUR 715,5 million for new actions). The financing source comes from reprogramming of Research and Innovation activities across all Commission services. This allows the immediate redeployment of significant resources for COVID19 actions, while keeping the level of ambition for the Green Deal call (EUR 1 billion).

Outlook for the 2021-2027 period

Horizon Europe is the European Union’s seven-year research and innovation programme, running from 2021 to 2027, designed to serve the EC headline ambitions. The programme’s general objective is to deliver scientific, technological, economic and societal impact from the Union’s investments in R&I, to strengthen the scientific and technological bases of the Union, and foster its competitiveness in all Member States.

Horizon Europe is the largest EU’s R&I framework programme. Horizon Europe has the potential to generate significant economic, social and scientific returns.

Horizon Europe Structure Horizon Europe has three pillars:

- The Excellent Science pillar supports frontier research projects designed and driven by researchers through the European Research Council (ERC). It also funds fellowships and a mobility of researchers through Marie Skłodowska-Curie Actions, and invests in world-class research infrastructures.
- The Global Challenges and European Industrial Competitiveness pillar supports research into societal challenges, reinforces technological and industrial capacities, and sets EU-wide missions with ambitious goals tackling some of our biggest problems (health, climate change, clean energy, mobility, security, digital, materials, etc.). It will also support partnerships with Member States, industry and other stakeholders to work jointly on research and innovation. It includes action by the Joint Research Centre that supports EU and national policymakers with independent scientific evidence and technical support.
- The Innovative Europe pillar aims to make Europe a frontrunner in market-creating innovation and SME growth through the European Innovation Council. It will help develop the overall European innovation landscape. The European Institute of Innovation and Technology (EIT) will continue to foster the integration of business, research, higher education and entrepreneurship.

A fourth component on Widening participation and Strengthening the European Research Area underpins the whole of Horizon Europe. It will support EU Member States in their efforts to unlock their national research and innovation potential and it will especially help low R&I performing Member States to participate better in Horizon Europe.

Horizon Europe is not just about grants to enable European R&I. Spending money would deliver few lasting results if the broader framework for R&I is not effective and efficient. Horizon Europe is also a powerful tool to give direction to European R&I and to European policy. It brings together partners from science, innovation and business, to jointly develop agendas, to divide the work, and to focus on framework conditions such as regulation to improve the R&I ecosystem as a whole.

Horizon Europe innovation in governance

Strategic planning is a new way of setting the detailed research and innovation priorities of Horizon Europe, co-created by various Commission services, Member States, stakeholders and civil society. During the Horizon Europe implementation strategy process, two major sets of co-design activities took place between July and October 2019. Firstly, an open web consultation on Horizon Europe co-design implementation that collected 1,549 replies between 31 July 2019 and 4 October 2019. Respondents appreciated the continuity approach taken by the Commission regarding the rules of participation and by extension in a wider sense, to Horizon Europe’s implementation. Secondly, through meetings and exchanges at the European Research and Innovation Days (24-26 September 2019), which attracted a large stakeholder community of almost 4,000 participants. The feedback collected will feed into the on-going work on the Horizon Europe Implementation Strategy.

Horizon Europe: Novelties

One of the main novelty on Horizon Europe is the mission-driven approach that are linked to key societal challenges and relevant to a broad range of stakeholders as well as to citizens. They should deliver European public goods on some of the issues that matter most to people. The five mission areas are: adaptation to climate change including societal transformation; cancer; healthy oceans, seas, coastal and inland waters; climate-neutral and smart cities and health soil and food.

The European Innovation Council is another key novelty of Horizon Europe, built on the experience gained with the pilot under Horizon 2020; it is the one-stop shop for innovation to bring the most promising ideas and breakthrough innovations from lab to real-world application and help the most innovative start-ups and companies to scale up.

Under Horizon Europe, all EU access to (risk) finance instruments will be implemented under a single Invest EU Fund. DG Research & Innovation is involved in two windows of InvestEU: the R&I Window and the SME Window.

III. Programme key facts and performance framework

1. Financial programming

| Legal Basis | Period of application | Reference Amount (EUR million) |
|---|-----------------------|--------------------------------|
| 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) and repealing Decision No 1982/2006/EC (OJ L 347, 20.12.2013, p. 104). Council Decision 2013/743/EU of 3 December 2013 establishing the Specific Programme Implementing Horizon 2020 – The Framework Programme for Research and Innovation (2014 – 2020) and repealing Decisions 2006/971/EC, 2006/972/EC, 2006/973/EC, 2006/974/EC and 2006/975/EC (OJ L 347, 20.12.2013, m. 965). Regulation (EU) 2015/1017 of the European Parliament and of the Council of 25 June 2015 on the European Fund for Strategic Investments, the European Investment Advisory Hub and the European Investment Project Portal and amending Regulations (EU) No 1291/2013 and (EU) No 1316/2013 – the European Fund for Strategic Investments (OJ L 169, 1.7.2015, p. 1). | 2014 – 2020 | 74 828,3 |

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|-------------------------------------|
| Financial Programming (EUR million) |
|-------------------------------------|

| | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Total Programme |
|----------------------------|----------------|----------------|----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Administrative support | 496,3 | 489,9 | 497,6 | 494,6 | 496,8 | 506,5 | 513,8 | 3 495,6 |
| Operational appropriations | 7 575,3 | 7 620,9 | 7 754,0 | 8 618,7 | 9 075,4 | 10 118,7 | 10 941,2 | 61 704,1 |
| Executive Agency | 99,9 | 114,2 | 124,5 | 138,3 | 145,1 | 155,5 | 164,6 | 942,2 |
| Joint undertaking | 625,2 | 1 060,6 | 916,7 | 872,0 | 1 103,6 | 1 154,6 | 1 369,6 | 7 102,4 |
| Other bodies | 226,4 | 253,8 | 249,6 | 300,4 | 396,2 | 456,1 | 496,7 | 2 379,3 |
| Total | 9 023,1 | 9 539,4 | 9 542,5 | 10 423,9 | 11 217,2 | 12 391,5 | 13 485,9 | 75 623,6 |

2. Implementation rates

| | 2019 | | | | 2020 | | | |
|-------------------------------|------------|------------|------------|------------|------------|------------|------------|------------|
| | CA | Impl. Rate | PA | Impl. Rate | CA | Impl. Rate | PA | Impl. Rate |
| Voted appropriations | 12 391,501 | 100,00 % | 10 503,099 | 99,22 % | 13 485,949 | 32,82 % | 11 649,542 | 25,92 % |
| Authorised appropriations (*) | 14 933,711 | 92,44 % | 14 109,548 | 79,25 % | 15 470,408 | 32,33 % | 15 321,731 | 22,12 % |

(*) Authorised appropriations include voted appropriations, appropriations originating from assigned revenues (internal and external) as well as carried-over and reconstituted appropriations; the execution rate is calculated on 15 April 2020

3. Performance information

Programme performance

By coupling research and innovation, Horizon 2020 is helping to achieve smart, sustainable and inclusive economic growth with its emphasis on excellent science, industrial leadership and tackling societal challenges. The goal is to ensure Europe produces world-class science, removes barriers to innovation and makes it easier for the public and private sectors to work together in delivering innovation.

To reinforce and facilitate knowledge sharing and evidence-based policy-making, the Common Support Centre of DG RTD has developed a dashboard that provides reporting on 18 out of the 23 Horizon 2020 KPIs. For example, it shows numbers of patent applications and patent awarded per specific objective. It allow to gauge exactly how well Horizon 2020 is performing. The dashboard is open to all. It answers to the need for more transparency in the spending of the EU research and innovation budget.

[<https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/horizon-dashboard>].

The method to set KPIs baseline depend on the maturity of KPI. Wherever possible the historic data from previous R&I programmes were used to set the baseline. When the data were not available, the ‘new approach’ is mentioned in the performance tables.

Some KPIs such as peer reviewed publications, patents and number of prototypes and testing activities have been set to evaluate the research and the innovation productivity of various funded activities. Even, in the performance tables some results are already given they are not yet representative at this stage of the implementation of the Horizon 2020 programme. Most of the first results from projects are available only from the 3rd year after the implementation. The final figures will be collected after all of the projects are closed and results reported i.e. several years after the formal end of the programme in 2020. The reference for their target is the year when the last actions financed under Horizon 2020 will be finished.

Concerning the milestones, notwithstanding our intention to report on these, again it turned out that there is no sufficient data at this stage to underpin any serious reporting.

Concerning the number of patent applications par EUR 10 million, the performance results are underestimated, as the ratio is calculated based on the budget that covers the period 2014-2019 while the patent applications being taken into account come from projects funded mainly over the 2014-2017 period. The patent applications originating from 2018-2019 R&I projects are not taken into account in the calculation as they are not yet filed.

As regard the Joint Undertakings set up under Horizon 2020 (SESAR, IMI2, CS2, FCH2, ECSEL, S2R, BBI), their performance is in general be considered to be positive, as reported by the ECA. Nevertheless, some measures will be taken to improve their performance such as the dissemination and exploitation of the JU projects results and the coordination with other EU and national research programmes.

Performance results

Horizon 2020 is making progress towards delivering scientific impacts through the reinforcement of R&I capabilities, scientific excellence and reputation, and through the integration of R&I efforts.

The pillar ‘**Excellence Science**’ is progressing towards the targets and is likely to meet them. Horizon 2020 is succeeding in attracting and involving the EU’s and world’s best research institutions and researchers.

- From 2014, 5522 high quality research projects have been funded by the ERC via Horizon 2020. The share of publications from ERC-funded projects which are among the top 1 % highly cited remains high, about 7 %, considerably exceeding the target of 1.8 %.

- From 2014, the Marie Skłodowska-Curie Actions (MSCA) has supported the mobility and training of around 58 000 researchers at all stages of their careers, including more than 20 000 PhD candidates. It has funded more than 900 excellent international doctoral programmes involving universities, research centres, enterprises including SMEs. It is well on track to achieve its target of 65 000 researchers, including 22 000 PhD.
- Thanks to Horizon 2020 support, many national research infrastructures have been made accessible to all researchers in Europe and beyond: 49 645 researchers have had access to e-research infrastructure; 8 534 researchers have had remote or physical access to research infrastructure. It clearly exceeded the agreed target of 20 000.
- Over 30 years the EU has invested more and more in future technologies, whether for economic, social or environmental reasons, including through the Future and Emerging Technologies programme with a budget under Horizon 2020 over EUR 2.5 billion. Although the FET have already generated more than 2 300 publications and more than 70 patents, Horizon 2020 had to do much better in terms of market-creating innovation. Therefore, it was decided to create a European Innovation Council Pilot, offering new opportunities for exploring the deep-tech of the future.

The actions of the programme as far as the pillar '**Industrial leadership**' is concerned are progressing well.

- LEIT projects already produced numerous outputs, such as patents (308 applications and 212 awarded); more than 5 700 public-private publication and 15 434 firms have introduced innovations with the potential to generate scientific breakthroughs.
- Under the access to risk finance programme, more than 23 000 organisations have been funded – which is above the target of 5 000; with EUR 29 billion amount of private funds leveraged. Total investments mobilised via debt financing and Venture Capital investments is of EUR 54 billion, which is above the target of EUR 15 billion.
- The SME instrument is producing more close-to-market outputs compared to other types of action, followed by innovation actions. So far, about 1 000 SMEs have introduced innovations new to the market and about 1 300 new to the company or the market. The SMEs instruments have generated around 430 jobs and a growth of EUR 9 million.

Horizon 2020 is succeeding in boosting Europe's industrial leadership and competitiveness through stimulating leadership in enabling and industrial technologies, improving access to risk finance, and stimulating innovation in SMEs. However, the interim evaluation report [http://ec.europa.eu/research/evaluations/pdf/book_interim_evaluation_horizon_2020.pdf] stated that closing the innovation gap and boosting industrial leadership is still a valid key objective for the EU and Horizon 2020, although the importance of supporting breakthrough, market-creating innovation is now more clearly recognised than when designing Horizon 2020. Following the 'call for ideas' in 2016 and advice from the high level group of innovators, a pilot European Innovation Council (EIC) was created within Horizon 2020. To further support innovation, between 2018 and 2020, the Commission has mobilised EUR 2.7 billion from Horizon 2020 to support high-risk, high-gain innovations to create the markets of the future. Moreover, Horizon 2020 will use EIC 'crack the challenge' prizes to deliver breakthrough technology solutions to pressing problems faced by our citizens. The EIC pilot will bring together different schemes supporting innovators to make them easier to understand and access. The EIC pilot provides funding and support to Start-ups and SMEs for breakthrough innovation projects with a market-creating potential. The pilot provides grant-only support along with blended finance (grant in combination with equity investment). The EIC Accelerator Pilot supports close-to-market activities, with the aim to give a strong boost to breakthrough innovation with a market-creating potential.

The progress of the pillar '**Societal Challenges**' is encouraging. Horizon 2020 projects have already produced numerous results such as publications, patents, prototypes, products, processes and methods in societal relevance domains.

- From the information available so far, the societal challenges pillar have already generated more than 6000 peer-reviewed publications; about 5200 public-private publications; 700 patent applications (not yet awarded) and 344 patents awarded and already 44 000 innovations that include prototypes and testing activities.

Considering the remark mentioned above on the productivity of publications and patent, the indicators are only interim, and it is too early to draw final conclusions on the performance of this pillar. Nevertheless, the interim evaluation of the programme has already proposes that, to improve the impact of research, a mission-oriented approach should be considered in order to deliver impact on global challenges at a scale, speed and scope that adds value compared to what can be done at the national or regional level. The next R&I programme Horizon Europe will address five missions oriented as described in the section II.

In 2018, 338 tangible specific impacts on European policies resulting from technical and scientific support have been provided by the Joint Research Centre and 538 peer reviewed publications in high impact journals have been generated by the JRC. These results show that **JRC** has exceeded its targets of 330 and 500 respectively.

As far as the **European Institute of Technology** is concerned, 1 650 organisations from universities, business and research are integrated in the Knowledge and Innovation Communities (KICs), above the target of 1 200. The performance results show also that the collaboration inside the knowledge triangle, leading to the development of innovative products, services and processes, is on track to achieve its innovation target and slightly behind in meeting the 'start-up and spin-off' target.

As regards the Joint Undertakings set up under Horizon 2020, their performance is in general be considered to be positive, as reported by the European Court of Auditors in the annual report on the EU Joint Undertakings for the financial year 2018. However, it has been reported that they can improve the link between research and societal growth, and bring innovation closer to the market. As regards the financial matters, the ECA confirms that their management is healthy, but in-kind contributions, internal control, grant management and staff turnover need to be improved.

The results of tracking Horizon 2020 expenditure for climate change show that the sums spent have fallen behind the expected expenditure for this objective as of 1 January 2020. For climate action, expenditure was 30 % compared to the target of 35 % applicable to the whole period of Horizon 2020. However, compared to FP7, the programme represents a considerable increase in research in those areas. The major difficulty in reaching the expected investments comes from the bottom-up parts of Horizon 2020 (especially ERC and MSCA), since their content is unpredictable by nature, and even difficult to assess at the moment of the research. Nevertheless, to support the Green deal priority a call with a budget of 1bn EUR dedicated to the Green Deal will be launched in 2020. This will considerably raise the level of expenditure on climate action.

General objectives

General Objective 1: to build a society and an economy based on knowledge and innovation across the whole Union, while contributing to sustainable development

| Indicator 1: The Europe 2020 R & D target (3 % of GDP) | | | | | | | | |
|--|---------------------|--------|--------|--------|------|------|--------|--------|
| Baseline | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Target |
| 2013 | Milestones foreseen | | | | | | | 2020 |
| 2.02 % | | | 2.50 % | | | | 3.00 % | 3.00 % |
| | Actual results | | | | | | | |
| | 2.03 % | 2.04 % | 2.03 % | 2.07 % | | | | |

| Indicator 2: Innovation Output Indicator | | | | | | | | |
|--|---------------------|------|------|-------|------|------|------|--|
| Baseline | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Target |
| 2013 | Milestones foreseen | | | | | | | 2020 |
| 102.1 | | | | | | | | The composite nature of this indicator is not particularly suited to establishing a target |
| | Actual results | | | | | | | |
| | 103.6 | | | 103.1 | | | | |

| Indicator 3: Share of researchers in the EU active population | | | | | | | | |
|---|---------------------|--------|--------|------|------|------|--------|--------|
| Baseline | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Target |
| 2013 | Milestones foreseen | | | | | | | 2020 |
| 1.14 % | | | 1.21 % | | | | 1.33 % | 1.33 % |
| | Actual results | | | | | | | |
| | 1.17 % | 1.20 % | 1.23 % | | | | | |

Comment: The General Objective contributes to the following Europe 2020 headline targets: By stimulating the generation of more sustainable growth and the creation of new jobs in the EU, it helps to raise the share of population employed. By contributing directly to R & D expenditure and leveraging public and private funds towards this sector, it helps raising the R & D investment in the EU. Finally, in order to promote sustainable development, support is provided to climate change and energy research. This has an impact on the reduction of emissions, the promotion of renewable energy sources and the increase of energy efficiency, thus making progress towards the 20/20/20 climate/energy targets. So far, only one of these indicators is making steady progress towards reaching its target. The share of researchers in the EU active population is on track towards the 1.33 % target by year 2020. This is a positive development, in that it meets one of the basic conditions necessary for increasing the research and innovation activities in the EU. On the other hand, there is no significant progress towards reaching the spending target (3 % of GDP). Member States and private enterprise have not increased their R & D budgets as expected, at least partly because of the difficult economic climate. It was expected that Horizon 2020's focus on financial instruments for R & D actions will have a significant impact on this indicator in the medium to long term, but even this element was not sufficient to reach the 3 % target by year 2020.

Specific objectives

Specific Objective 1: Excellent science – European Research Council (ERC) – strengthening frontier research

| Indicator 1: Share of publications from ERC-funded projects which are among the top 1 % highly cited per field of science | | | | | | | | |
|---|---------------------|------|------|------|-------|-------|-------|--------|
| Baseline | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Target |
| | Milestones foreseen | | | | | | | 2020 |
| none | | | | | 1.5 % | | 1.8 % | 1.8 % |
| | Actual results | | | | | | | |
| | | | | | 7.0 % | 7.0 % | | |

Comment: No Baseline, because of new approach.

The reference for this target is the year when the last actions financed under Horizon 2020 will be finished, i.e. several years after the formal end of the programme in 2020.

Expenditure related outputs

| | Number | EUR million |
|--|--------|---------------|
| Budget line 08 02 01 01 (RTD) | | |
| Grants | 1185 | 2150,3 |
| Prizes | | |
| Procurement | 1 | 0,1 |
| Financial instruments | | |
| Experts | 1 | 18,2 |
| Others | 1 | 1,4 |
| Total | | 2170,0 |
| of which, Climate-related expenditure | | 324 |

Specific Objective 2: Excellent science – Future and Emerging Technologies – strengthening research in future and emerging technologies

| Indicator 1: Publications in peer-reviewed high impact journals | | | | | | | | |
|---|---------------------|------|------|------|-------|-------|------|--------|
| Baseline | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Target |
| | Milestones foreseen | | | | | | | 2020 |
| Publications in peer-reviewed high impact journals per EUR 10 million funding: none | | | | 2 | | | 25 | 25 |
| | Actual results | | | | | | | |
| | | | | 7 | 10 | 14 | | |
| | Milestones foreseen | | | | | | | 2020 |
| Number of Publications in peer-reviewed high impact journals: none | | | | | | | | |
| | Actual results | | | | | | | |
| | | | | 590 | 1 397 | 2 317 | | |

Comment: No Baseline, because of new approach.

The reference for this target is the year when the last actions financed under Horizon 2020 will be finished, i.e. several years after the formal end of the programme in 2020

| Indicator 2: Patent applications and patents awarded in Future and Emerging Technologies | | | | | | | | |
|--|---------------------|------|------|------|------|------|------|--------|
| Baseline | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Target |
| | Milestones foreseen | | | | | | | 2020 |
| Patent applications and patents awarded in Future and Emerging Technologies per EUR 10 million funding: none | | | | | | 1.0 | | 1.0 |
| | Actual results | | | | | | | |
| | | | | | 0.2 | 0.4 | | |
| | Milestones foreseen | | | | | | | 2020 |
| Number of Patent | | | | | | | | |

| | | | | | | | |
|--|----------------|--|--|---|---|----|--|
| applications and patents awarded in Future and Emerging Technologies: none | Actual results | | | | | | |
| | | | | 3 | 7 | 73 | |

Comment: No Baseline, because of new approach.

The reference for this target is the year when the last actions financed under Horizon 2020 will be finished, i.e. several years after the formal end of the programme in 2020

The number of patent application given is the number of patent application not awarded.

Expenditure related outputs

| Output | Budget 2020 | |
|--|-------------|--------------|
| | Number | EUR million |
| Budget line 08 02 01 02 (RTD) | | |
| Grants | | |
| Prizes | | |
| Procurement | | |
| Financial instruments | | |
| Experts | | |
| Others ⁽¹⁾ | | |
| Subtotal | | p.m |
| of which, Climate-related expenditure | | |
| Budget line 09 04 01 01 (C-NET) | | |
| Grants | 168 | 431,3 |
| Prizes | | 0 |
| Procurement | | 0,2 |
| Financial instruments | | 0 |
| Experts | | 1,5 |
| Others | | 20,0 |
| Total of the Specific Objective | | 453,0 |
| of which, Climate-related expenditure | | 60,0 |

Specific Objective 3: Excellent science – Marie Skłodowska-Curie actions – strengthening skills, training and career development

| Indicator 1: Cross-sector and cross-country circulation of researchers, including PhD candidates (cumulative number) | | | | | | | | |
|---|---------------------|--------|--------|--------|--------|--------|--------|--------|
| Baseline | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Target |
| 2007-2013 | Milestones foreseen | | | | | | | 2020 |
| Researchers: 50 000 | 7 500 | 16 500 | 25 000 | 34 000 | 43 500 | 53 500 | 65 000 | 65 000 |
| | Actual results | | | | | | | |
| | 7 700 | 15 400 | 25 000 | 36 000 | 48 000 | 58 200 | | |
| 2007-2013 | Milestones foreseen | | | | | | | 2020 |
| PhD: 10 000 | 3 000 | 6 000 | 10 000 | 13 000 | 17 400 | 21 400 | 25 000 | 25 000 |
| | Actual results | | | | | | | |
| | 3 400 | 6 800 | 11 000 | 14 000 | 18 000 | 22 200 | | |

Expenditure related outputs

| Output | Budget 2020 | |
|--------------------------------------|-------------|-------------|
| | Number | EUR million |
| Budget line 15 03 01 01 (EAC) | | |
| Grants | 1900 | 1029,4 |
| Prizes | | |
| Procurement | 5 | 2,2 |

⁽¹⁾ For example: grants to named beneficiaries, Public-Public Partnership based on Article 185 TFEU.

| | | |
|--|-----|---------------|
| Financial instruments | | |
| Experts | 360 | 1,0 |
| Others | | |
| Total of the Specific Objective | | 1032,6 |
| of which, Climate-related expenditure | | 197,4 |

Specific Objective 4: Excellent science – Research infrastructures – strengthening European research infrastructures, including e-infrastructures

| Indicator 1: Number of researchers who have access to research infrastructures through Union support | | | | | | | | |
|--|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|--------|--------|
| Baseline | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Target |
| 2013 | Milestones foreseen | | | | | | | 2020 |
| 22 000 | | | | | 12 000 | | 20 000 | 20 000 |
| | Actual results | | | | | | | |
| | | 41 475 (+ 5 086) | 42 265 (+ 6 764) | 49 645 (+ 7 922) | 49 645 (+ 8 008) | 49 645 (+ 8 325) | | |

Comment: In brackets are presented the figures for Number of researchers who have access to research infrastructure

Expenditure related outputs

| Output | Budget 2020 | |
|--|-------------|--------------|
| | Number | EUR million |
| Budget line 08 02 01 03 (RTD) | | |
| Grants | 37 | 246,9 |
| Prizes | | |
| Procurement | | |
| Financial instruments | | |
| Experts | | 0,4 |
| Other | | |
| Subtotal | | 247,3 |
| of which, Climate-related expenditure | | 52,6 |
| Budget line 09 04 01 02 (C-NECT) | | |
| Grants | 9 | 73,2 |
| Prizes | | 0 |
| Procurement | | |
| Financial instruments | | |
| Experts | | 0,4 |
| Others (SGA for the GEANT FPA) | | |
| Subtotal | | 73,6 |
| of which, Climate-related expenditure | | 0 |
| Total of the Specific Objective | | 320,9 |
| of which, Climate-related expenditure | | 52,6 |

Specific Objective 5: Industrial leadership – boosting Europe’s industrial leadership through research, technological development, demonstration and innovation in the following enabling and industrial technologies (information and communication technologies; nanotechnologies; advanced materials; biotechnology; advanced manufacturing and processing; space)

| Indicator 1: Patent applications and patents awarded in the different enabling and industrial technologies | | | | | | | | |
|--|---------------------|------|------|------|------|------|------|--------|
| Baseline | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Target |
| 2013 | Milestones foreseen | | | | | | | 2020 |
| Patent applications in the different enabling and industrial technologies per EUR 10 million funding: ICT (FP7: 0.9) NMBP (FP7: 2.0) Space (FP7 Cooperation projects: 0.3) | | | | | | 3.00 | 3.00 | 3.00 |
| | Actual results | | | | | | | |
| | | | | 0.30 | 0.30 | 0.49 | | |

| | Milestones foreseen | | | | | | 2020 |
|--------------------------------|---------------------|--|--|-----|-----|-----|------|
| Number of patent applications: | | | | | | | |
| | Actual results | | | | | | |
| | | | | 136 | 210 | 308 | |
| | Milestones foreseen | | | | | | 2020 |
| Number of patent awarded: | | | | | | | |
| | Actual results | | | | | | |
| | | | | 52 | 55 | 212 | |

Comment: The reference for this target is the year when the last actions financed under Horizon 2020 will be finished, i.e. several years after the formal end of the programme in 2020.

The number of patent application given is the number of patent application not awarded.

Indicator 2: Share of participating firms introducing innovations new to the company or the market (covering the period of the project plus three years)

| Baseline | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Target |
|----------|---------------------|------|------|------|--------|--------|------|--------|
| | Milestones foreseen | | | | | | 2020 | |
| none | | | | | | | | |
| | Actual results | | | | | | | |
| | | | | | 11 609 | 15 434 | | |

Comment: No Baseline, because of new approach.

Total number of firms introducing innovations.

Comment: The reference for this target is the year when the last actions financed under Horizon 2020 will be finished, i.e. several years after the formal end of the programme in 2020.

Indicator 3: Number of joint public-private publications

| Baseline | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Target |
|----------|---------------------|------|------|------|-------|-------|------|--------|
| | Milestones foreseen | | | | | | 2020 | |
| none | | | | | | | | |
| | Actual results | | | | | | | |
| | | | | 620 | 3 340 | 5 747 | | |

Comment: No Baseline, because of new approach.

Comment: The reference for this target is the year when the last actions financed under Horizon 2020 will be finished, i.e. several years after the formal end of the programme in 2020.

Expenditure related outputs

| Output | Budget 2020 | |
|---|--------------|--------------|
| | Output (no.) | EUR million |
| Budget line 08 02 02 01 (RTD) | | |
| Grants | 100 | 593,3 |
| Prizes | 1 | 3,0 |
| Procurement | 0 | 0 |
| Financial instruments | 0 | 0 |
| Experts | 0 | 0 |
| Others | 0 | 0 |
| Subtotal | | 596,3 |
| of which, Climate-related expenditure | | |
| Budget line 08 02 07 33 (BBI JU) – Support expenditure ⁽²⁾ | | 1,3 |
| Budget line 08 02 07 34 (BBI JU) ² | | 9,8 |
| Subtotal | | 11,1 |
| of which, Climate-related expenditure | | |
| Budget line 09 04 02 01 (C-NECT) | | |
| Grants | 180 | 807,1 |
| Prizes | | 0 |

⁽²⁾ Part of the line is also included under Specific Objective 9.

| | | |
|--|----|---------------|
| Procurement | | 13,0 |
| Financial instruments | | |
| Experts | | 6,5 |
| Others | | 50,8 |
| Subtotal | | 893,6 |
| of which, Climate-related expenditure | | |
| Budget line 09 04 07 31 (ECSEL JU) – Support expenditure | | 6,8 |
| Budget line 09 04 07 32 (ECSEL JU) | | 199,1 |
| Subtotal | | 205,9 |
| of which, Climate-related expenditure | | |
| Budget line 02 04 02 01(GROW) | | |
| Grants | 53 | 187,4 |
| Prize | 1 | 5,0 |
| Procurement | 5 | 3,2 |
| Financial instruments | 1 | 7,0 |
| Experts | | 1,8 |
| Other (Delegation Agreement ESA) | 1 | 10,0 |
| Subtotal | | 214,4 |
| of which, Climate-related expenditure | | |
| Total of the Specific Objective | | 1921,3 |
| of which, Climate-related expenditure | | 433,4 |

Specific Objective 6: Industrial leadership – enhancing access to risk finance for investing in research and innovation

| Indicator 1: Total investments mobilised via debt financing and Venture Capital investments | | | | | | | | |
|---|---------------------|------|------|------|------|------|------|--------|
| Baseline | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Target |
| | Milestones foreseen | | | | | | | 2020 |
| none | | | | 8 | | | 15 | 15 |
| | Actual results | | | | | | | |
| | | 17 | 22 | 32 | 47 | 54 | | |

Comment: No Baseline, because of new approach.
 Availability of Data: 2019: As of 30/06/2019 in last reports available for indirect debt financing, actual results are based on the portfolio volume made available to financial intermediaries.

| Indicator 2: Number of organisations funded and amount of private funds leveraged | | | | | | | | |
|---|---------------------|------|-------|--------|--------|--------|-------|--------|
| Baseline | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Target |
| | Milestones foreseen | | | | | | | 2020 |
| Number of organisations: none | | | | 2 000 | | | 5 000 | 5 000 |
| | Actual results | | | | | | | |
| | | 793 | 4 051 | 10 484 | 19 107 | 23 774 | | |
| | Milestones foreseen | | | | | | | 2020 |
| Amount of private funds leveraged: none | | | | 15.0 | | | 35.0 | 35.0 |
| | Actual results | | | | | | | |
| | | 7.2 | 10.5 | 15.5 | 24.4 | 29.0 | | |

Comment: No Baseline, because of new approach.

Expenditure related outputs

| Output | Budget 2020 | |
|--|-------------|-------------|
| | Number | EUR million |
| Budget line 08 02 02 02 (RTD) | | |
| Grants | 1 | 0,3 |
| Prizes | 6 | 30 |
| Procurement | 0 | 0 |
| Financial instruments (InnovFin EIB, SMEG & IFE – including EIC blending instrument) | 4 | 360,0 |
| Experts | | |

| | | |
|--|---|--------------|
| Others | 0 | 0 |
| Total | | 390,3 |
| of which, Climate-related expenditure | | 2,0 |

Specific Objective 7: Industrial leadership – increasing innovation in SMEs

Indicator 1: Share of participating SMEs introducing innovations new to the company or the market (covering the period of the project plus three years)

| Baseline | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Target |
|----------|---------------------|------|------|------|------|-------|------|--------|
| | Milestones foreseen | | | | | | | 2020 |
| none | | | | 20 % | | | 50 % | 50 % |
| | Actual results | | | | | | | |
| | | | | | | 2 913 | | |

Narrative: the figure given for 2019 is the total of: 1 616 innovations to the market and 1 297 innovations to the companies

Comment: No Baseline, because of new approach.

Indicator 2: Growth and job creation in participating SMEs

| Baseline | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Target |
|----------|---------------------|------|------|------|------|---|------|--------|
| | Milestones foreseen | | | | | | | 2020 |
| none | Actual results | | | | | | | |
| | | | | | | SME Growth: EUR 9 million; SMEs Job creation: 431 | | |

Comment: No Baseline, because of new approach.

Expenditure related outputs

| Output | Draft Budget 2019 | |
|--|-------------------|--------------|
| | Number | EUR million |
| Budget line 08 02 02 03 (RTD) | | |
| Grants | 1 | 0,3 |
| Prizes | | |
| Procurement | 0 | 0 |
| Financial instruments | | |
| Experts | 0 | 0 |
| Others (mainly Eurostars 2) | 1 | 58,4 |
| Subtotal | | 58,7 |
| Budget line 02 04 02 03 (GROW) | | |
| Grants | 117 | 49,2 |
| Prizes | 4 | 0,2 |
| Procurement | 2 | 1,2 |
| Financial instruments | 0 | 0 |
| Experts | 0 | 0 |
| Others | 0 | 0 |
| Subtotal | | 50,6 |
| Total of the specific objective | | 109,3 |
| of which, Climate-related expenditure | | 12,3 |

Specific Objective 8: Societal challenges – improving the lifelong health and wellbeing of all

Indicator 1: Publications in peer-reviewed high impact journals in the area of health and wellbeing

| Baseline | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Target |
|-----------------------|---------------------|------|------|------|------|------|------|--------|
| 2013 | Milestones foreseen | | | | | | | 2020 |
| Publications in peer- | | | | | | 20.0 | 20.0 | 20.0 |

| | | | | | | | |
|--|---------------------|--|-----|-----|-------|-------|------|
| reviewed high impact journals in the area of health and wellbeing per EUR 10 million funding: 42 | Actual results | | | | | | |
| | | | | 2.8 | 3.9 | 6.0 | |
| | Milestones foreseen | | | | | | 2020 |
| Number of publication in peer-reviewed in the area of health and wellbeing: | Actual results | | | | | | |
| | | | 130 | 722 | 1 331 | 2 854 | |

Methodology: Targets are for whole Societal challenges pillar (Specific objectives: 8-14) and not per each individual specific objective.

Comment: The reference for this target is the year when the last actions financed under Horizon 2020 will be finished, i.e. several years after the formal end of the programme in 2020.

| Indicator 2: Patent applications and patents awarded in the area of health and wellbeing | | | | | | | | |
|--|---------------------|------|------|------|------|------|------|--------|
| Baseline | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Target |
| | Milestones foreseen | | | | | | 2020 | |
| Patent applications in the area of health and wellbeing per EUR 10 million funding: 2.00 | Actual results | | | | | | | 2.00 |
| | | | | | 0.13 | 0.32 | | |
| | Milestones foreseen | | | | | | 2020 | |
| Number of patent applications in the area of health and wellbeing: | Actual results | | | | | | | |
| | | | 14 | 28 | 42 | 63 | | |
| | Milestones foreseen | | | | | | 2020 | |
| Number of patent awarded in the area of health and wellbeing: | Actual results | | | | | | | |
| | | | | 19 | 29 | 58 | | |

Methodology: Targets are for whole Societal challenges pillar (Specific objectives: 8-14) and not per each individual specific objective.

Comment: The reference for this target is the year when the last actions financed under Horizon 2020 will be finished, i.e. several years after the formal end of the programme in 2020.

The number of patent application given is the number of patent application not awarded.

| Indicator 3: Number of prototypes and testing activities | | | | | | | | |
|--|---------------------|------|------|------|------|-------|------|--------|
| Baseline | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Target |
| | Milestones foreseen | | | | | | 2020 | |
| Number of prototypes: none | Actual results | | | | | | | |
| | | | | 237 | 972 | 1 384 | | |

Comment: No Baseline, because of new approach.

The reference for this target is the year when the last actions financed under Horizon 2020 will be finished, i.e. several years after the formal end of the programme in 2020.

| Indicator 4: Number of joint public-private publications | | | | | | | | |
|--|---------------------|------|------|------|-------|-------|------|--------|
| Baseline | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Target |
| | Milestones foreseen | | | | | | 2020 | |
| none | Actual results | | | | | | | |
| | | | | 620 | 3 340 | 5 747 | | |

Comment: No Baseline, because of new approach.

The reference for this target is the year when the last actions financed under Horizon 2020 will be finished, i.e. several years after the formal end of the programme in 2020.

Expenditure related outputs

| Output | Budget 2020 | |
|---|--------------|--------------|
| | Output (no.) | EUR million |
| Budget line 08 02 03 01 (RTD) | | |
| Grants | 80 | 473,2 |
| Prizes | 0 | 0 |
| Procurement | 10 | 1,5 |
| Financial instruments (Fast-track to innovation) | 2 | 34,8 |
| Experts | | 2,0 |
| Others (EDCTP2: 98,2, subscription to HFSP0: 5,3 + grant to identif. benef: 50; RIA grants without call / in case of Public Health Emergencies: 10) | | 163,5 |
| Subtotal | | 675,0 |
| of which, Climate-related expenditure | | |
| Budget line 08 02 07 31 (IMI 2JU) – Support expenditure | | 27,2 |
| Budget line 08 02 07 32 (IMI 2JU) | | 249,9 |
| Subtotal | | 277,1 |
| of which, Climate-related expenditure | | |
| Budget line 09 04 03 01 (CNECT) | | |
| Grants | 35 | 184,4 |
| Prizes | 0 | 0 |
| Procurement | 4 | 2,0 |
| Financial instruments | | |
| Experts | | 1,5 |
| Others ⁵ | | |
| Subtotal | | 187,9 |
| of which, Climate-related expenditure | | |
| Total of the Specific Objective | | 1140 |
| of which, Climate-related expenditure | | 67,9 |

Specific Objective 9: Societal challenges – securing sufficient supplies of safe, healthy and high quality food and other bio-based products, by developing productive, sustainable and resource-efficient primary production systems, fostering related ecosystem services and the recovery of biological diversity, alongside competitive and low-carbon supply, processing and marketing chains

| Indicator 1: Publications in peer-reviewed high impact journals in the area of food security | | | | | | | | |
|--|---------------------|------|------|------|------|------|------|--------|
| Baseline | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Target |
| | Milestones foreseen | | | | | | | 2020 |
| Publications in peer-reviewed high impact journals in the area of food security per EUR 10 million funding: 23 | | | | | | | 20.0 | 20.0 |
| | Actual results | | | | | | | |
| | | | | 1.2 | 1.5 | 3.3 | | |
| | Milestones foreseen | | | | | | | 2020 |
| Number of publication in peer-reviewed journals in the area of food security: | | | | | | | | |
| | Actual results | | | | | | | |
| | | | | 180 | 292 | 822 | | |

Methodology: Targets are for whole Societal challenges pillar (Specific objectives: 8-14) and not per each individual specific objective.
 Comment: The reference for this target is the year when the last actions financed under Horizon 2020 will be finished, i.e. several years after the formal end of the programme in 2020.

| Indicator 2: Patent applications and patents awarded in the area of food security | | | | | | | | |
|--|---------------------|------|------|------|------|-----------|------|--------|
| Baseline | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Target |
| | Milestones foreseen | | | | | | | 2020 |
| Number of patent applications in the area of food security per EUR 10 million: 1 (Number of patent applications in this area:) | | | | | | | 2 | 2 |
| | Actual results | | | | | | | |
| | | | | (10) | (12) | 0.29 (30) | | |

| | Milestones foreseen | | | | | | 2020 |
|---|---------------------|--|--|---|---|----|------|
| Number of patent applications awarded in the area of food security: | | | | | | | |
| | Actual results | | | | | | |
| | | | | 2 | 3 | 23 | |

Methodology: Targets are for whole Societal challenges pillar (Specific objectives: 8-14) and not per each individual specific objective.

Comment: The reference for this target is the year when the last actions financed under Horizon 2020 will be finished, i.e. several years after the formal end of the programme in 2020.

The number of patent application given is the number of patent application not awarded.

| Indicator 3: Number of prototypes and testing activities | | | | | | | | |
|--|---------------------|------|------|------|-------|-------|------|--------|
| Baseline | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Target |
| | Milestones foreseen | | | | | | 2020 | |
| Number of prototypes: none | | | | | | | | |
| | Actual results | | | | | | | |
| | | | | 237 | 972 | 1 384 | | |
| | Milestones foreseen | | | | | | 2020 | |
| Number of testing activities: none | | | | | | | | |
| | Actual results | | | | | | | |
| | | | | 327 | 3 059 | 3 745 | | |

Comment: No Baseline, because of new approach.

The reference for this target is the year when the last actions financed under Horizon 2020 will be finished, i.e. several years after the formal end of the programme in 2020.

| Indicator 4: Number of joint public-private publications | | | | | | | | |
|--|---------------------|------|------|------|-------|-------|------|--------|
| Baseline | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Target |
| | Milestones foreseen | | | | | | 2020 | |
| none | | | | | | | | |
| | Actual results | | | | | | | |
| | | | | 620 | 3 340 | 5 747 | | |

Comment: No Baseline, because of new approach.

The reference for this target is the year when the last actions financed under Horizon 2020 will be finished, i.e. several years after the formal end of the programme in 2020.

Expenditure related outputs

| Output | Budget 2020 | |
|---|--------------|--------------|
| | Output (no.) | EUR million |
| Budget line 08 02 03 02 (RTD) | | |
| Grants | 36 | 236,1 |
| Prizes | 0 | 0 |
| Procurement | | 7,0 |
| Financial instruments | | |
| Experts | | 0,3 |
| Others (includes EUR 40 million to Art. 185 initiative PRIMA implemented under Specific Objective 12) | | 45,3 |
| Subtotal | | 288,7 |
| Budget line 08 02 07 33 (BBI JU) – Support expenditure ⁽³⁾ | | 7,3 |
| Budget line 08 02 07 34 (BBI JU) ⁽⁴⁾³ | | 55,5 |
| Subtotal | | 62,8 |
| Budget line 05 09 03 01 (AGRI) | | |
| Grants | | 281,6 |
| Prizes | | 0 |
| Procurement | | 0 |

⁽³⁾ Part of the line is also included under Specific Objective 5.

| | | |
|--|--|--------------|
| Financial instruments | | |
| Experts | | 0,6 |
| Others – PRIMA | | 40 |
| Subtotal | | 358,4 |
| Total of the Specific Objective | | 709,9 |
| of which, climate-related expenditure | | 423,4 |

Specific Objective 10: Societal challenges – making the transition to a reliable, affordable, publicly accepted, sustainable and competitive energy system, aiming at reducing fossil fuel dependency, in the face of increasingly scarce resources, increasing energy needs and climate change

| Indicator 1: Publications in peer-reviewed high impact journals in the area of secure, clean and efficient energy | | | | | | | | |
|---|---------------------|------|------|------|------|------|------|--------|
| Baseline | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Target |
| | Milestones foreseen | | | | | | | 2020 |
| Publications in peer-reviewed high impact journals in the area of secure, clean and efficient energy per EUR 10 million funding: 14 | Actual results | | | | | | | 20.0 |
| | | | | 0.8 | 1.2 | 2.2 | | |
| | Milestones foreseen | | | | | | | 2020 |
| Number of publications in peer-reviewed high impact journals in the area of secure, clean and efficient energy: | Actual results | | | | | | | |
| | | | | 183 | 347 | 815 | | |

Methodology: Targets are for whole Societal challenges pillar (Specific objectives: 8-14) and not per each individual specific objective.

Comment: The reference for this target is the year when the last actions financed under Horizon 2020 will be finished, i.e. several years after the formal end of the programme in 2020.

| Indicator 2: Patent applications and patents awarded in the area of secure, clean and efficient energy | | | | | | | | |
|---|---------------------|------|------|------|------|------|------|--------|
| Baseline | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Target |
| | Milestones foreseen | | | | | | | 2020 |
| Patent applications in the area of secure, clean and efficient energy per EUR 10 million funding: 2 | Actual results | | | | | | | 2.0 |
| | | | | | 0.2 | 0.6 | | |
| | Milestones foreseen | | | | | | | 2020 |
| Number of patents applications in the area of secure, clean and efficient energy: | Actual results | | | | | | | |
| | | | | 66 | 69 | 119 | | |
| | Milestones foreseen | | | | | | | 2020 |
| Number of patent awarded in the area of secure, clean and efficient energy: | Actual results | | | | | | | |
| | | | | 19 | 19 | 102 | | |

Methodology: Targets are for whole Societal challenges pillar (Specific objectives: 8-14) and not per each individual specific objective.

Comment: The reference for this target is the year when the last actions financed under Horizon 2020 will be finished, i.e. several years after the formal end of the programme in 2020.

The number of patent application given is the number of patent application not awarded.

| Indicator 3: Number of prototypes and testing activities | | | | | | | | |
|---|---------------------|------|------|------|------|------|------|--------|
| Baseline | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Target |
| | Milestones foreseen | | | | | | | 2020 |
| Number of Prototypes: | | | | | | | | |

| | | | | | | | |
|------|----------------|--|--|-----|-----|-------|--|
| none | Actual results | | | | | | |
| | | | | 237 | 972 | 1 384 | |

Comment: No Baseline, because of new approach.

The reference for this target is the year when the last actions financed under Horizon 2020 will be finished, i.e. several years after the formal end of the programme in 2020.

| | | | | | | | | |
|---|---------------------|------|------|------|-------|-------|------|--------|
| Indicator 4: Number of joint public-private publications | | | | | | | | |
| Baseline | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Target |
| | Milestones foreseen | | | | | | | 2020 |
| none | Actual results | | | | | | | |
| | | | | 620 | 3 340 | 5 747 | | |

Comment: No Baseline, because of new approach.

The reference for this target is the year when the last actions financed under Horizon 2020 will be finished, i.e. several years after the formal end of the programme in 2020.

| | | | | | | | | |
|---|---------------------|--------|--------|--------|--------|--------|--------|--------|
| Indicator 5: Share of the overall Energy challenge funds allocated to the following research activities: renewable energy, end-user energy-efficiency, smart grids and energy storage activities | | | | | | | | |
| Baseline | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Target |
| | Milestones foreseen | | | | | | | 2020 |
| none | Actual results | | | | | | | 85.0 % |
| | | | 85.0 % | | | | 85.0 % | |
| | 91.0 % | 94.0 % | 94.0 % | 87.9 % | 90.9 % | 89.2 % | | |

Comment: No Baseline, because of new approach.

Expenditure related outputs

| Output | Budget 2020 | |
|--|--------------|--------------|
| | Output (no.) | EUR million |
| Budget line 08 02 03 03 (RTD) | | |
| Grants | 60 | 384,9 |
| Prizes | 3 | 1,7 |
| Procurement | 4 | 0,8 |
| Financial instruments | 1 | 50,0 |
| Experts | | 0,2 |
| Others | | 0,2 |
| Subtotal | | 437,8 |
| Budget line 08 02 07 37 (FCH 2 JU)– Support expenditure | | |
| | | 8,0 |
| Budget line 08 02 07 38 (FCH 2 JU) | | |
| Subtotal | | 51,2 |
| Budget line 32 04 03 01(ENER) | | |
| Grants | 50 | 308,5 |
| Prizes | 0 | |
| Procurement | 50 | 38,1 |
| Financial instruments | | 0 |
| Experts | | 0,6 |
| Others | | 50,7 |
| Subtotal | | 457,0 |
| Total of the Specific Objective of which, Climate-related expenditure | | 776,6 |
| | | 954 |

Specific Objective 11: Societal challenges – achieving a European transport system that is resource-efficient, climate- and environmentally-friendly, safe and seamless for the benefit of all citizens, the economy and society

| | | | | | | | | |
|---|---------------------|------|------|------|------|------|------|--------|
| Indicator 1: Publications in peer-reviewed high impact journals in the area of smart, green and integrated transport | | | | | | | | |
| Baseline | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Target |
| 2017 | Milestones foreseen | | | | | | | 2020 |

| | | | | | | | | |
|---|---------------------|--|--|-----|-----|-----|-----|------|
| Publications in peer-reviewed high impact journals in the area of smart, green and integrated transport per EUR 10 million funding: 2 | | | | | | 2.0 | 2.0 | 2.0 |
| | Actual results | | | | | | | |
| | | | | 0.2 | 0.5 | 0.7 | | |
| 2017 | Milestones foreseen | | | | | | | 2020 |
| Number of publications in peer-reviewed high impact journals in the area of smart, green and integrated transport: | | | | | | | | |
| | Actual results | | | | | | | |
| | | | | 55 | 149 | 306 | | |

Methodology: Targets are for whole Societal challenges pillar (Specific objectives: 8-14) and not per each individual specific objective.

Comment: The reference for this target is the year when the last actions financed under Horizon 2020 will be finished, i.e. several years after the formal end of the programme in 2020.

| Indicator 2: Patent applications and patents awarded in the area of smart, green and integrated transport | | | | | | | | |
|--|---------------------|------|------|------|------|------|-----------|--------|
| Baseline | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Target |
| | Milestones foreseen | | | | | | | 2020 |
| Number of patent applications in the area of smart, green and integrated transport per EUR 10 million funding: 1 (Number of patent applications in this area:) | | | | | | 2 | 2 | 2 |
| | Actual results | | | | | | | |
| | | | | | (29) | (34) | 0.37 (64) | |
| | Milestones foreseen | | | | | | | 2020 |
| Number of patents awarded in the area of smart, green and integrated transport: | | | | | | | | |
| | Actual results | | | | | | | |
| | | | | | 8 | 8 | 77 | |

Methodology: Targets are for whole Societal challenges pillar (Specific objectives: 8-14) and not per each individual specific objective.

Comment: The reference for this target is the year when the last actions financed under Horizon 2020 will be finished, i.e. several years after the formal end of the programme in 2020.

The number of patent application given is the number of patent application not awarded.

| Indicator 3: Number of prototypes and testing activities | | | | | | | | |
|--|---------------------|------|------|------|------|-------|-------|--------|
| Baseline | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Target |
| | Milestones foreseen | | | | | | | 2020 |
| Number of Prototypes: none | | | | | | | | |
| | Actual results | | | | | | | |
| | | | | | 237 | 972 | 1 384 | |
| | Milestones foreseen | | | | | | | 2020 |
| Number of Testing activities: none | | | | | | | | |
| | Actual results | | | | | | | |
| | | | | | 327 | 3 059 | 3 745 | |

Comment: No Baseline, because of new approach.

The reference for this target is the year when the last actions financed under Horizon 2020 will be finished, i.e. several years after the formal end of the programme in 2020.

| Indicator 4: Number of joint public-private publications | | | | | | | | |
|--|---------------------|------|------|------|------|------|------|--------|
| Baseline | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Target |
| | Milestones foreseen | | | | | | | 2020 |
| none | | | | | | | | |

| | Actual results | | | | | |
|--|----------------|--|--|-----|-------|-------|
| | | | | 620 | 3 340 | 5 747 |

Comment: No Baseline, because of new approach.

The reference for this target is the year when the last actions financed under Horizon 2020 will be finished, i.e. several years after the formal end of the programme in 2020.

Expenditure related outputs

| Output | Budget 2020 | |
|--|--------------|--------------|
| | Output (no.) | EUR million |
| Budget line 08 02 03 04 (RTD) | | |
| Grants | 70 | 289,7 |
| Prizes | 0 | 0 |
| Procurement | 1 | 0,2 |
| Financial instruments | 0 | 0 |
| Experts | | 1,0 |
| Others | | 0,2 |
| Subtotal | | 291,1 |
| Budget line 08 02 07 35 (Clean Sky 2 JU) – Support expenditure | | 20,0 |
| Budget line 08 02 07 36 (Clean Sky 2 JU) | | 284,1 |
| Subtotal | | 304,1 |
| Budget line 08 02 07 37 (FCH 2 JU) – Support expenditure | | 4,4 |
| Budget line 08 02 07 38 (FCH 2 JU) | | 28,4 |
| Subtotal | | 32,8 |
| Budget line 06 03 03 01 (MOVE) | | |
| Grants | 18 | 71,3 |
| Prizes | | |
| Procurement | 1 | 1,0 |
| Financial instruments | | |
| Experts | | 1,0 |
| Others (FTI, EASA, TRIMIS, ELENA, Smart Airports) | | 29,3 |
| Subtotal | | 102,6 |
| Budget line 06 03 07 31 (SESAR 2JU) – Support expenditure | | 16,3 |
| Budget line 06 03 07 32 (SESAR 2JU) | | 104,5 |
| Subtotal | | 120,8 |
| Budget line 06 03 07 33 (Shift2Rail) – Support expenditure | | 5,2 |
| Budget line 06 03 07 34 (Shift2Rail) | | 74,7 |
| Subtotal | | 79,9 |
| Total of the Specific Objective | | 931,3 |
| of which, Climate-related expenditure | | 383,8 |

Specific Objective 12: Societal challenges – achieving a resource – and water – efficient and climate change resilient economy and society, protection and sustainable management of natural resources and ecosystems and a sustainable supply and use of raw materials, in order to meet the needs of a growing global population within the sustainable limits of the planet’s natural resources and ecosystems

Indicator 1: Publications in peer-reviewed high impact journals in the area of climate action, resource efficiency and raw materials

| Baseline | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Target |
|--|---------------------|------|------|------|------|------|------|--------|
| 2017 | Milestones foreseen | | | | | | | 2020 |
| Publications in peer-reviewed high impact journals in the area of climate action, resource efficiency and raw materials per EUR 10 million funding: 27 | | | | | | 20.0 | 20.0 | 20.0 |
| | Actual results | | | | | | | |
| | | | | 1.3 | 2.1 | 4.4 | | |
| 2017 | Milestones foreseen | | | | | | | 2020 |
| Number of publications in peer-reviewed high impact journals in the area of climate action, | | | | | | | | |
| | Actual results | | | | | | | |
| | | | | 167 | 331 | 840 | | |

| | | | | | | | | |
|--|--|--|--|--|--|--|--|--|
| resource efficiency and raw materials: | | | | | | | | |
|--|--|--|--|--|--|--|--|--|

Methodology: Targets are for whole Societal challenges pillar (Specific objectives: 8-14) and not per each individual specific objective.

Comment: The reference for this target is the year when the last actions financed under Horizon 2020 will be finished, i.e. several years after the formal end of the programme in 2020.

| Indicator 2: Patent applications and patents awarded in the area of climate action, resource efficiency and raw materials | | | | | | | | |
|---|---------------------|------|------|------|------|------|------|--------|
| Baseline | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Target |
| | Milestones foreseen | | | | | | | 2020 |
| Patent applications in the area of climate action, resource efficiency and raw materials per EUR 10 million funding: 0.3 | Actual results | | | | | | | 2.0 |
| | | | | | 0.6 | 0.8 | | |
| | Milestones foreseen | | | | | | | 2020 |
| Number of patents applications in the area of climate action, resource efficiency and raw materials: | Actual results | | | | | | | |
| | | | | 9 | 40 | 76 | | |
| | Milestones foreseen | | | | | | | 2020 |
| Number of patent awarded in the area of climate action, resource efficiency and raw materials: | Actual results | | | | | | | |
| | | | | 22 | 58 | 77 | | |

Methodology: Targets are for whole Societal challenges pillar (Specific objectives: 8-14) and not per each individual specific objective.

Comment: The reference for this target is the year when the last actions financed under Horizon 2020 will be finished, i.e. several years after the formal end of the programme in 2020.

The number of patent application given is the number of patent application not awarded.

| Indicator 3: Number of prototypes and testing activities | | | | | | | | |
|--|---------------------|------|------|------|-------|-------|------|--------|
| Baseline | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Target |
| | Milestones foreseen | | | | | | | 2020 |
| Number of Prototypes: none | Actual results | | | | | | | |
| | | | | 237 | 972 | 1 384 | | |
| | Milestones foreseen | | | | | | | 2020 |
| Number of Testing activities: none | Actual results | | | | | | | |
| | | | | 327 | 3 059 | 3 745 | | |

Comment: No Baseline, because of new approach.

The reference for this target is the year when the last actions financed under Horizon 2020 will be finished, i.e. several years after the formal end of the programme in 2020.

| Indicator 4: Number of joint public-private publications | | | | | | | | |
|--|---------------------|------|------|------|-------|-------|------|--------|
| Baseline | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Target |
| | Milestones foreseen | | | | | | | 2020 |
| none | Actual results | | | | | | | |
| | | | | 620 | 3 340 | 5 747 | | |

Comment: No Baseline, because of new approach.

The reference for this target is the year when the last actions financed under Horizon 2020 will be finished, i.e. several years after the formal end of the programme in 2020.

Expenditure related outputs

| Output | Budget 2020 | |
|--|--------------|--------------|
| | Output (no.) | EUR million |
| Budget line 08 02 03 05 (RTD) | | |
| Grants | 25 | 298,3 |
| Prizes | 0 | 0 |
| Procurement | 0 | 0 |
| Financial instruments | 0 | 0 |
| Experts | 2 | 1,4 |
| Others (Includes PRIMA Art. 185, 'taxation' for call H2020-EIC-FTI-2018-2020, 2 grants to identified beneficiary, GEO subscription and a SLA with EEA) | 5 | 57,6 |
| Subtotal | | 357,3 |
| of which, Climate-related expenditure | | |
| Budget line 02 04 03 01 (GROW) | | |
| Grants | 11 | 129,6 |
| Prizes | 0 | 0 |
| Procurement | 1 | 0,6 |
| Financial instruments | 0 | 0 |
| Experts | 1 | 0,1 |
| Others | 1 | 1,0 |
| Subtotal | | 131,3 |
| of which, Climate-related expenditure | | |
| Total of the Specific Objective | | 488,6 |
| of which, Climate-related expenditure | | 323,0 |

Specific Objective 13: Societal challenges – fostering a greater understanding of Europe, provide solutions and support inclusive, innovative and reflective European societies in a context of unprecedented transformations and growing global interdependencies

| Indicator 1: Publications in peer-reviewed high impact journals in the area of inclusive, innovative and reflective societies | | | | | | | | |
|---|---------------------|------|------|------|------|------|-------|--------|
| Baseline | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Target |
| 2017 | Milestones foreseen | | | | | | | 2020 |
| Publications in peer-reviewed high impact journals in the area of inclusive, innovative and reflective societies per EUR 10 million funding: 10 | | | | | | | 20.00 | 20.00 |
| | Actual results | | | | | | | |
| | | | | 0.60 | | 2.45 | | |
| 2017 | Milestones foreseen | | | | | | | 2020 |
| Number of publications in peer-reviewed high impact journals in the area of inclusive, innovative and reflective societies: | | | | | | | | |
| | Actual results | | | | | | | |
| | | | | 25 | | 196 | | |

Methodology: Targets are for whole Societal challenges pillar (Specific objectives: 8-14) and not per each individual specific objective.

Comment: The reference for this target is the year when the last actions financed under Horizon 2020 will be finished, i.e. several years after the formal end of the programme in 2020.

Expenditure related outputs

| Output | Budget 2020 | |
|--------------------------------------|--------------|-------------|
| | Output (no.) | EUR million |
| Budget line 08 02 03 06 (RTD) | | |
| Grants | 14 | 112,8 |
| Prizes | 6 | 1,5 |
| Procurement | 5 | 7,0 |
| Financial instruments | | |

| | | |
|---|----|--------------|
| Experts | 3 | 0,7 |
| Others (including 17 million of a Specific Grant Agreement – COST contribution) | 1 | 18,0 |
| Subtotal | | 140,0 |
| Budget line 09 04 03 02 (C-NECT) | | |
| Grants | 20 | 50,5 |
| Prizes | 0 | 0 |
| Procurement | | 1,0 |
| Financial instruments | | |
| Experts | | 0,5 |
| Others (COST Contribution) | | 2,6 |
| Subtotal | | 54,6 |
| Total of the Specific Objective | | 194,6 |
| of which, Climate-related expenditure | | 3,7 |

Specific Objective 14: Societal challenges – fostering secure European societies in a context of unprecedented transformations and growing global interdependencies and threats, while strengthening the European culture of freedom and justice

| Indicator 1: Publications in peer-reviewed high impact journals in the area of secure societies | | | | | | | | |
|--|---------------------|------|------|------|------|------|------|--------|
| Baseline | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Target |
| 2017 | Milestones foreseen | | | | | | | 2020 |
| Publications in peer-reviewed high impact journals in the area of secure societies per EUR 10 million funding: 1 | Actual results | | | | | | | 20.0 |
| | | | | | 0.5 | 1.8 | | |
| 2017 | Milestones foreseen | | | | | | | 2020 |
| Number of publications in peer-reviewed high impact journals in the area of secure societies: | Actual results | | | | | | | |
| | | | | 31 | 39 | 87 | | |

Methodology: Targets are for whole Societal challenges pillar (Specific objectives: 8-14) and not per each individual specific objective.

Comment: The reference for this target is the year when the last actions financed under Horizon 2020 will be finished, i.e. several years after the formal end of the programme in 2020.

| Indicator 2: Patent applications and patents awarded in the area of secure societies | | | | | | | | |
|--|---------------------|------|------|------|------|------------|------|--------|
| Baseline | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Target |
| | Milestones foreseen | | | | | | | 2020 |
| Number of patent applications in the area of secure societies per EUR 10 million funding: none (Number of patent applications in this area:) | Actual results | | | | | | | 2 |
| | | | | (2) | (1) | 0.1 (6) | | |
| | Milestones foreseen | | | | | | | 2020 |
| Number of patents awarded in the area of secure societies: none | Actual results | | | | | | | |
| | | | | 3 | 3 | 5 | | |

Methodology: Targets are for whole Societal challenges pillar (Specific objectives: 8-14) and not per each individual specific objective.

Comment: No Baseline, because of new approach.

The reference for this target is the year when the last actions financed under Horizon 2020 will be finished, i.e. several years after the formal end of the programme in 2020.

The number of patent application given is the number of patent application not awarded.

Indicator 3: Number of prototypes and testing activities

| Baseline | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Target |
|------------------------------------|---------------------|------|------|------|-------|-------|------|--------|
| | Milestones foreseen | | | | | | | 2020 |
| Number of Prototypes: none | Actual results | | | | | | | |
| | | | | 237 | 972 | 1 384 | | |
| | Milestones foreseen | | | | | | | 2020 |
| Number of Testing activities: none | Actual results | | | | | | | |
| | | | | 327 | 3 059 | 3 745 | | |

Comment: No Baseline, because of new approach.

The reference for this target is the year when the last actions financed under Horizon 2020 will be finished, i.e. several years after the formal end of the programme in 2020.

Indicator 4: Number of joint public-private publications

| Baseline | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Target |
|----------|---------------------|------|------|------|-------|-------|------|--------|
| | Milestones foreseen | | | | | | | 2020 |
| none | Actual results | | | | | | | |
| | | | | 620 | 3 340 | 5 747 | | |

Comment: No Baseline, because of new approach.

The reference for this target is the year when the last actions financed under Horizon 2020 will be finished, i.e. several years after the formal end of the programme in 2020.

Expenditure related outputs

| Output | Budget 2020 | |
|--|--------------|--------------|
| | Output (no.) | EUR million |
| Budget line 09 04 03 03 (C-NECT) | | |
| Grants | 16 | 67,5 |
| Prizes | 0 | 0 |
| Procurement | | 0,5 |
| Financial instruments | | |
| Experts | | 0,2 |
| Others | | |
| Subtotal | | 68,2 |
| Budget line 18 05 03 01 (HOME) | | |
| Grants | 28 | 178,1 |
| Prizes | 0 | 0 |
| Procurement | | 3 |
| Financial instruments | | 0 |
| Experts | | 1,4 |
| Others | | 3 |
| Subtotal | | 185,5 |
| Total of the Specific Objective | | 253,7 |
| Of which, Climate-related expenditure | | 21,4 |

Specific Objective 15: Spreading excellence and widening participation – fully exploiting the potential of Europe’s talent pool and to ensure that the benefits of an innovation-led economy are both maximised and widely distributed across the Union in accordance with the principle of excellence

Indicator 1: Evolution of the publications in high impact journals in the relevant research fields

| Baseline | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Target |
|----------|---------------------|------|------|------|------|------|------|--------|
| | Milestones foreseen | | | | | | | 2020 |
| none | Actual results | | | | | | | |
| | | | | | | 17 | | |

Comment: No Baseline, because of new approach.

The reference for this target is the year when the last actions financed under Horizon 2020 will be finished, i.e. several years after the formal end of the programme in 2020.

Expenditure related outputs

| Output | Budget 2020 | |
|--|-------------|--------------|
| | Number | EUR million |
| Budget line 08 02 04 (RTD) | | |
| Grants | 127 | 124,49 |
| Prizes | | |
| Procurement | | |
| Financial instruments | | |
| Experts | | |
| Others (WIRE, COST JPI UE) | 37 | 14,2 |
| Subtotal | | 138,6 |
| of which, Climate-related expenditure | | 16,3 |

Specific Objective 16: Science with and for society – building effective cooperation between science and society, to recruit new talent for science and to pair scientific excellence with social awareness and responsibility

| Indicator 1: Number of institutional change actions promoted by the programme | | | | | | | | |
|--|---------------------|------|------|------|------|------|------|--------|
| Baseline | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Target |
| | Milestones foreseen | | | | | | | 2020 |
| none | Actual results | | | | | | | 100 |
| | | | | 7 | 16 | 27 | 100 | |
| | | | | 233 | 265 | | | |

Comment: No Baseline, because of new approach.

Expenditure related outputs

| Output | Budget 2020 | |
|--|--------------|-------------|
| | Output (no.) | EUR million |
| Budget line 08 02 06 (RTD) | | |
| Grants | 14 | 63,1 |
| Prizes | 1 | 0,4 |
| Procurement | 5 | 4,4 |
| Financial instruments | | |
| Experts | 2 | 1,0 |
| Others | 6 | 4,5 |
| Subtotal | | 73,4 |
| of which, Climate-related expenditure | | 1,8 |

Specific Objective 17: Non-Nuclear Direct Actions of the Joint Research Centre – providing customer-driven scientific and technical support to Union policies, while flexibly responding to new policy demands

| Indicator 1: Number of occurrences of tangible specific impacts on European policies resulting from technical and scientific support provided by the Joint Research Centre | | | | | | | | |
|---|---------------------|------|------|--------|------|------|----------|----------|
| Baseline | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Target |
| 2013 | Milestones foreseen | | | | | | | 2020 |
| 248 | Actual results | | | | | | | > 330±15 |
| | 215±5 | | | 330±10 | | | > 330±15 | |
| | 275 | 305 | 376 | 339 | 338 | 295 | | |

Comment: Milestone and long term target for this indicator reflect two opposing trends: a slightly upward and fluctuating evolution regarding the total number of policy impacts identified on the one hand, and a continuous predictable downward trend in resources on the other hand. Policy support impact indicators count cases where JRC’s support becomes part or even the basis of European policy, i.e. cases where JRC’s work helped

putting Commission priorities on a solid and robust scientific evidence base. Impacts are identified in the JRC's annual evaluation exercise performed by an internal peer group of experts on the basis of an ISO certified evaluation methodology.

| Indicator 2: Number of peer reviewed publications in high impact journals | | | | | | | | |
|---|---------------------|------|------|--------|------|------|----------|----------|
| Baseline | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Target |
| 2010-2013 | Milestones foreseen | | | | | | | 2020 |
| 460 | 460±10 | | | 500±15 | | | > 500±20 | > 500±20 |
| | Actual results | | | | | | | |
| | 465 | 518 | 553 | 515 | 538 | 522 | | |

Expenditure related outputs

| Output | Budget 2020 | |
|--|--------------|-------------|
| | Output (no.) | EUR million |
| Budget line 10 02 01 | | |
| Policy support deliverables | 900 | 38,7 |
| Total | | 38,7 |
| of which, Climate-related expenditure | | 11,6 |

Specific Objective 18: The European Institute of Innovation and Technology – integrating the knowledge triangle of higher education, research and innovation and thus to reinforce the Union's innovation capacity and address societal challenges

Indicator 1: organisations from universities, business and research integrated in the Knowledge and Innovation Communities (KICs)

| Baseline | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Target |
|-----------|---------------------|------|-------|-------|-------|------|-------|--------|
| 2010-2012 | Milestones foreseen | | | | | | | 2020 |
| 200 | 240 | 450 | 500 | 800 | | | 1 200 | 1 200 |
| | Actual results | | | | | | | |
| | 550 | 800 | 1 097 | 1 238 | 1 650 | | | |

Narrative: Baseline: with 3 KICs

Comment: The KICs will only report the 2019 results in March/April 2020. The validated EIT figures will then not be available before June 2020 at the earliest.

Indicator 2: collaboration inside the knowledge triangle leading to the development of innovative products, services and processes

| Baseline | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Target |
|-----------------------------|---------------------|-------|-------|-------|-------|------|-------|--------|
| 2010-2012 | Milestones foreseen | | | | | | | 2020 |
| Start-ups and spin-offs: 33 | 30 | 280 | 400 | 500 | | | 600 | 600 |
| | Actual results | | | | | | | |
| | 181 | 250 | 286 | 356 | 359 | | | |
| 2010-2012 | Milestones foreseen | | | | | | | 2020 |
| Innovation: 210 | 300 | 800 | 1 500 | 2 200 | | | 6 000 | 6 000 |
| | Actual results | | | | | | | |
| | 1 184 | 2 145 | 3 904 | 4 471 | 3 159 | | | |

Comment: The KICs will only report the 2019 results in March/April 2020. The validated EIT figures will then not be available before June 2020 at the earliest.

Expenditure related outputs

| Output | Budget 2020 | |
|-----------------------------------|-------------|--------------|
| | Number | EUR million |
| Budget line 15 03 05 (EAC) | | |
| Others | | |
| Subtotal | | 496,7 |

| | |
|---------------------------------------|-------|
| of which, Climate-related expenditure | 248,3 |
|---------------------------------------|-------|

4. Contribution to Europe 2020 Strategy and mainstreaming of policies

Contribution to Europe 2020 headline targets

Table Contribution to Europe 2020 headline targets

| |
|--|
| 75 % of the population aged 20-64 should be employed |
| 3 % of the EU's GDP should be invested in R & D |
| The '20/20/20' climate/energy targets should be met (including an increase to 30 % of emissions reduction if the conditions are right) |

Contribution to mainstreaming of climate action

Relevant objective/output

| Relevant objective/output | Budget 2019 | Budget 2020 |
|--|----------------|----------------|
| Specific Objective – European Research Council | 294,3 | 324,0 |
| Specific Objective – Future and Emerging Technologies | 63,8 | 60,0 |
| Specific Objective – Marie Skłodowska-Curie actions | 211,0 | 197,4 |
| Specific Objective – Research infrastructures | 67,4 | 52,6 |
| Specific Objective – Enabling and Industrial Technologies | 377,3 | 433,4 |
| Specific Objective – Access to risk finance | 2,4 | 2,0 |
| Specific Objective – SMEs | 11,1 | 12,3 |
| Specific Objective – Health | 26,2 | 67,9 |
| Specific Objective – Food | 261,3 | 423,4 |
| Specific Objective – Energy | 791,4 | 954,0 |
| Specific Objective – Transport | 440,0 | 383,8 |
| Specific Objective – Resource efficient and climate change resilient economy | 248,1 | 323,0 |
| Specific Objective – Inclusive, innovative and reflective European societies | 2,7 | 3,7 |
| Specific Objective – Secure European societies | 19,2 | 21,4 |
| Specific Objective – Spreading excellence and widening participation | 15,0 | 16,3 |
| Specific Objective – Science with and for society | 1,0 | 1,8 |
| Specific Objective – Non-Nuclear Direct Actions of the Joint Research Centre | 11,5 | 11,6 |
| Specific Objective – European Institute of Innovation and Technology | 228,1 | 248,3 |
| Total | 3 071,8 | 3 536,9 |

Programmation climate action

| 2014-2018 | | | | | 2019-2020 estimates | | Total |
|-----------|---------|---------|---------|---------|---------------------|---------|----------|
| 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | |
| 2 387,5 | 2 709,6 | 2 623,0 | 3 245,0 | 2 608,7 | 3 071,8 | 3 536,9 | 20 182,5 |

(*)The appropriations for the year 2014 have been reviewed to take account of the transfer to subsequent years of the allocations not used in 2014 (reprogramming exercise carried-out in 2015 in accordance with Article 19 of the Multiannual Financial Framework Regulation).

Justification

The tracking approach used is based on the OECD 'Rio Markers' methodology. It distinguishes actions that have climate-related action as principal objective (marker = 100 %), as secondary objective (marker = 40 %) or that do not target climate change at all (marker = 0 %).

As for the 2019 exercise, please note that the figures for 2020 are estimations based on the history of the previous expenditures in the period 2014-2019. For the latter, we have only taken the operational expenditure into account (Joint Undertakings included, but all administrative expenditure excluded).

It should be noted that the 'tracking percentages' mentioned above – as well as all calculations of climate contributions in past years – have been calculated exclusively on the basis of the climate contribution in grant agreements signed. This approach best reflects the reality of the research projects that are being implemented.

The Regulation establishing Horizon 2020 states that climate-related expenditure should exceed 35 % of the overall Horizon 2020 budget. Despite a considerable increase compared to FP7, investment for climate action has not yet reached its target yet. Therefore, targeted action is being taken to address this challenge. A new Green Deal call will be launched that will have a positive impact on the tracking for climate. However, at this early stage, we are not in the position of quantifying the contributions.

Contribution to financing biodiversity

Relevant objective/output

| Relevant objective/output | Budget 2019 | Budget 2020 |
|--|--------------|--------------|
| Specific Objective – European Research Council | 87,6 | 96,5 |
| Excellent science –Marie Skłodowska-Curie actions – strengthening skills, training and career development | 51,0 | 44,2 |
| Excellent science – Research infrastructures | 33,2 | 27,9 |
| Industrial leadership – boosting Europe’s industrial leadership through research, technological development, demonstration and innovation in the following enabling and industrial technologies | 17,6 | 21,3 |
| Societal challenges – to secure sufficient supplies of safe and high quality food and other bio-based products, by developing productive and resource-efficient primary production systems, fostering related ecosystem services, alongside competitive and low carbon supply chains | 132,8 | 231,0 |
| Societal challenges – to achieve a resource efficient and climate change resilient economy and a sustainable supply of raw materials | 66,3 | 83,6 |
| Non-Nuclear Direct Actions of the Joint Research Centre – to provide customer-driven scientific and technical support to Union policies, while flexibly responding to new policy demands | 4,2 | 4,2 |
| Total | 392,7 | 508,7 |

Programmation biodiversity

| 2014-2018 | | | | | 2019-2020 estimates | | Total |
|-----------|-------|-------|-------|-------|---------------------|-------|---------|
| 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | |
| 354,7 | 352,6 | 392,2 | 359,6 | 434,1 | 392,7 | 508,7 | 2 794,6 |

(*)The appropriations for the year 2014 have been reviewed to take account of the transfer to subsequent years of the allocations not used in 2014 (reprogramming exercise carried-out in 2015 in accordance with Article 19 of the Multiannual Financial Framework Regulation).

Justification

The tracking approach used is based on the OECD ‘Rio Markers’ methodology. To obtain estimates for 2020, we have calculated the share of the EU contribution (in %) for each of the programme parts shown above for the period 2014-2019 and we have then applied these percentages to budget figures for 2020. We have only taken the operational expenditures into account (joint undertakings included, support expenditures excluded). A new Green Deal call will be launched that will have a positive impact on the tracking for biodiversity. However, at this early stage, we are not in the position of quantifying the contributions.

Contribution to financing clean air

Horizon 2020 support projects that provide a better knowledge base and innovative, market-oriented solutions to tackle the air quality problem from different angles in many ways.

For instance with a dedicated call on ‘Improving the air quality and reducing the carbon footprint of European cities’, three air quality projects(iSCAPE; CLAiR-City and ICARUS) were funded with a total EU contribution of about 19 million EUR and 20 European cities involved. Citizens are actively engaged in the projects by participating in measurement campaigns and by shaping local strategies for emission reduction.

Another example is the SME Instrument that provided more than 43 million EUR in grants to clean tech companies. Just to name two of them:

- Amminex deployed the technology in London’s buses to reduce NOx emissions under real-world driving conditions;
- Plume LABS developed an app (Android and iOS) that brings air quality forecasts to every city on Earth.

Air quality, being a very cross-cutting issue, also benefits from impacts generated by other projects funded by the EU, for example those targeting topics such as water treatment and management, climate change mitigation, waste management, resource efficiency, green infrastructure and health. Some of the air quality projects showcased their activities and results at the European Clean Air Forum, a forum that brings together decision-makers at different governmental levels.

The following table provides the Air Quality expenditure per relevant objective for the full 2014-2020 period, in order to make possible future comparison with subsequent multiannual financial framework Horizon Europe. A high-level tracking methodology has been applied based on the so-called ‘Rio markers’ which were developed and convened in the OECD.

More precisely, this means that the climate related expenditure can be calculated in accordance with three categories:

- *Expenditure-related outputs where Air Quality is the principal (primary) objective are those for which air quality objectives can be identified as being fundamental in the design and impact of the activity, and are an explicit objective of the activity; to be counted as 100 % Air Quality related.*
- *Expenditure-related outputs where Air Quality is a significant, but not predominant, objective are those for which – although important – air quality objectives are not one of the principal reasons for undertaking the activity; to be counted as 40 % Air Quality related.*
- *Expenditure not targeted to Air Quality objectives; to be counted as 0 % Air Quality related.*

| Relevant objective/output | Draft (2014-2020) |
|--|-------------------|
| Specific Objective – European Research Council | (1) |
| Specific Objective – Future and Emerging Technologies | 0 (2) |
| Specific Objective – Marie Skłodowska-Curie actions | (1) |
| Specific Objective – Research infrastructures | (1) |
| Specific Objective – Enabling and Industrial Technologies | 0 (2) |
| Specific Objective – Access to risk finance | 0 |
| Specific Objective – SMEs | 0 (2) |
| Specific Objective – Health | 0 |
| Specific Objective – Food | 0 (2) |
| Specific Objective – Energy | 1 987 707 |
| Specific Objective – Transport | 1 143 909 |
| Specific Objective – Resource efficient and climate change resilient economy | 1 087 895 |
| Specific Objective – Inclusive, innovative and reflective European societies | 0 |
| Specific Objective – Secure European societies | 0 |
| Specific Objective – Spreading excellence and widening participation | 0 |
| Specific Objective – Science with and for society | 0 |
| Specific Objective – Non-Nuclear Direct Actions of the Joint Research Centre | 0 (2) |
| Specific Objective – European Institute of Innovation and Technology | 0 (2) |
| Total | 4 219 511 |

- (1) For Bottom-up activities such as ERC and MSCA no value can be set for this first exercise. This need to be adjusted (upwards) in a tracking exercise. A more accurate estimate of the contribution of these activities to air quality action will be possible in the next MFF.
- (2) Although a number of projects, air quality is a significant, the scoring of ‘0’ has been applied for the overall activity.

Clean air quality, being a very cross-cutting issue, also benefits from impacts generated by other projects funded by the EU, for example those targeting topics such as sustainable transport, climate change mitigation (e.g. energy efficiency), water treatment and management, waste management, resource efficiency, green infrastructure and health. Some of the air quality projects showcased their activities and results at the European Clean Air Forum, a forum that brings together decision-makers at different governmental levels.

The following table provides a rough estimate of the Air Quality expenditure per relevant objective for the full 2014-2020 period. A high-level tracking methodology has been applied based on the so-called ‘Rio markers’ which were developed and convened in the OECD.

While this table gives indication on the contribution of Horizon 2020 to financing Air Quality, but in view of ensuring more accurate figures, the tracking of Air Quality related expenditure will be tracked up at call or project level through corresponding reporting formats in the next programme Horizon Europe (2021-2027).

Gender mainstreaming

The 2018-2020 Work Programme includes seven specific calls on gender topics, under Specific Objective 16 (‘Science with and for Society’). Examples of the topics for these calls are to support research organisations to implement gender equality plans, and to analyse gender gaps and biases in the allocation of grants.

In Horizon 2020, the strategy on gender equality as a cross-cutting issue focuses on three main objectives:

- Fostering equal opportunities and gender balance in research teams, in order to close the gaps in the participation of women;
- Ensuring gender balance in decision-making, in order to reach the target of 40 % of the under-represented sex in panels and groups and of 50 % in advisory groups;
- Integrating the gender dimension in Research & Innovation (R&I) content, taking into account as relevant biological characteristics as well as social and cultural features of both women and men in research content (through sex and gender analysis).

These objectives are implemented through a series of Commission provisions which are integrated, as relevant, at various stages of the Research and Innovation cycle.

Gender balance in research teams

In the Work Programmes, applicants are encouraged to promote equal opportunities in the implementation of the action and to ensure a balanced participation of women and men at all levels in research and innovation teams. Up to January 2020 of Horizon 2020 the share of women participants in Horizon 2020 projects was **41** % of the total workforce, including non-researchers, while women represented **27** % of projects coordinators.

Gender balance in decision-making

The share of contracts signed with women experts participating in evaluation panels was 41 %, while in Horizon 2020 advisory groups women's participation was 55 %.

Gender dimension in research and innovation content

The gender dimension in research content continues being explicitly mentioned in several topics across the parts of the Work Programme and applicants' attention is drawn to the relevance of taking into account the biological characteristics and/or the social/cultural features of both women and men in the content of their planned research. In the Work-Programme 2020, **119 out of 337 topics** for call for proposal had integrated an explicit gender dimension in their content.

Gender equality in R&I in the European Research Area (ERA).

Gender Equality in R&I, as one of the key priority in the European Research Area (ERA), addresses the same objectives as in Horizon 2020. In collaboration with Member States and research institutions, the focus is put on institutional change at the level of research performing organisations (RPOs) and research funding organisations (RFOs), including universities to:

- a) Remove cultural and institutional barriers that generate direct or indirect discrimination in scientific careers;
- b) Ensure gender balance in decision-making and;
- c) Integrate the gender dimension in research content.

As reported in the 2018 ERA Progress Report, while parity in the earliest stages of the research career seems at hand, the levels of parity diminish as researchers move up the ladder of career progression stages; furthermore, these decreases at more senior career stages show no signs of substantial change in recent years. Regarding gender dimension in research content, European research takes into account the biological characteristics as well as the social and cultural features of both women and men, and integrates a gender dimension about as often as the global average. The increasing integration of the gender dimension in research in Europe is essentially moving in parallel with increases at the world level, and at a slightly lower rate.'

5. Programme contribution to the Sustainable Development Goals

Contribution to the Sustainable Development Goals

The EU is committed to development that meets the needs of the present without compromising the ability of future generations to meet their own needs. A life of dignity for all within the planet's limits that reconciles economic prosperity and efficiency, peaceful societies, social inclusion and environmental responsibility is at the essence of sustainable development. To create from these challenges opportunities for new businesses and new jobs, a strong engagement in research and innovation is necessary. Research and innovation policy sets the direction of travel, creates knowledge and solutions for the transformation towards sustainability, while improving our well-being and ensuring long-term prosperity. It also promotes systemic approaches beyond disciplines, sectors, conversations and policy areas.

The EU Framework Programme for Research and Innovation, Horizon 2020, addresses several of the Sustainable Development Goals (SDGs). This is expressed in the expectation that, overall, at least 60 % of the programme's budget should contribute to sustainable development. Ten SDGs have been identified as of particular relevance to guide present and future R&I work. They can be grouped in **six focus areas**:

- 'Climate change and energy' (SDG7, 13),
- 'Natural resources and biodiversity' (SDG 6, 11, 14),
- 'Food and nutrition security' (SDG 2, 15),
- 'Circular and bio-economy' (SDG 12, 15),
- 'Health' (SDG 3),
- 'Enabling technologies' (SDG 9).

In the programme's budget, the following **Specific Objectives** are the biggest contributors to the respective focus areas:

- Focus area 'Climate change and energy' – Specific Objective 10 (transition to a sustainable energy system);
- Focus area 'Natural resources and biodiversity' – Specific Objective 12 (protection of natural resources and ecosystems);
- Focus area 'Food and nutrition security' – Specific Objective 9 (high quality food);
- Focus area 'Circular and bio-economy' – Specific Objective 9 (bio-based products);
- Focus area 'Health' – Specific Objective 8 (improving lifelong health);
- Focus area 'Enabling technologies' – Specific Objective 2 (future and emerging technologies) and Specific Objective 5 (industrial leadership).

In addition, the specific objectives not mentioned above also contribute to several of the focus areas.

The tracked expenditure of the Horizon 2020 budget for signed Grant Agreements indicates **an overall contribution of 66 % to Sustainable Development**. Within the Societal Challenges pillar, this contribution rises to 75 % overall, with some of its

programme parts being close to 100 % (SC 1 ‘Health, demographic change and wellbeing’, SC 2 ‘Food security, sustainable agriculture and forestry, marine and maritime and inland water research and the bioeconomy’, SC 3 ‘Secure, clean and efficient energy’ and SC 5 ‘Climate action, environment, resource efficiency and raw materials’).

6. Information about financial instrument(s) and trust fund(s) financed by the Programme

| Financial instruments | Debt | | Equity | Total |
|--|-------|------------|--------|-------------|
| | Loans | Guarantees | | |
| Horizon 2020 Budget (EUR billion) | 1,7 | 1,4 | 0,8 | 3,9 |
| EFSI & EIF Contribution (EUR billion) | 0 | 1.1 | 0,4 | 1,5 |
| Expected amount of financing leveraged (EUR billion) | 13,6 | 20 | 6 | 39,6 |

Horizon 2020 funds contribute to a number of Financial Instruments under the ‘InnovFin’ label. The Instruments are managed by the European Investment Bank Group (EIB and EIF). The Commission’s maximum financial exposure is limited to the amounts paid to the EIB group.

In 2014, the European Commission and the European Investment Bank Group (EIB and EIF) launched a new generation of EU financial instruments and advisory services to help innovative firms access finance more easily. It is expected that the ‘InnovFin – EU Finance for Innovators’ products will in Horizon 2020 (2014-2020) make available more than EUR 39 billion of financing for research and innovation (R&I) to small, medium and large companies and the promoters of research infrastructures. The final investments in R&I should reach more than 1,5 times the total amount invested.

‘InnovFin – EU Finance for Innovators’ consists of a range of tailored products – from guarantees to intermediaries that lend to SMEs, to direct loans to enterprises – helping support from the smallest up to the largest R&I projects in the EU and countries associated to Horizon 2020. InnovFin guarantees and loans will be backed by funds set aside under Horizon 2020 and by the EIB Group for the purpose of supporting R&I investment, which by nature is riskier and harder to appraise than tangible investments. All are demand-driven instruments, with no prior allocations between sectors, countries or regions. These debt instruments are complemented by a suite of equity instruments managed by the EIF. In total, some EUR 3.9 billion out of Horizon 2020’s nearly EUR 77 billion budget support these financial instruments.

The EIB Group consists of the European Investment Bank and the European Investment Fund (EIF). The European Investment Bank provides loans to medium-size and larger companies, as well as guarantees to banks that lend to them. The EIF provides guarantees to banks that lend to small and medium-sized firms and – at a later stage – will invest in venture capital funds, which provide startups and fast-growing firms with equity.

1. Debt finance (Loans Service for R&I; SME & small midcaps R&I Loans Service; SME Initiative)

Loans are provided through the EIB to large and mid-size companies, and to research infrastructures. In addition, products for energy and infectious diseases have been developed to address specific needs in these areas. The total foreseen budget for loans in Horizon 2020 amounts to around EUR 1,7 billion. This is expected to generate around EUR 13,6 billion of loans.

Guarantees provided to local financial intermediaries (mostly banks) through the EIF are specifically designed for innovative SMEs and small mid-caps. The overall budget in Horizon 2020 is about EUR 1,4 billion. Because of the high demand for this type of support, the EFSI fund has stepped in with a ‘top-up’ of EUR 1,1 billion, which allows a faster implementation. More than 170 financial intermediaries are currently implementing these guarantees. With the leverage effect, they are expected to generate over EUR 20 billion of financing to innovative SMEs and small mid-caps.

2. Equity finance (Early stage finance for innovative enterprises; Pilot facility for technology transfer, the Pan-European VC Fund-of-Funds)

On the **equity** side (i.e. financing own capital for companies), the financial instruments make available venture capital (VC) for the early stages of R&I-driven SMEs & small mid-caps. The overall budget for Horizon 2020 amounts to EUR 0,8 billion. This is done through the EIF, which supports risk capital funds that invest, on a predominantly cross-border basis, in individual enterprises.

Within the equity financial instrument, the **Pan-European VC Fund-of-Funds** is a priority action under the Commission’s [Capital Markets Union \(CMU\)](#), and complements other actions to boost VC in Europe, notably [proposed expansion of the European VC Funds \(EuVECA\) regulation](#) and [proposals to address the bias in the tax system towards debt over equity](#). The EU will provide cornerstone investments of up to EUR 300 million in one or more independently managed VC Fund-of-Funds, up to a maximum budget of EUR 400 million for all Fund-of-funds. The selected fund manager(s) must raise at least three times as much from other sources (the EU investment is capped at 25 %). This means additional potential investments to VC of around EUR 1.6 billion, which is a major boost, as the total of VC funds raised last year in the EU was EUR 11 billion. The EU investment combines resources from Horizon 2020’s InnovFin Equity scheme (up to EUR 200 million), EFSI (up to EUR 100 million) and COSME (where up to EUR 100 million is foreseen). The 2016 call for managers interested in applying to run the Pan-European VC Fund-of-Funds can be found on the [EIF’s website](#). This call is now closed. All applications have been assessed by the Commission and the EIF. The Funds-of-Funds are under due diligence. Three agreements have been signed for a target size of 0.9 billion.

7. Programme related additional information

Expenditure related outputs not linked to a specific objective

| Output | Budget 2020 | |
|---------------------------------------|-------------|--------------|
| | Number | EUR million |
| Budget line 08 02 05 (RTD) | | |
| Others (e.g. Dissemination and EMPIR) | | 115,4 |
| Total | | 115,4 |