



**BELGIAN REPORT
ON SCIENCE TECHNOLOGY
AND INNOVATION
(BRISTI) 2021**



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PREFACE

We are at a key moment for research and innovation. I am therefore particularly pleased to preface this Belgian Report on Science, Technology and Innovation (BRISTI).

Research and innovation (R&I) have never been more in the spotlight as during the Covid-19 pandemic. The responsiveness of the medical and pharmaceutical sector, as well as actors from other R&I sectors, to respond to this crisis in Belgium and in Europe, has been remarkable.

Similarly, R&I are actively contributing to addressing other major challenges such as climate change, cyber security, the energy transition or population movements.

Belgium has exceeded the European target of 3% of GDP invested in research and development (R&D) for the first time in 2019 and has joined the leading European countries. According to the initial data for 2020, Belgium is now at the top of the European ranking on an equal footing with Sweden.

This confirms that our country is a land of research and development (R&D) and a place that welcomes and fosters innovation. There is no question of resting on our laurels and we will continue to do our utmost to strengthen R&D and innovation intensity.

This will be done, amongst other actions, via the national recovery and resilience plan and the recovery plans of the various Belgian authorities, where R&I projects will support the green and digital transitions.

In my view, these plans represent the beginning of a welcome shift from a regulatory State towards a strategic state. The pandemic and the fragility of our economies that it has highlighted, have convinced our governments that all or part of certain value chains need to be repatriated and that it is necessary to reinforce support for R&D and innovation, especially for products and services that are still far from being marketable and for which the profitability of investments cannot be guaranteed in the short term.

Belgium is a federal country where the responsibility for science policy is shared between the national level and the federated entities, and where coordination is, more than in other European Member States, at the heart of our work.

In the run-up to the Presidency of the Council of the EU (1st semester 2024), this report presents the broad outlines of the Belgian institutional landscape in the field of research, technology and innovation and highlights the respective competences of the different authorities, namely the Federal State, the Regions and the Communities, their priorities, actors and instruments, as well as their perspectives for the future. More than ever, Belgium has the ambition to build on and further enhance an impressive track record in the R&I field.



Thomas Dermine,
State Secretary for Economic Recovery and Strategic Investments, in charge of Science Policy

INTRODUCTION

The Belgian Report on Science, Technology and Innovation (BRISTI) has been published twice to date, in 2001 (with an online update in 2005) and in 2010.¹ The first two editions were published to mark previous Belgian presidencies of the European Union (EU). As with the two previous reports, this report provides readers, notably those from other EU Member States, with an overview of the institutions, the policies and the main research and innovation (R&I) actors in Belgium.

Much has changed in the last decade at Belgian, European and global levels concerning the governance, funding mechanisms and priorities of R&I policy. The rapid digitalisation of the economy and society is mirrored in the R&I field, with open science, ‘fair’ data, artificial intelligence and (big) data analytics driving new ways of conducting scientific research and leading to new innovative products and services. Societal challenges were already moving up the agenda in 2010. But in the last 10 years, finding solutions to the climate crisis, access to and management of increasingly scarce resources, biodiversity loss, poverty and inequality have all gained growing urgency. In the last two years, the importance of R&I in responding to public health emergencies has been made crystal clear during the COVID-19 pandemic. **These challenges require a coordinated response from all those involved in R&I policy management and implementation**, through a growing focus on designing mission-driven R&I agendas, joint investment in European and international research infrastructures, and reinforcing broad-based R&I partnerships that foster the involvement of societal actors in a process of open innovation.

Accordingly, compared to the previous editions, which were more focused on scientific and industrial research, this BRISTI report adopts a broader perspective on research and innovation. This choice reflects the growing understanding that the main challenge for R&I policy is to empower transformative change. In turn, this requires cross-departmental policy coordination, policy measures that foster all forms of innovation and involve a diverse set of actors, increased ‘directionality’ through shared visions and missions, plus the broad dissemination of innovation in the economy and society.

Belgium has a long and remarkable history of scientific discoveries and innovations: from the father of the Big Bang theory, Georges Lemaître (1894-1966), to Marie-Anne Libert (1782-1865) one of the first women plant pathologists who discovered the organism that causes potato blight. This long tradition of scientific excellence continues today, with, for instance, Ingrid Daubechies recognised for her study of the mathematical methods that enhance image-compression technology (JPEG, etc.) or Robert Cailliau, a computer scientist who proposed the first (pre-www) hypertext system for CERN in 1987 and contributed to the development of the Internet.

1. See: http://www.belspo.be/belspo/organisation/publ/pub_ostc/BRISTI/Bristi_tome1_2010_en.pdf

The most recent Belgian to be awarded a Nobel Prize is François Englert, who shared with Peter Higgs the 2013 Nobel Prize in Physics for the theoretical discovery of a mechanism that contributes to our understanding of the origin of mass of subatomic particles (confirmed through the discovery of the predicted fundamental particle, by the ATLAS and CMS experiments at CERN's Large Hadron Collider). In the field of social sciences and humanities, examples of notable Belgian scientists include Isabelle Stengers, a Belgian philosopher, renowned for her work in the philosophy and history of science, and winner of the Ludwik Fleck Prize in 2013; or Laurens Cherchye, Bram De Rock and Frederic Vermeulen who shared the 2019 Francqui Prize² for their innovative and important work on decision-making by households.

Belgian researchers have a high scientific impact in fields such as medicine, biochemistry, genetic and molecular biology, physics and astronomy or mathematics. Their commitment to pushing the frontier of scientific knowledge is maintained by the research funded and carried out in Belgium and notably in the higher education sector, but also through Belgian participation in European R&I framework programmes and in international research infrastructures.

With a highly productive industrial sector and strong presence in knowledge-intensive services, the Belgian economy is one of the most open in the world, both in terms of trade and via the high penetration of inward investment in the national economy. Belgium hosts a vibrant ecosystem of start-ups and spin-offs and it has the third highest rate of innovative enterprises in the EU27.³ Moreover, many international companies have chosen to establish their research & development (R&D) operations in Belgium and these firms contribute to a sizeable share of business R&D. Over the last decade, investment in Belgium on R&D has increased as a share of gross domestic product (GDP), notably thanks to the growth of spending by the business sector.⁴

Under the Belgian constitution, each of the federated authorities (regions and linguistic communities) is solely competent for specific policy areas. Since the 1970s, a process of

2. See: <http://www.francquifoundation.be>

3. See: <https://ec.europa.eu/eurostat/web/products-eurostat-news/-/ddn-20210115-2>

4. See: https://www.plan.be/publications/publication-2071-en-the_most_important_r_d_industries_in_belgium_structural_evolution_firm_strategy

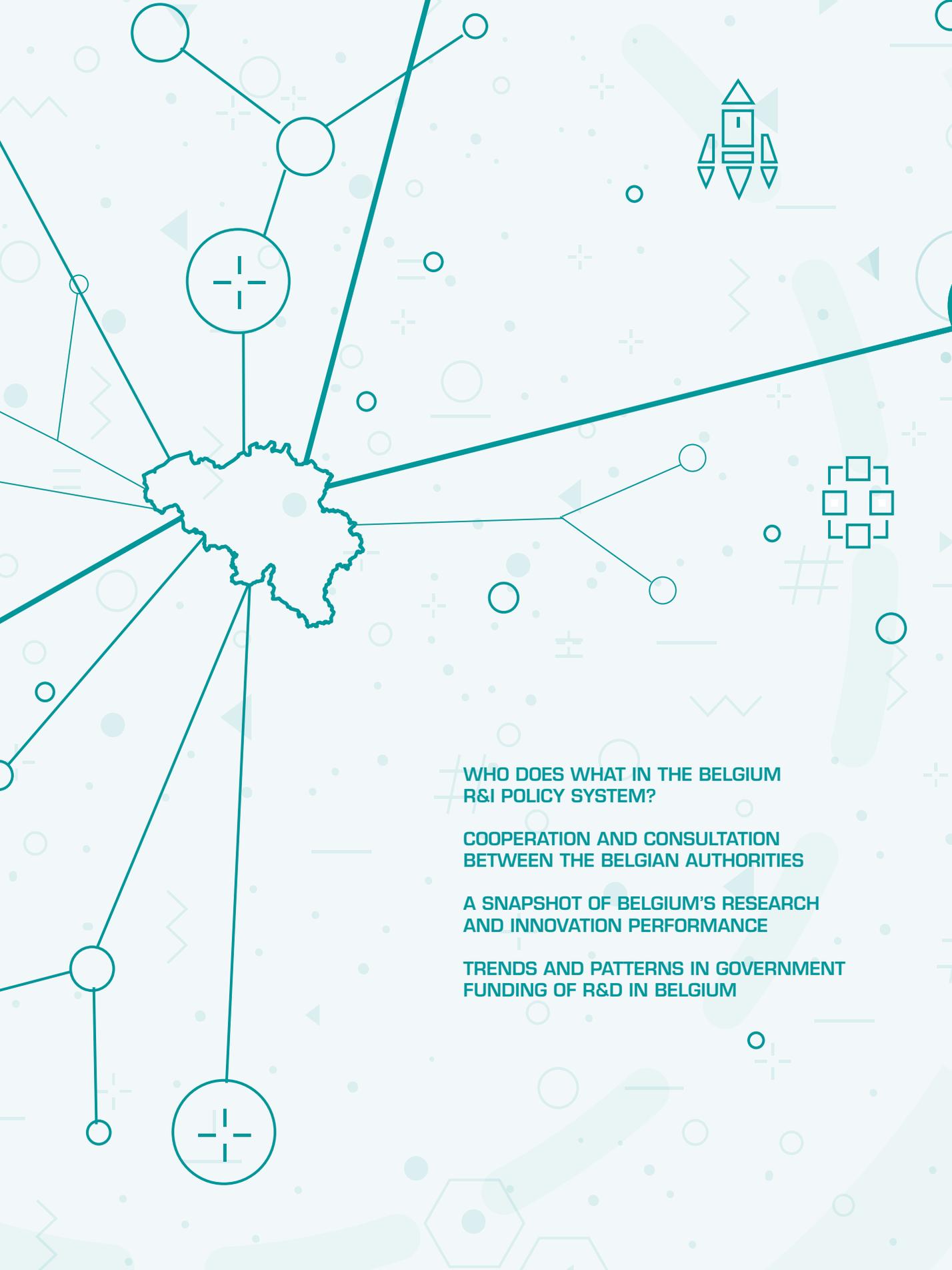
decentralisation has resulted in the development of institutions and policies adapted to the R&I potential, as well as the social and economic needs of each part of Belgium.

Following the first chapter framing the overall Belgian R&I system, this BRISTI report is structured in five main chapters:

- ▶ The Federal Authority
- ▶ Flanders
- ▶ The French Community (known as the Wallonia-Brussels Federation)
- ▶ The Brussels-Capital Region, and
- ▶ Wallonia.

Each chapter sets out the current R&I policy objectives, the main policy measures and describes the key stakeholders involved in the governance and performance of R&I (universities, enterprises, etc.).

A final chapter brings together a series of cross-cutting topics for Belgium R&I policy and places them in the context of European and global trends.



**WHO DOES WHAT IN THE BELGIUM
R&I POLICY SYSTEM?**

**COOPERATION AND CONSULTATION
BETWEEN THE BELGIAN AUTHORITIES**

**A SNAPSHOT OF BELGIUM'S RESEARCH
AND INNOVATION PERFORMANCE**

**TRENDS AND PATTERNS IN GOVERNMENT
FUNDING OF R&D IN BELGIUM**

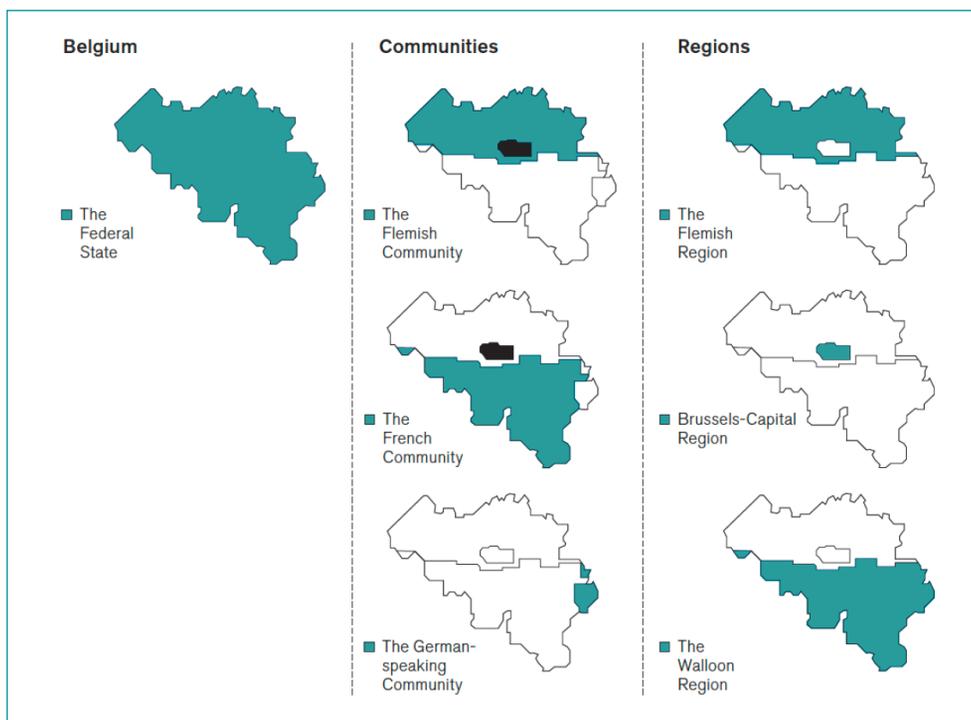
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THE INSTITUTIONAL LANDSCAPE FOR RESEARCH AND INNOVATION POLICY IN BELGIUM

1.1 WHO DOES WHAT IN THE BELGIUM R&I POLICY SYSTEM?

Through a process of State (constitutional) reform beginning in 1970,¹ Belgium has evolved into a federal country composed of seven autonomous entities: the Federal State and six federated entities: three regions and three communities. Each entity elects its own government and parliament and determines all regulations and institutions necessary to ensure effective government for all areas that fall under its responsibility under the constitution.

Figure 1: Belgium – a federal country



Each entity has exclusive powers in specific areas:

- The Federal Government is competent in areas of national interest, such as defence, justice, monetary and fiscal policy, (elements of) social security and health policies. In these policy areas, the federal authorities have competence for funding scientific research.

5. For more details on the process of the creation of the federal state, see: https://www.belgium.be/en/about_belgium/country/history/belgium_from_1830/formation_federal_state

- ▶ The communities are defined on the basis of the languages used within specific territorial areas (see figure above) and they have powers in fields related to the citizen as an individual. These include culture, education and training, higher education, child protection, family and youth services (including assistance to immigrants), health and sport. The country has three official languages: Dutch, French and German, and hence three communities: the Flemish Community,⁶ the French Community (commonly called the Wallonia-Brussels Federation), and the German-speaking Community;⁷ the Brussels-Capital territory is a bilingual (French and Dutch) area.
- ▶ At a territorial level, Belgium is organised in three regions: Brussels-Capital, Flanders and Wallonia. The regions have powers in fields that relate to their territory in the widest sense of the term, including the economy and business development, applied research and innovation employment, agriculture, foreign trade, energy and utility companies, transport, the environment and natural resources, and local democracy. The regions are competent for international relations, in these fields, and they develop socio-economic policies adapted to their specific situation.

Since the last BRISTI report in 2010, a sixth reform of the Belgian state was adopted through an institutional agreement in December 2011 and implemented in two phases. The second phase was in 2014, following the adoption of a law that revised the financing mechanisms for the federated entities (additional funding transferred from the federal budget and increased fiscal autonomy as 25% of personal income tax is now collected by the regions). This financial reform enabled the transfer of additional powers to the federated entities. In the field of R&I policy, the additional powers transferred from the federal to the federated entities concerned notably the organisation of Belgium-wide scientific and technological cooperation. In particular, the Interuniversity Attraction Poles (IAP) programme, a federal measure supporting basic research, was transferred to the communities and replaced by the Excellence of Science⁸ programme. Similarly, the Technological Attraction Poles (TAP) programme was transferred to the regions and was replaced by BEL-COO.

Figure 2: Belgium-wide R&I cooperation programmes – EOS and BEL-COO

The **Excellence of Science (EOS) programme** was launched in 2017 to promote joint research between researchers in the Flemish and French-speaking communities, as well as foreign researchers, through funding of joint basic research projects in any scientific discipline. The community governments decided jointly to invest the €158 million of the former IAP programme in the reinforcement of basic research through the new EOS programme⁹. The projects selected can have a duration of up to four years, with budgets of between €450,000 and €1 million covering staff, consumables,

6. The Flemish Region and the Flemish Community merged to form a single government, parliament and administration.
 7. In addition to the Flemish and French communities, there is a German-speaking Community (covering several municipalities located in the east of the Walloon region): unlike the other two communities, it does not exercise powers over scientific research and so is not presented in this BRISTI report.
 8. See: <https://www.eosprogramme.be/>
 9. The last phase of the IAP programme ran from 2012-2017 with a total budget of €156.5 million which funded 47 IAP-research networks, involving 369 research teams (257 Belgian teams and 112 European partners).

coordination costs and small-scale research equipment. A first EOS call was launched in 2017. A first group of 38 projects (total budget of €118 million) kicked off in January 2018 and was to be concluded by 31 December 2021. Following an evaluation of the first round and some adaptations to the procedures, a second call for new projects, in a two-stage process, was launched in November 2020 with a total budget of €120 million. New projects were to be selected in December 2021 and start in January 2022.

The **BEL-COO programme** (which in 2017-2020 was known as the BEL-SME programme) is an initiative of the three regional R&D funding departments/agencies – VLAIO (Flanders), SPW Research (Wallonia) and Innoviris (Brussels). It is aimed at Belgian enterprises wishing to develop a joint research or development project with enterprises from other Belgian regions. BEL-COO has a broader scope than the previous programme, funding applied research as well as development projects and opening eligibility to large companies and not only SMEs. In addition, consortia will be able to submit projects continuously to the BEL-COO programme, instead of once a year under BEL-SME.

A first call for proposals for BEL-COO was launched in 2021. Projects must involve at least two enterprises from two different Belgian regions. The projects aim to develop innovative products, processes or services, with a clear market potential. The funding is granted at regional level. So in addition to an application form describing the joint project, individual application forms must be submitted by each partner to their respective regional funding agency. The three regional agencies agree on the projects to be supported and each agency funds the project partners from its region using existing regional funding measures.

Regarding the specific competence of each entity in the R&I policy field:

- ▶ The Federal Government is competent for funding research necessary for the exercise of its own powers (e.g. nuclear power, food safety and quality), including scientific research in execution of international or supranational agreements (e.g. Antarctic research); the implementation and organisation of data exchange networks between scientific institutions at national and international level; space research in the framework of international or supranational institutions, agreements or acts; the federal scientific institutions, including their research and public service activities; and actions in areas of shared competence requiring a coordinated approach (e.g. climate policy) at national or international level;¹⁰ the maintenance of a permanent inventory of the country's scientific potential; and Belgian representation in activities of international research bodies. The Federal Government is responsible for several other R&I policy topics, notably R&D tax credits and fiscal incentives to encourage the recruitment of researchers, scientific visas¹¹ and intellectual property law.

10. The Federal Government may intervene in areas for which the federated entities are competent based on an opinion issued by the Federal Council for Science Policy. These actions must be related to either an international agreement or concern actions or programmes that are of common interest to more than one entity in Belgium.

11. See: http://www.belspo.be/belspo/visa/intro_en.stm

- ▶ The Communities are responsible for research in their areas of competence and notably organise and finance research carried out in higher education institutions, in particular grants and including the international activities of these institutions. They are also in charge of the popularisation and communication of science.
- ▶ The Regions are competent for basic and applied research in their fields of competence via a broad range of measures to support R&D and innovation including loans and equity finance to small and medium-sized enterprises (SMEs) and large enterprises, funding for (collaborative) research done by public and collective research centres, funding and organisation of intermediaries (such as science parks, technology transfer and entrepreneurship and innovation advisory services).

Given the powers allocated by the Belgian constitution to each authority, the governance of R&I policy is organised by each authority at the executive level (parliament, government ministers) supported by advisory bodies, government departments and public funding and investment agencies, etc.

Over the last decade, several changes have occurred in the governance and implementation structures of the Belgian authorities, particularly related to the rationalisation of the number of agencies and the organisation of higher education or research institutes. The figure below provides an overview of the governance system and the following sub-section explains the coordination and consultation processes organised between the Belgian authorities, notably for agreeing on joint positions on European and international programmes, statistics and cooperation.

Figure 3: The Belgian R&I system

R&I Advisory Councils

Governments



Government policy & funding bodies



R&I Performers



1.2 COOPERATION AND CONSULTATION BETWEEN THE BELGIAN AUTHORITIES

Given that competence for R&I policy matters is distributed between the Belgian authorities, a well-structured and effective co-ordination framework is essential. This consultation and co-ordination process is based on several cooperation agreements that were signed during the period 1994-1998. Within the Federal Science Policy Office (BELSPO), the Federal, Interfederal and International Coordination directorate provides the secretariat for the consultation structures at the level of the various administrations that support the Belgian Interministerial Conference for Science Policy (IMCSP). In a manner akin to *comitology*¹² at European level, the Belgian authorities meet at ministerial and senior official levels to discuss and agree on common positions or actions.

At the **Ministerial** level, the IMCSP is composed of members of the federal, community and regional governments competent for science policy. The IMCSP is a forum in which cooperation agreements are worked out (including on international cooperation) and where procedures for collaboration and exchange of information between the different authorities are agreed. At the **senior official** level, the International Co-operation Commission (ICC) and the Federal Co-operation Commission (FCC) are two permanent commissions of the IMCSP. They are responsible for handling consultations on matters of interest to the Federal Authority and the federated entities, respectively at the international level and at the Belgian level (IMCSP). They are made up of senior officials representing the federal, community and regional authorities.

The ICC and the FCC have created a series of specialised 'concertation groups'. The two commissions meet approximately every six weeks to discuss matters that need a common position. The chair of the commissions rotates between the different government entities. The ICC groups have responsibility for preparing the position of the Belgian delegation in international meetings, notably the programme committees of the EU R&I framework programme (Horizon Europe), as well as other international cooperation such as bilateral and multilateral activities, COST, Eureka and R&I partnerships at European level, plus the OECD's science & technology policy committee. The FCC groups focus on R&I statistical management (CFS/STAT), open science and gender issues. They also discuss, when necessary, cooperation agreements between the Federal Authority and the federated entities for certain R&I activities, such as the Earth Observation programme STEREO III¹³ or Belgian Biodiversity Platform.¹⁴

The ICC thematic groups prepare the negotiations with the European Commission and the Council regarding the EU R&I framework programme together with the priorities and further development of the European Research Area (ERA) as well as open science. This happens in close cooperation with the Federal Public Service (FPS) for Foreign Affairs, in particular the Permanent Representation of Belgium to the EU, and the other entities in Belgium in charge of

12. Comitology in the EU refers to a process by which EU law is modified or adjusted and takes place within 'comitology committees' chaired by the European Commission. The official term is 'committee procedure'.

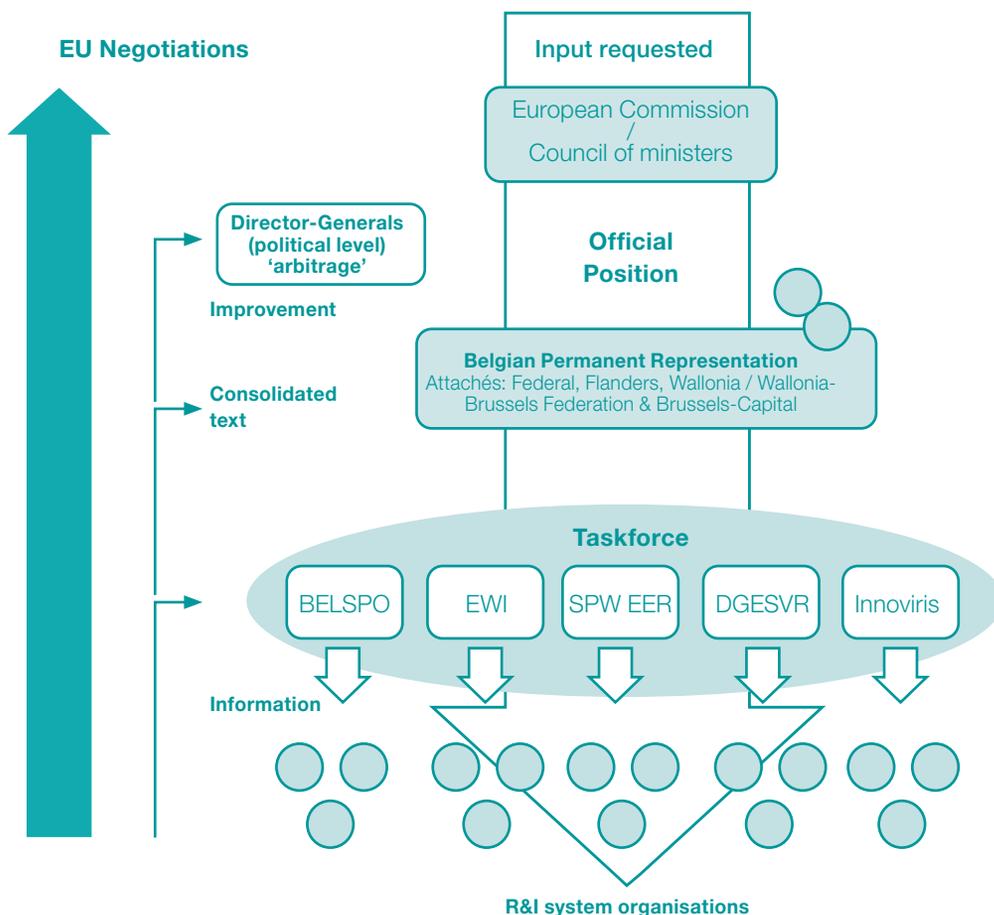
13. See: <https://eo.belspo.be/en>

14. See: <https://www.biodiversity.be/3222/>

research and innovation. The ICC groups prepare the official Belgian positions and they decide who represents Belgium in which programme committee of the Horizon Europe programme.

To prepare for the negotiations on Horizon Europe, the ICC and FCC commissions developed a task force to collect the contributions of each Belgian entity and to coordinate with the Permanent Representation. To ensure political support for the official positions for Belgium, the temporary structure also included feedback from the ministerial cabinets. Figure 4 provides an overview of the coordination process that was used during the Horizon Europe negotiations.

Figure 4: Coordination processes to define Belgium's position in the Horizon Europe negotiations



Similarly, in 2020 the ICC developed a joint Belgian position on the Future of the ERA (see the extract in figure 5),¹⁵ as a contribution to the European Commission communication on this subject. This position paper stressed that the ERA priorities, as set down in the ERA roadmap, are still valid, but that an evolution is needed to take account of new challenges such as the Green Deal, digitalisation and the risk of further health pandemics. The position paper underlined that a renewed ERA should engage more broadly with society via a ‘quadruple helix model’ (academia, industry, governments, and civil society) whilst spanning multiple levels of governance. An emphasis was also placed on the importance of developing synergies between research, innovation and education sectors.

Figure 5: Belgium’s perspective on the future of the ERA

A successful ERA should deliver on the promise of supporting (more and better) co-creation, free circulation, absorption and application of knowledge. This must be grounded in a sound logical framework as well as a well-defined and evidence-based process by which the various countries, together with the European Commission, come up with common priorities, actions and goals. A successful ERA should therefore deliver open science and open innovation, with incentives for open access offering conditions that facilitate researchers’ access to the best research infrastructures and that support the exchange, sharing, access and analysis of R&I information and FAIR data in a collaborative spirit at European and global level. To support this, a revised system of research evaluation – going beyond the quantification of publications and patents, with indicators of excellence better adapted to the delivered research activities and/or services (e.g. research infrastructures) and to the need to interact with non-academic players and to inter-sectoral mobility – should be developed and implemented. Moreover, gender equality and gender mainstreaming in R&I should be made a reality for the ERA to be successful.

The ERA should not forget the importance of basic research, from which it is possible to rapidly develop solutions, as the Covid-19 crisis has illustrated. A ‘smart directionality’ approach, containing the right mix of curiosity-driven and mission-driven R&I policies would be beneficial. In other words, the ERA should support a continuum between basic research and applied research, leading to the recognition of researchers and of innovators as essential partners of the value chain.

In the future, the ERA (or rather a ‘European Knowledge Area’) requires improved communication and visibility. Before the pandemic, research results often lacked visibility. The ERA should become a recognisable and trusted brand within and beyond Europe’s borders. Through the ERA, science should enable European citizens to develop critical thinking and to reject fake news and conspiracy theories. This goal requires an integrated approach with the European Higher Education Area, including the development of attractive career paths for researchers and educators. To improve ERA

visibility and communication, it will be important to develop appropriate mechanisms and transparent processes to monitor and assess the impacts and the benefits of ERA's achievements.

Finally, funding is a crucial enabler for the successful renewal of the ERA. To achieve this ambitious mission, the appropriate level of funding is needed, as symbolised by the 3% R&I investment, which should remain an ERA target for every ERA country.

To conclude, the ERA should remain faithful to European core values (of academic freedom, excellence, inclusiveness, solidarity, ethics, reciprocity, and diversity) in order to provide a democratic setting where everyone has the possibility and knowledge to participate in R&I processes. Europe should distinguish itself from other global R&I leaders, by supporting excellent R&I for the well-being of people and not only for the goal of achieving economic growth. This principle should be the cornerstone of the negotiation of scientific agreements with other regional blocs.

Source: The Future ERA. Belgium's contribution to the debate, 2020.

1.3 A SNAPSHOT OF BELGIUM'S RESEARCH AND INNOVATION PERFORMANCE

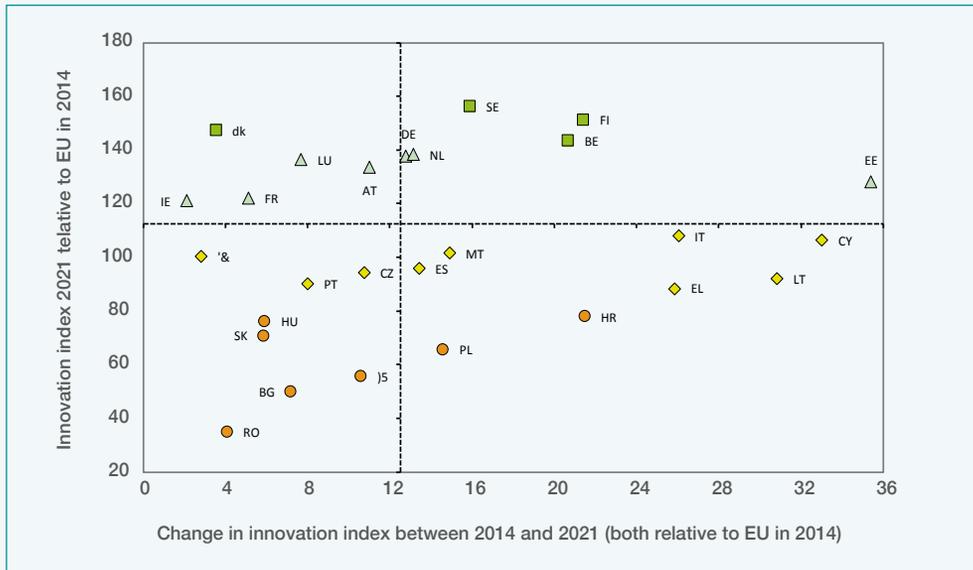
There is a wealth of data and information on Belgium's research and innovation performance, so this short sub-chapter does not seek to provide an in-depth analysis. Rather it aims to provide the reader with a snapshot of the key trends and relative performance of Belgium (as a whole), in order to frame the discussion on specific policies and priorities that are presented in the rest of this report.

Belgium's overall R&I performance has improved over the last decade, with particularly strong performance and trends in R&D expenditure in the business sector and research outputs (international scientific co-publications, etc.) and in SMEs innovation and collaboration. The European Innovation Scoreboard (2021) ranked Belgium as amongst the EU's 'Innovation leaders', with a summary innovation index relative to the EU average (=100) in 2021 of 128.¹⁶ In light of the trend from 2014-2021, Belgium has achieved a change in performance of 20.7%, as the summary innovation index performance is 144 (EU = 100) compared to the base year of 2014.

Considering the EIS 2021 results in more detail, Belgium outperforms the EU27 average for all but one of the 12 sub-groups of indicators. It performs particularly strongly on linkages, attractive research systems and employment impact. Indeed, in only six out of 32 indicators does Belgium fall below the EU27 average, with the biggest gaps being in lifelong learning (73.7% of EU27), environment-related technologies (76.4%) and design-related technologies (76.6%).

16. See: <https://ec.europa.eu/docsroom/documents/45905>

Figure 6: Performance and performance change of EU Member States' innovation systems (2014-2021)

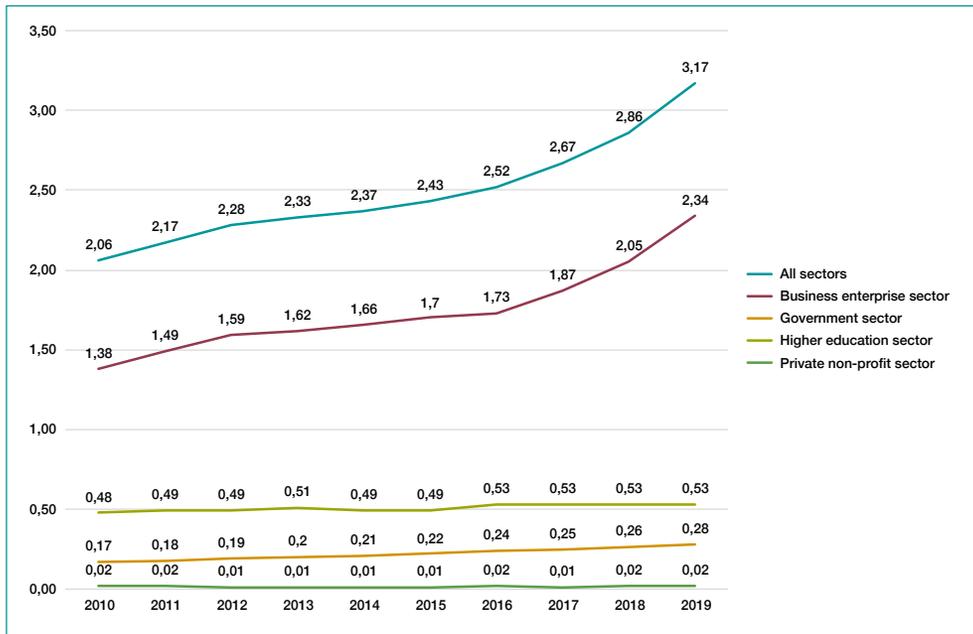


Source: European Innovation Scoreboard

Thanks to strong growth in business R&D since 2010, Belgium has moved above the 3% gross domestic expenditure on R&D (GERD) as a share of GDP target (rising from 2.06% in 2010 to 3.179% in 2019, according to Eurostat). Belgium was the second-most R&D intensive country in the EU in 2019 (after Sweden and followed by Germany, Austria and Denmark). The growing absolute business R&D expenditure (BERD) and relative share of business in GERD are partly explained by the R&D tax credits system (see section 2.2.4). The OECD estimates that as a percentage of GDP, R&D tax support increased from 0.03% of GDP to 0.21% of GDP over the 2007-2019 period.

However, BERD is highly concentrated: based on a sample of 1,964 R&D performing firms, the top 10 companies in terms of R&D investment accounted for more than half of all R&D expenditure in 2015 and less than 3% of business R&D comes from firms younger than five years (Vennix, 2019). Moreover, due to the open structure of the Belgian economy and the significant presence of multinational firms, a significant share of BERD is conducted by foreign-owned companies in Belgium.

Figure 7: Gross expenditure on R&D as a percentage of GDP, by sector of performance



Source: Eurostat / RD_E_GERDTOT

The chemical and pharmaceutical sector is the most important (approximately half of BERD in 2015, see also Figure 8), followed by scientific R&D (largely due to larger companies spinning out their R&D departments as subsidiaries) as well as electronic and electrical equipment manufacturing. A similar concentration exists in patenting of R&D results, with almost 40% of patents filed at the European Patent Office (EPO) by the 10 top applicants (companies and universities). In terms of technologies, Belgium is relatively specialised in mechanical engineering, biotechnology, pharmaceuticals, materials, transport and medical devices (Cheliout, 2020).

Figure 8: Life Science Innovation in Belgium

In August 2020, Belgium accounted for about a quarter (24%) of the stock exchange value of public biotech companies in Europe, or about €42 billion, ahead of other European countries such as Denmark (21%), Germany (18%) and Spain (9%). The performance of the pharma and biotech sector in Belgium is thanks to major players such as UCB, Argenx and Galapagos, as well as smaller Belgian biotech companies. Belgian firms with a market value of less than €1 billion – such as Bone Therapeutics, MDX Health, Biocartis, Iteos, Hyloris and Mithra – accounted for a market value of €2.6 billion in 2020, putting them in fourth place in Europe. The presence of big firms like Janssen or GSK plays an important role in supporting the growth of the biopharmaceutical ecosystem in Belgium. In terms of regional specialisation, Flanders is well positioned in the field of small molecule therapeutics, nanobodies technologies, mRNA technologies,

agrotech and nanotechnology in health. Wallonia is strong in biotechnologies, medtech, radiotherapy and e-health. Jointly, universities, strategic research centres, competitiveness poles, university hospitals and biopharmaceutical firms have capacities along the value chain – from research and discovery to development (1,500 ongoing clinical trials in 2020) and commercialisation.

In terms of human resources, Belgium had the fourth highest share in the EU27 of R&D personnel and researchers in total employment in 2019 (Eurostat). As with expenditure on R&D, the Belgian business sector accounts for most R&D personnel and researchers. The number of researchers (full-time equivalents) grew significantly between 2010 and 2019, from 40,832 to 62,606: of these, in 2019, 56.7% were employed in the business sector and a third in the higher education sector.

Figure 9: Key 10 R&I investment and employment indicators – Belgium vs selected benchmark countries (2019)

Country	Austria	Belgium	Denmark	France	Germany	Netherlands	EU27	OECD
GERD as a % of GDP	3.13	3.17	2.91	2.20	3.19	2.18	2.12	2.48
BERD as a % of GDP	1.72	2.04	1.73	1.24	2.06	1.26	1.23	1.56
BERD as a % of value added in industry	3.38	3.79	3.05	2.53	3.48	2.29	2.23	2.73
Government-financed GERD as a % of GDP	0.84	0.57	0.84	0.71	0.89	0.64	0.63	0.61
% of GERD financed by the business sector	54.85	64.29	59.56	56.66	64.46	57.60	58.25	62.83
% of GERD performed by the Business Enterprise sector	70.32	73.75	62.57	65.79	68.92	66.70	66.23	71.25
% of GERD performed by the Higher Education sector	21.79	16.70	34.12	20.08	17.43	27.59	21.62	16.54
% of Population with tertiary education	31.30	37.60	33.70	35.30	27.20	36.60	29.00	..
Total R&D personnel per thousand total employment	18.43	19.12	20.74	16.31	16.25	16.75	14.00	..
Total Business Enterprise R&D personnel as a % of total	70.04	61.65	60.41	61.88	64.67	71.76	59.65	..
Employment in knowledge-intensive activities (% total employment)	36.60	42.50	39.00	37.70	40.40	37.90	35.30	

Source: Eurostat / OECD MSTI

Belgium's scientific output continues to be well placed internationally, with four universities ranked in the top 200 in the world (the top-ranked Belgian university was the KU Leuven in 45th place in 2021).¹⁷ The share of Belgian scientific publications in the EU and OECD totals has increased steadily, rising to 3.82% of the EU total in 2020. The share of publications based on international collaboration rose from 55% in 2010 to 70.5% in 2020. Belgium performs well above the EU average for the share of most-cited publications (131.5% relative to the EU average in 2019). Based on the H-Index, which measures simultaneously the quality and quantity of scientific output, Belgium is ranked 14th globally¹⁸. Moreover, roughly 50% of Belgian scientific publications are open access underlining the progress made to meeting the open science objectives set at European level¹⁹.

Looking at broader innovation activity, data from the Community Innovation Survey (CIS) highlights that, during 2016-2018, Belgium had the third highest rate of innovative enterprises (67.8%) and the fourth highest share of turnover of enterprises from new or significantly improved products (15.7%) in the EU27. According to the CIS, the Belgian innovation system is characterised by a relatively high rate of cooperation: 28% of enterprises cooperated with other enterprises and organisations on R&D and innovation (2016-2018), compared to 16.8% in Germany or 15% in France, and this rate was only marginally lower than Finland (29.3%). By type of cooperation pattern, Belgian enterprises cooperate most frequently with other enterprises (23.9%) followed by suppliers (16.9%) and commercial labs and consultants (15.4%). About 11% of enterprises reported cooperation with universities, which is similar to the rate in Germany (10.5%) but below that of Finland (14.7%).

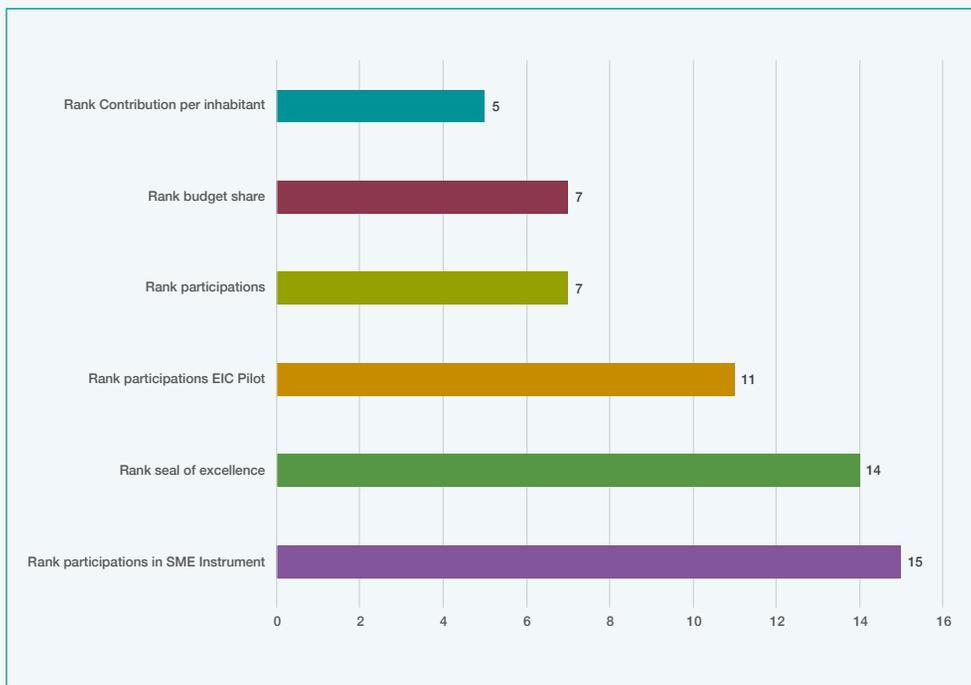
Belgium performs well in European competitive R&I programmes, ranking seventh out of the EU countries for participation and budget share in Horizon 2020, with a total net EU contribution of €3.3 billion since 2014; plus 296 ERC principal investigators and 237 EIC participations (as of October 2021). Although the Belgian budget share includes the funding awarded to European associations and organisations (e.g. the COST association) located in Brussels, removing them from the total does not change the overall ranking. On the other hand, the strong performance of a limited number of universities and research centres results in a diverse regional performance within Belgium.

17. Times / Elsevier Higher Education World University Rankings 2021

18. <https://www.scimagojr.com/countryssearch.php?country=BE>

19. See : https://research-and-innovation.ec.europa.eu/strategy/strategy-2020-2024/our-digital-future/open-science/open-science-monitor/trends-open-access-publications_en

Figure 10: Belgium's performance in Horizon 2020



Source: Horizon 2020 Dashboard (October 2021)

Institutional or competitive funding of higher education institutions (HEI) and research centres is provided by each of the authorities, based on their respective powers. The Flemish and French-speaking universities serve students and carry out research activities in both Flanders and Brussels-Capital as well as in Wallonia and Brussels-Capital respectively. More details on the universities and other higher education institutions (HEIs) and their R&I activities are provided in the chapters for Flanders and the Wallonia-Brussels Federation. In addition, each authority has created or funds certain public, inter-university or autonomous research and technology centres. These centres are presented in the respective chapters. Moreover, since the 1950s, a group of private (not-for-profit) collective research centres have operated across Belgium and they support companies in their sectors of activity (see Figure 11).

Figure 11: The Belgian industrial collective research centres

The collective centres were founded by the Belgian business federations, usually in the form of a not-for-profit association, based on the 1947 De Grootte Law, which specified that each company in their sector is obliged to be a paying member. The target groups of the applied research activities are defined by sector or by technology field. Their main activities include collective research, various scientific or technical services to their

members, dissemination of technical information, and training. Since 2010, a restructuring has taken place, with some centres merging or being taken over by commercial firms.²⁰

The 11 centres are:

- ▶ CENTEXBEL – Scientific & Technical Service Centre for the Belgian Textile Industry
- ▶ CRIC – Belgian Research Centre for the Cement Industry
- ▶ BCRC – Belgian Ceramic Research Centre
- ▶ SIRRIS – Collective Centre for the Belgian Technology Industry
- ▶ BBRI – Belgian Building Research Institute
- ▶ BRRC – Belgian Road Research Centre
- ▶ WOOD.BE (CTIB-TCHN) – Belgian Institute for Wood Technology and the Wood Training Centre
- ▶ CRM – Metallurgic Research Centre
- ▶ BWI – Belgian Welding Institute
- ▶ BPI – Belgian Packaging Institute
- ▶ Volta – electrotechnical industry

Collective research centres, if they are recognised as a scientific organisation by BELSPO, are eligible to claim for tax reductions on researchers' salaries. Moreover, the FPS Economy provides funding to the collective research centres to carry out activities in support of standardisation and intellectual property. The centres conduct contract research at the request of individual companies. They also participate in European, Belgian federal and regional R&I programmes and carry out own-initiative research to maintain their level of knowledge and expertise.

In 2020, 10 of the centres grouped themselves under the umbrella brand of 'Innovaders'²¹ to strengthen joint promotion of their research and standardisation services to industry.

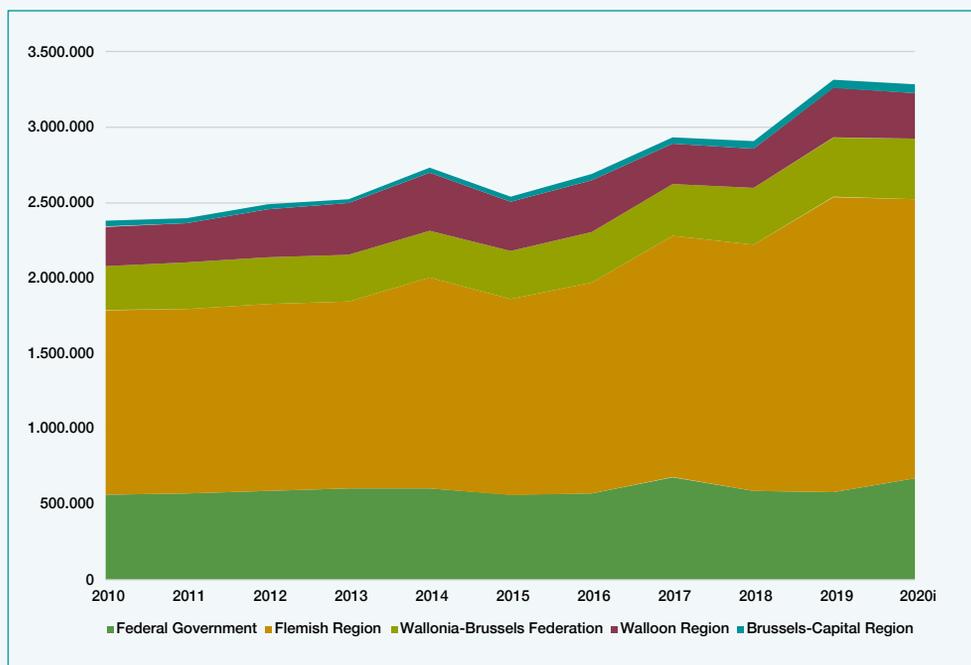
1.4 TRENDS AND PATTERNS IN GOVERNMENT FUNDING OF R&D IN BELGIUM

Over the decade since the last BRISTI report (2010 to 2020), total government budgetary appropriations for R&D (GBARD) in Belgium have increased by 38% from €2.375 billion in 2010 to €3.279 billion in 2020. The largest relative increase in GBARD has been in Brussels-Capital (62%), followed by Flanders (51%). On average, GBARD accounts for about 50% of government spending and investments in R&I-related policy, the remainder being made up by support for other forms of innovation support. In Belgium, over 80% of the total public R&D and innovation funding (not including tax credits) is thus managed by the regions and communities. However, R&D tax credits, managed by the federal authority represent an additional €2.3 billion per annum and account for three-quarters of total government financial support for business R&D (see section 2.2.4).

20. The case of the former CRC for the diamond industry.

21. <https://www.innovaders.be>

Figure 12: Evolution of GBARD by Belgian authority 2010-2020 (thousand euro, current prices)



Source: CFS/STAT - BELSPO

In 2020, Flanders accounted for 56% of Belgian GBARD, followed by the Federal Authority (20.6%), the Wallonia-Brussels Federation (12.3%), the Walloon Region (9.1%) and Brussels-Capital (1.7%).

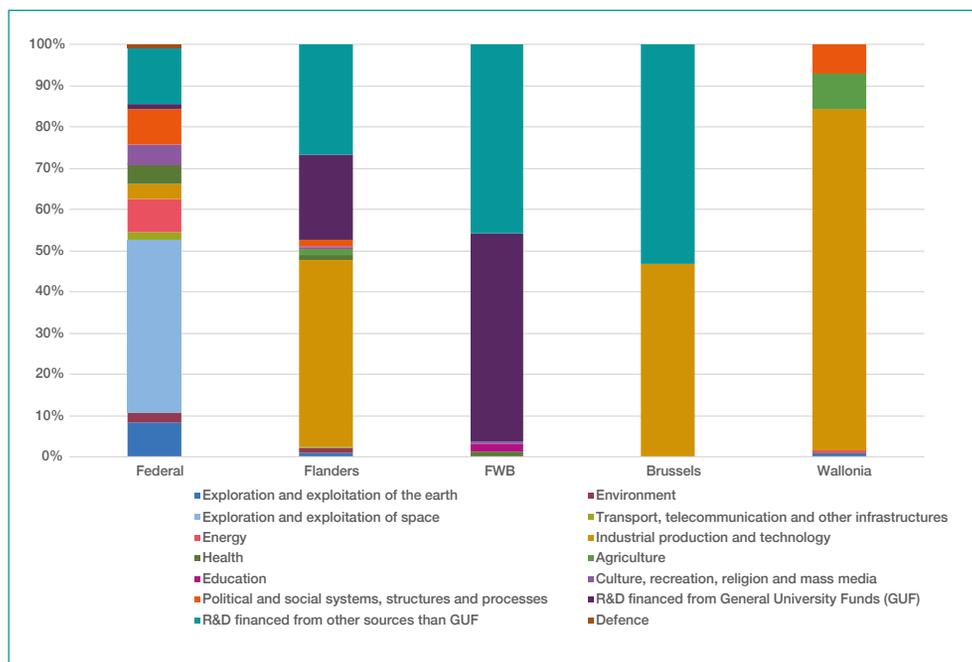
Figure 13: GBARD (€ million, constant prices) 2010-2020

Authority	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Change 2010-2020
Federal Government	563	569	591	601	601	561	574	678	590	583	675	19.83%
Flemish Region	1,224	1,227	1,236	1,243	1,398	1,298	1,395	1,598	1,631	1,952	1,847	50.93%
Wallonia-Brussels Federation	290	305	313	309	315	319	334	345	378	394	404	39.13%
Walloon Region	264	262	312	339	380	325	340	265	254	331	298	13.15%
Brussels-Capital Region	34	31	37	30	34	34	43	45	53	52	55	61.97%

Source: CFS/STAT - BELSPO

The distribution of competence of the Belgian authorities and the focus of government R&D expenditure are illustrated by the breakdown of GBARD by socioeconomic objective²² (see Figure 14).

Figure 14: GBARD by socioeconomic objective (2020)



Source: BELSPO

All three regions invest a significant share of GBARD into industrial production and technology (ranging from 83% in Wallonia to 45-46% in Brussels-Capital and Flanders). This ‘catch-all’ categorisation obscures to some extent the investment in specific applied research fields (such as energy or transport). Wallonia is the only region that classifies a sizeable share (8%) of GBARD to agricultural research. The Federal Authority’s funding for space and (nuclear and renewable) energy research is also visible in the statistics.

A large share of funding of the Flemish and FWB authorities is allocated to universities; while in Brussels over half of GBARD is allocated to general advancement of knowledge R&D. A breakdown of these two categories by scientific fields (natural sciences, engineering sciences, medical sciences, agricultural sciences and social sciences and humanities) would provide a more detailed insight into the thematic focus of GBARD. However, this is not possible in Belgium.

22. Nomenclature for the analysis and comparison of scientific budgets and programmes (NABS) is the EU classification system that breaks down government expenditure for R&D according to the socioeconomic objectives. The classification reflects the authorities’ intentions rather than the details of the R&D activities.

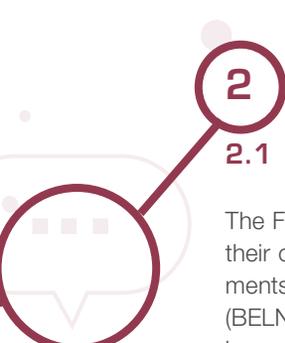


**OVERALL POLICY FRAMEWORK
AND PRIORITIES**

**ACTORS AND INSTRUMENTS
OF R&I POLICY**

**MAIN RESEARCH AND
INNOVATION ORGANISATIONS**

FUTURE R&I POLICY PERSPECTIVES



2 FEDERAL AUTHORITY

2.1 OVERALL POLICY FRAMEWORK AND PRIORITIES

The Federal authorities have competence for scientific research necessary for the exercise of their own competences, including the implementation of international or supranational agreements or acts, space research; networks of data-exchange on a national or international basis (BELNET); the federal scientific institutes and museums; programmes and actions requiring homogeneous implementation at national or international level in areas defined by and according to modalities established by cooperation agreements with the federated entities and Belgian participation in activities of international research bodies on the basis of cooperation agreements with the federated entities. Alongside the mandate of BELSPO to fund research in the fields relevant for federal policy, other Federal Public Services (the term used for ministries) have a mandate to fund R&D necessary for them to perform their mission, such as energy, health and food safety and defence research.

While the regions and communities have prime responsibility for R&I policies, the Federal authorities retains responsibility for key policy fields with an influence on R&I performance, notably a significant intervention through fiscal incentives as well as scientific visas, and intellectual property law. In particular, the importance of fiscal incentives for business R&D has grown over the last decade and represents the largest share of the national R&D funding policy mix. The rationale behind the expansion of fiscal measures is to boost business R&D expenditures in Belgium.

Beyond financing, the federal authorities play a role in facilitating dialogue amongst all Belgian authorities. As explained in chapter 1, BELSPO provides the secretariat of the consultative bodies where the Belgian positions on ERA policy, European R&I funding programmes and international co-operation are developed and agreed upon.

2.2 ACTORS AND INSTRUMENTS OF R&I POLICY

The Federal Council of Ministers is the political body responsible for the major decisions of R&I policy at federal level. The Federal Council for Science Policy (FRWB-CFPS) advises the Federal authorities and policies are developed by the Federal Secretary of State responsible for science policy and implemented by the Belgian Science Policy Office (BELSPO). Other federal ministers deal with research matters within their own areas of competence and, in several cases, in cooperation with BELSPO (e.g. for energy or defence R&D investments).

2.2.1 Policy advice

The FCSP advises the Federal authorities on the design and focus of science policy. It is composed of 33 members representing scientific, economic and social actors. The Federal Minister for Science appoints 16 of its members, while the others are nominated by the federated authorities distributed by their size. The FCSP secretariat is provided by BELSPO. The tasks of the FCSP are, as set out in a Royal Decree (August 1997), to give advice on:

- ▶ scientific research in line with the federal competences, or in execution of international or supranational agreements;
- ▶ the creation of networks of data exchange, on a national or international basis;
- ▶ space research in the context of international or supranational cooperation agreements;
- ▶ the federal scientific and cultural institutions, their missions and research activities.

The FCSP can react to a specific request from the Federal authorities, but also upon a request from a federated authority. The opinions or recommendations formulated by the council always examine an issue from the perspective of its impact on science across the country.

The Federal authorities must consult the FCSP if they intend to develop structures or funding schemes for scientific research that impinge on the competences of the communities or of the regions, but that go beyond their respective interests²³. The same holds if these structures or funding schemes pertain to international or supranational agreements that would be binding on all Belgian public authorities.

In recent years, the FCSP has been asked to advise on significant measures in research policy such as the mergers of several centres to form the single health research centre Sciensano (see section 2.3.3), the investment in the MYRRHA research infrastructure (see section 2.3.2) in 2018 and the design of the Brain.be programme (see section 2.2.3.1), the change in the partial exemption of payment of the withholding tax on wages (PWHT) of R&D personnel of private firms (see section 2.2.4.1), as well as the updating of the ESFRI Roadmap in 2017.

2.2.2 Federal Public Services involved in research and innovation

Policies to support R&I are managed by several Federal Public Services²⁴ (FPS) and range from financial measures supporting basic and applied science to ensuring there are appropriate framework conditions for R&I for the private sector. Figure 15 gives a concise overview of the key Federal Public Services and policy instruments that each has developed. The fiscal incentives for R&D are the competence of the FPS Finance but the obligatory notification for the withholding tax incentive is managed by BELSPO²⁵.

23. As required by the Special law of 8 August 1980 on institutional reforms, articles art. 6bis, 92bis, 92ter. See https://senlex.senate.be/fr/dia/structure/str_82/toc for the full text (in French).

24. The Federal Public Services, as they are called at the federal level in Belgium, are comparable to what in other EU countries are called Ministries. They are the administrative bodies that design and sometimes implement policy measures, including funding programmes for researchers and research institutions.

Figure 15: FPS key measures of support to R&I (2021)

BELSPO	FPS economy, SMEs, Self-employed and Energy	FPS Finance	FPS Health, Food Chain Safety and Environment	Ministry of Defence	FPS Foreign Affairs, Trade and Development Cooperation
federal Scientific Institutes	Nuclear energy and medical research	Fiscal incentives for R&I for industry and public sector research institutes (mostly deduction of professional Withholding Tax or Corporation tax)	Institutional funding to R&D in the fields of food chain safety, environment and health	Defra programme	Support to diplomatic relations in R&I (EY, bilateral)
Space research (ESA)	Digitalisation and AI			R&D funding programme for defence related research	Support to R&I within development cooperation
National R&I programmes	Federal Energy Transition Fund			Participation in International R&D programmes	Institutional funding to research on European and multilateral Affairs
International research organisations & infrastructures	IP policies and support				
Support to national, EU & international R&I policy	Standardisation & Metrology				
	Continental Shelf service				

As outlined in section 1.3, while varying year-on-year, the federal budget for R&D has increased significantly (roughly 20%) from 2010-2020. In addition to these budgetary funds, R&D tax credits have become the most significant source of government support and are discussed in section 2.2.4. Figure 16 provides an estimate of the annual budgets the FPS allocate through various policy measures or institutional funding in the R&I policy field.

Figure 16: Annual budgets of the different Federal Public Services, dedicated to R&I

Name of FPS or Ministry	Key involvement	Approximate annual budget 2020/2021 in euro
BELSPO	▶ National R&D Programmes	€ 526 million
	▶ Federal Science Institutes (FSI)	
	▶ International R&D Programmes and international Research Infrastructures	
	▶ Policy support and services	
Finance	▶ R&D tax incentives	€ 2.6 billion*
Economy SMEs, Self-employed and Energy	▶ Support for Intellectual, Standards, Metrology	€ 6.3 million
	▶ (Nuclear) energy research and development	€ 140 million
	▶ Nuclear research for medical research (IRE)	€ 100 million**
Health, Food Chain Safety and Environment	▶ Health, Food safety research: Sciensano	€ 82 million
Ministry of Defence	▶ Defence-related research institutes	€ 10 million
	▶ Defence-related research programmes	
Foreign Affairs, Foreign Trade and Development Cooperation	▶ Egmont Institute	€ 96 million
	▶ Development cooperation	
	▶ Contribution to international organisations	

Note: *the annual budget for tax incentives is an estimation by the FPS Finance, as it depends on the tax declarations by companies and institutions and therefore fluctuates from year to year
 **part of this budget may come from sources other than the FPS Economy.

Figure 17: Overview of research performers related to federal-level R&I policies

BELSP0	FPS economy, SMEs, Self-employed and Energy	FPS Health, Food Chain Safety and Environment	Ministry of Defence	Other departments
The Belgian Institute for Space Aeronomy The Royal Belgian Institute of Natural Sciences The Royal Library of Belgium The Royal Institute for Cultural Heritage The Royal Meteorological Institute of Belgium The Royal Museums of Art and History The Royal Museums of Fine Arts of Belgium The Royal Museum for Central Africa The Royal Observatory of Belgium The State Archives Research Infrastructures: BCCM, Bbpf, Princess Elisabeth Station, New Research Vessel Belgica	<ul style="list-style-type: none"> ▶ SCK CEN ▶ IRE / IRE-ELIT 	<ul style="list-style-type: none"> ▶ Sciensano 	<ul style="list-style-type: none"> ▶ Royal Higher Institute for Defence ▶ The Royal Military Academy ▶ Military Hospital ▶ Defence Laboratories 	<ul style="list-style-type: none"> ▶ Egmont Institute ▶ The National Institute for Criminology ▶ Federal Planning Bureau ▶ National Bank of Belgium

The R&I performers that benefit directly and/or indirectly from these policy measures are public, higher education and not-for-profit research institutes. While most federal programmes do not directly target industrial R&D, Belgium-based businesses can benefit from tax incentives and certain innovation support measures (intellectual property, standardisation) from Federal services. Figure 17 gives an overview of the main direct Belgian research performers.

The following sections provide a more detailed description of the Federal Public Services and their policy instruments relevant to research and innovation policy; they are followed by a brief description of the main federal research institutes (see section 2.3).

2.2.3 The Belgian Science Policy Office (BELSPO)

The mission of the Belgian Science Policy Office (BELSPO) is the preparation, execution and evaluation of the federal science policy, in particular the implementation, on behalf of the Government, of scientific and technical resources in support of the competences of the Federal Authority and the constitution of a permanent expertise capacity at the service of the latter in the scientific and technical fields. It prepares and implements programmes and activities at the national, European and international levels. These are developed autonomously or in the framework of cooperation agreements with the regions or communities.

The activities of BELSPO are structured in four main action lines:

- ▶ BELSPO contributes funding to European and international research programmes and coordinates international research initiatives;

- ▶ BELSPO provides the core funding and administrative support to the 10 Federal Scientific Institutes (FSI) which are presented in more detail in section 2.3.1;
- ▶ BELSPO funds research through programmes, research infrastructures and dedicated actions;
- ▶ BELSPO provides R&I services and policy support on behalf of the Federal Government and in coordination with regional and community levels,

BELSPO is the main federal science policy player and accounts for approximately two-thirds of federal science policy expenditures (not including the R&D tax incentives). It is structured in an over-arching support service, which includes BELNET (the Belgian National Research & Education Network providing high-bandwidth internet access and related services to universities, etc.)²⁶, and 11 operational directorate-generals (DG): the research funding and applications DG and the 10 FSI²⁷.

The annual budget for BELSPO was approximately €526 million in 2021, divided as presented below:

Figure 18: BELSPO annual budget (2021)

Budget lines	Approximate budget in €m (commitments)
National R&D funding	90
<i>R&D funding programmes</i>	34
<i>Belnet</i>	9
<i>Belgian Polar Secretariat</i>	3.5
<i>MYRHHA</i>	44
International R&D funding	293
<i>European Space Agency (ESA)</i>	254
<i>Space related organisations (ESO, EUMETSAT, ECMWF, etc.)²⁸</i>	25
<i>Von Karman Institute</i>	2.6
<i>Non-space related (ESFRI RIs, EMBL, ESRF, ILL)²⁹</i>	9.5
<i>International research programmes</i>	2.5
Federal Scientific Institutes - see section 2.3.1 for details	123
Education/training and cultural activities	
<i>Notably : Foundation Biermans-Lapôtre (€144,000), Europalia (€73,000), Queen Elisabeth Competition (€156,000)</i>	6
Operating budget (staff, etc.)	15
Total budget	526

26. See: <https://www.belnet.be>

27. See: https://www.belspo.be/belspo/organisation/about_organigram_en.stm

28. See: https://www.belspo.be/belspo/space/index_int_fr.st

29. See: https://www.belspo.be/belspo/coordination/euCoor_infra_fr.stm & https://www.belspo.be/belspo/coordination/euCoor_ESFRI_fr.stm

The budget share by category has been stable over the last decade, apart from the budget for space research that was increased by an additional yearly appropriation of €50 million from 2018.

BELSPO has faced considerable budget cuts in recent years, which led to a reduction in staff across all its activities. In total, BELSPO has 2,340 staff members of which 170 are currently in the central administration, with the remainder working for the Federal Scientific Institutes (FSIs) that are managed by BELSPO. The current government's policy note covering science policy (of November 2020) acknowledged the negative effects of these reductions on the administration and on the scientific staff of the FSIs³⁰.

2.2.3.1 BELSPO research programmes

BELSPO manages a set of research funding programmes that are open to Belgian (and in certain cases foreign) research organisations. Eligible organisations include higher education institutes, public and not-for-profit research centres and in some cases the private sector (e.g. through ESA funding or via the DEFRA programme, see section 2.2.8). Some of these programmes support the participation of Belgium in European partnerships (e.g. ERA-NET Cofund schemes under Horizon 2020, Joint Programming Initiatives, etc.). On average since 2016, the average annual commitments for the research funding programmes were about €36 million.

Of the programmes listed in the table below, Brain.be is the most important in budgetary terms with an average of close to €15 million per year. FED-tWin launched in 2019 has committed some €19m in expenditure by 2021 and the annual funding going forward is expected to be in the range of €13m. STEREO III was also an important programme during the period 2014-2021 with a budget of €28.6m funding 96 projects. A fourth STEREO programme has been officially launched for the period 2022-2027 with a budget of €28.15m.

30. Belgische Kamer van Volksvertegenwoordigers, Beleidsverklaring, Relance, Strategische Investerings en Wetenschapsbeleid, 2 november 2020

Figure 19: Federal research programmes

Programme	Short description	Time frame
Brain.be Phase II	Funding interdisciplinary networks in three main pillars: <ul style="list-style-type: none"> ▶ Challenges and knowledge of the living and non-living world ▶ Heritage science ▶ Federal societal challenges 	2018-2023
DIGIT	DIGIT supports the Belgian federal scientific institutes and the Royal Film Archive of Belgium (CINEMATEK) with the digitisation of their cultural and scientific heritage.	2019-2024
Research programme on Drugs	The federal Drugs Research programme has been set up with a view to supporting an integrated and coordinated policy to address drugs abuse.	2001 – ongoing
FED-tWin	Funding research cooperation between the federal scientific institutes and the Belgian universities. The programme supports individual post-docs that can pursue a career half-time in one of the federal institutes and half-time at one of the universities.	2017 – ongoing
Defence Related Research Actions (DEFRA)	BELSPO co-manages this defence research programme with the Ministry of Defence.	2021 – ongoing
STEREO	A research programme on Earth observation with a focus on remote sensing and access to international resources for Earth Observation.	1984 – ongoing

The Brain.be programme enables interdisciplinary research projects, facilitating collaboration between FSI, Belgian universities or other research institutions. The programme is structured around 3 pillars: Challenges and knowledge of the living and non-living world; Heritage Science and Federal Societal Challenges. Furthermore, BELSPO funds specific programmes targeting the FSI. Within the BRAIN programme bottom-up projects initiated by the FSI are supported. The DIGIT programme is used to support the digitisation³¹ of the important scientific collections that the FSI host and maintain. The FED-tWIN programme supports structured cooperation between the FSI and the Belgian universities. To this end, research profiles are jointly elaborated by a FSI and a university, to be implemented by a post-doctoral researcher who is employed part-time at the FSI and part-time at the university. The implementation of the research profile is part-funded (50%) by BELSPO. A total of 125 research profiles will be funded, in five batches of 25 research profiles selected between 2019 and 2025. The STEREO programme aims to develop autonomous expertise of an international standard in the field of earth observation. Through the multi-disciplinary research it funds, the DRUGS programme supports the Interfederal Drug Policy, of which it is a pillar in an evidence-based policy approach.

31. Digitisation means the conversion of text, pictures, or sound into a digital form that can be processed by a computer.

2.2.3.2 BELSPO funding for research infrastructures and platforms

BELSPO funds and coordinates the following national research infrastructures (RIs) and platforms, which are used by a range of Belgian and international researcher. The operational management and research services are provided by FSI's and/or consortia of Belgian research teams.

Figure 20: Federal research infrastructures and platforms

Research infrastructure / platform	Description
Belnet	Provides high-bandwidth internet access, the national research networks and related services to the HEI sector, public research centres, hospitals, public administrations.
Princess Elisabeth Antarctic Station	BELSPO ensures the functioning of the Belgian Polar Secretariat service, which oversees the financial, administrative and material management of the Belgian Antarctic Station Princess Elisabeth.
The Belgian Coordinated Collections of Microorganisms (BCCM)	BCCM is a consortium of seven decentralised biological resource centres. It provides access to these resources for scientific research and provides services to academia and industry.
The Belgian Biodiversity Platform	The platform provides services to the Belgian scientific community engaged in biodiversity research and to policymakers as well as to practitioners. The platform is hosted by institutions at federal and regional level.
The New Belgica research vessel³²	The Belgian oceanographic research ship RV Belgica is placed at the disposal of Belgian scientists to carry out marine scientific research. The RV Belgica monitors the quality of the North Sea by constantly collecting all kinds of data about the biological, chemical, physical, geological and hydrodynamic processes that occur there. The ship is a floating laboratory used by researchers of Belgian universities and scientific institutes, with a home port in Zeebrugge. A new vessel was commissioned in 2017 and will begin operational service from 2022, replacing the previous ship, which operated for 37 years (and was transferred to Ukraine in 2021). The new ship is designed to be as environmentally friendly as possible (MARPOL tier III standard). Owned by BELSPO, the ship's scientific management is the responsibility of the Royal Belgian Institute of Natural Sciences and its operational management is done by the French company Genavir (a subsidiary of IFREMER).

32. See: https://www.belspo.be/belspo/NewRV/index_en.stm

Moreover, the preparatory phase of the MYRRHA (Multi-purpose hYbrid Research Reactor for High-tech Applications) infrastructure, coordinated by the Belgian Nuclear Research Centre (SCK CEN), is co-funded by BELSPO and the FPS Economy (see Figure 29). In 2022, a funding of €16.2m was granted to VKI to develop a Hydrogen Test Facility. This budget will be released in 3 phases during the period 2022-2024. The funding for 2022 amounts to €300,000.

In addition to the national level RIs, Belgium is an active member in European and international RI consortia. BELSPO finances the annual Belgian contribution to international RIs (e.g. the European Synchrotron Radiation Facility³³), to the ESFRI landmark RIs and to major intergovernmental organisations (like IPCC) to ensure that all scientists in Belgium have equal access to them. Support for the implementation of research projects, experiments and observations is provided by the competent authorities (federal and/or regional), including the support for the national/regional facilities that are integrated in a distributed European research infrastructure.

Figure 21: Participation of Belgium in the ESFRI Roadmap

Belgium is a member of the following ESFRI landmark research infrastructures:
▶ ACTRIS – Aerosols, Clouds and Trace gases Research Infrastructure
▶ BBMRI-ERIC – Biobanking and BioMolecular resources Research Infrastructure
▶ CESSDA ERIC – Consortium of European Social Science Data Archives
▶ CLARIN ERIC – Common Language Resources and Technology Infrastructure
▶ DARIAH ERIC – Digital Research Infrastructure for the Arts and Humanities
▶ ELIXIR – A distributed infrastructure for life-science information
▶ EMBRC ERIC – European Marine Biological Resource Centre
▶ EPOS ERIC – European Plate Observing System
▶ ESS ERIC – European Social Survey
▶ ICOS ERIC – Integrated Carbon Observation System
▶ INSTRUCT ERIC – Integrated Structural Biology Infrastructure
▶ LIFEWATCH ERIC – e-infrastructure for Biodiversity and Ecosystem Research
▶ MIRRI – Microbial Resource Research Infrastructure
▶ PRACE – Partnership for Advanced Computing in Europe
▶ SHARE ERIC – Survey of Health, Ageing and Retirement in Europe
Belgium is also an observer of the following research infrastructures:
▶ ANAEE – Infrastructure for Analysis and Experimentation on Ecosystem
▶ Euro-BioImaging ERIC – European Research Infrastructure for Imaging Technologies in Biological and Biomedical Sciences

Belgium participates in the following infrastructures under development (project stage):
▶ DISSCO – Distributed System of Scientific Collections
▶ EHRI – European Holocaust Research Infrastructure
▶ EIRENE RI – Research Infrastructure for EnvIRonmental Exposure assessmeNt in Europe
▶ EMPHASIS – European Infrastructure for multi-scale Plant Phenomics and Simulation for food security in a changing climate
▶ E-RIHS – European Research Infrastructure for Heritage Science
▶ ET – Einstein Telescope
▶ EU-IBISBA – Industrial Biotechnology Innovation and Synthetic Biology Accelerator
▶ MARINERG-I – Marine Renewable Energy Research Infrastructure
▶ METROFOOD – Infrastructure for Promoting Metrology in Food and Nutrition
▶ SLICES – Scientific Large-scale Infrastructure for Computing/Communication Experimental Studies

Belgium participates to the Einstein Telescope (ET) preparatory phase project, the European Third-Generation Gravitational Wave (3G GW) Observatory, a multi-detector, and multi-interferometer designed to observe the whole universe. Two candidate sites are under investigation: one in Sardinia and one in the Euregio Meuse-Rhine. If the latter site is chosen, it would mean Belgium would co-host the ET. The site-characterisation studies are under way for site selection, which is expected by 2024.

Figure 22: Belnet - the Belgian national research and education network

Belnet, founded in 1993 as a research programme of BELSPO, has evolved over time to become the privileged partner for Internet connectivity and data storage and exchange of the higher education and research sector and public services. In 2000, Belnet became a separately managed service within BELSPO. In 2009, a law broadened Belnet’s field of competence to the entire Belgian public administration.

Today, as the Belgian National Research & Education Network (NREN). Belnet provides high-bandwidth internet access and related services for specific target groups: universities and higher education institutions; research centres; hospitals; cultural institutions and public administrations. Belnet provides access to:

- ▶ the national research network and the commercial internet
- ▶ services on the internet
- ▶ international research networks (other NREN’s, GÉANT).

In the coming years, BELNET will refocus on supporting research, both for its internal and external customers, in an innovative and co-creative way. Its activities towards the federal administration will be anchored in a simplified funding mechanism. BELNET will also develop its product catalogue to cover new themes such as cybersecurity (as a technical broker) and tools to support Open Science, storage solutions (large amounts of data that need to be accessed very quickly for complex processing) and quantum communication infrastructures.

2.2.3.3 BELSPO funding for space research

One of the key domains for international research at the Belgian federal level is space research. Annual funding for space research has increased by €50 million to a yearly budget of €275 million allocated by BELSPO from 2020 onwards. Belgium was one of the founding members of the European Space Agency (ESA) and is currently its fifth largest contributor (2021). BELSPO manages the Belgian contribution to ESA. The exploitation of space is significant for Belgium from a scientific, societal (e.g. Earth observation monitoring, meteorology), industrial and a commercial perspective. Belgium has a leading role in space research, as well as an expanding industry active in various domains of space technology and participating in ESA activities. In the space sector, Belgium has the sixth largest industrial employment in Europe (after France, Germany, Italy, United Kingdom and Spain), with nearly 1,600 employees in 2020³⁴, a number that is growing annually.

A recent study³⁵ on the impact of investments through ESA on the Belgian space sector found that €559 million in contracts received in the period 2015-2018 (first quarter) resulted in up to €642 million in added value, €1,566 million in turnover and 6,473 full-time jobs in the nation's wider economy (direct, indirect and derived). In addition, it was shown that the investments made through ESA during this period resulted in a 57% fiscal return to the government. The largest clusters of industrial activity relate to engineering and technical consultancy and space-related software design. Nevertheless, the largest volume of Belgian ESA participation in terms of funding is awarded to activities in the manufacturing of spacecraft and related machinery (32%), the manufacturing of electronic equipment (21%), and engineering activities and related technical consultancy (18%). The type of companies engaged in ESA-related activities ranges from subsidiaries of large international companies to SMEs.

Cybersecurity is another focus of Belgian investment notably support for the development of ESA's Space Security and Education Centre (ESEC) in Redu as a centre of excellence and the node of the agency's cybersecurity strategy. Via the support of ESEC's education activities and the dedicated ESA education programme, BELSPO contributes to the promotion of STEM education in Belgium.

Earth Observation is another stronghold of Belgian science policy. Complementary to the ESA Programmes, funding for research is also provided by the national STEREO programme, which is currently in its fourth generation. BELSPO also funds the TERRASCOPE centre, facilitating the use of Earth observation data from the EU Sentinel satellites (Copernicus Programme) for the development of applications.

In the framework of the Recovery and Resilience Plan in 2022, a €10 million space call dedicated to cybersecurity, secure connectivity and management of data matters will be launched. Therefore, given the scientific and industrial opportunities in this domain, space research remains high on the future policy agenda in Belgium.

34. ASD – Eurospace, Facts & Figures 2020

35. IDEA Consult (2019) Impact of Belgian investments in space research programmes

Furthermore, BELSPO also represents Belgium in several intergovernmental organisations related to space, such as CEOS, COPUOS, ECMWF, ESO, EUMETSAT and GEO as well as managing bilateral cooperation with several countries such as France and Argentina.

2.2.3.4 International collaboration activities

BELSPO also coordinates various activities under bilateral cooperation agreements with various target countries.³⁶ These activities range from support to networking activities (international scientific events, labs visits, etc.) to funding of specific research infrastructures (e.g. an optical telescope in India in exchange for observation time on it for Belgian researchers).

For more than two decades, BELSPO has also co-funded Belgian participation in the European aeronautic development programme AIRBUS and participates in a range of other multilateral and bilateral cooperation platforms. The funding for the aeronautic industry is provided by the FPS Economy and BELSPO. In the framework of the Recovery and Resilience Plan in 2022 a €25 million call dedicated to the greening of aeronautics will be launched.

2.2.3.5 BELSPO policy support

In addition to being a funding agency, BELSPO has an important role in developing science policy as well as providing services to other federal public services and coordinating with the federated entities as well as the international R&I community. The policy role includes:

- ▶ Facilitating the consensus that it is required in all the positions taken on behalf of Belgium regarding R&I matters that concern various public authorities in Belgium;
- ▶ Representing Belgium in international R&I communities and platforms;
- ▶ Developing an evidence-based science policy at federal level;
- ▶ Generating data, study reports and official R&D statistics on Belgium for national policymakers (e.g. the Minister for Science Policy, preparation of Council meetings) and international organisations such as the European Commission, the OECD and Eurostat;
- ▶ Coordinating the Belgian position regarding Horizon Europe (see section 1.2);
- ▶ Supporting the Ministry of Finance in the monitoring of the R&D tax incentive schemes.

2.2.4 FPS Finance – fiscal incentives for R&D

The FPS Finance is responsible for taxation and tax collection as part of its State Treasury role. The FPS Finance manages several fiscal incentives in favour of R&D and innovation, supported by other services, in particular the FPS Economy for the assessment of innovation projects and bonuses (see below) and BELSPO for the monitoring and assessment of the Partial Exemption of Payment of Withholding Taxes. In comparison to 2010, the importance of fiscal incentives for R&D has grown, for both the number of schemes available and the share of these schemes in the Belgian R&I policy mix. The expansion of tax incentives schemes was introduced to contribute to the Europe 2020 target, aiming to raise expenditures on R&D to 3% of GDP.

2.2.4.1 R&D tax incentives measures

The Federal Government has tax incentives schemes for R&D in companies in two main categories. The first type has different variations of exemption of withholding tax for staff that is involved

36. See: https://www.belspo.be/belspo/coordination/biCoop_en.stm

36. See: https://www.belspo.be/belspo/coordination/biCoop_en.stm

in R&D or has a particular university degree. The second type includes schemes that allow deduction of corporation tax, either as tax credit or a deduction of incomes from innovation.

Belgium has four schemes for the partial exemption of payment of the withholding tax on wages (PWHT) of R&D personnel in private firms and public research institutes:

- ▶ For companies involved in research cooperation with a higher education or scientific institution;
- ▶ For Young Innovative Companies;
- ▶ For R&D staff with a masters (in sciences), PhD or engineering degree in qualifying studies (sciences, (veterinary) medicine or civil engineering);
- ▶ For R&D staff with a bachelor's degree in qualifying studies (since January 2018) and then raised to 80% of their withholding tax in 2020 in line with other degrees.

Since 2007, Belgian companies can choose between a tax deduction (reduces the taxable income) or a tax credit (reduces the amount of taxes that is due) for investments in R&D. In 2017, the tax deduction scheme for patent income was replaced by a tax reduction for innovation income and the former scheme was phased out in 2021. The new innovation income deduction scheme is less generous than the former scheme, in order to comply with OECD guidelines on Base Erosion Profit Shifting.

The deduction system for innovation income (DRI) was updated by the law of 9 February 2017. This allows companies generating profits to reduce part of their taxable base by the deduction of a share of net income from patents, supplementary protection certificates, plant variety rights, software protected by copyright or related to orphan drugs, data exclusivity or commercial exclusivity. The scope of this deduction regime has been considerably broadened since it was set up in 2008 (then limited to patents): the tax deduction is no longer only granted for income from titles issued but is extended to IP applications.

The tax deduction does not require Belgian companies and Belgian establishments of foreign companies to apply for and obtain an intellectual property right in Belgium. Nevertheless, this tax regime has favoured the setting up of structures that led an increase in the number of applications for Belgian patents and European patents leading to an increase in the number of European patents subsequently validated in Belgium.

Belgian companies and Belgian establishments of foreign companies may deduct up to 85% of the net income from intellectual property rights resulting from their own R&D, under the following conditions: expenditure corresponding to income must be incurred in Belgium, their recognition is essential in the calculation of the 'Nexus ratio', which highlights the intensity of the R&D produced on Belgian soil; or the eligible income is the direct income from innovation but also the part of the improvements made to or patents provided by third parties (royalties).

Another tax measure available for companies is a deduction for tangible and intangible fixed assets (such as patents) used for R&D activities related to new products and advanced technologies that have no negative effect on the environment. There are different arrangements on how to reduce this tax, such as 13.5% at once on the investment value, 20.5% as annual depreciated and additionally there is a carry forward option if the measure is not used for consecutive years.

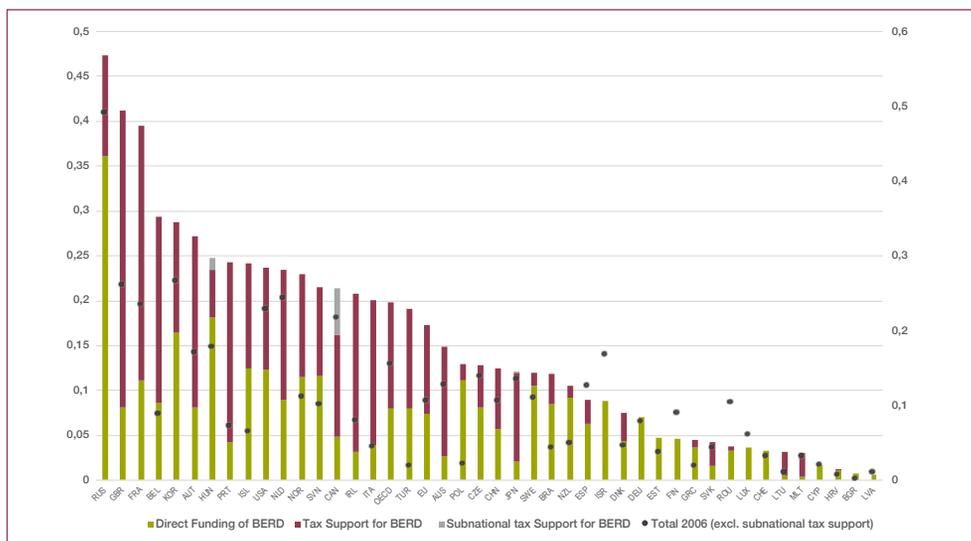
A smaller fiscal federal measure is the Innovation Bonus, for which the FPS Economy acts as a 'subcontractor' for the evaluation of innovation aspects. The Innovation Bonus is granted and paid by a company to its creative employees. For employees, it has the advantage that it is completely exempt from social contributions or income tax. Its application is subject to innovation conditions, bonus and limitations on the numbers of employees per innovation project who can benefit from it. There is no fixed budget, but this measure reduces the government's income tax revenues.

A tax shelter scheme for individual citizens who invest in start-ups and growing scale-ups (as externals, not receiving a salary, involved in the companies' management or having an equity share of more than 30%) is not specifically targeted at R&I companies, but also helps to support high-tech start-ups. The tax deduction here is 30-45% of the investment depending on the type of company and with a ceiling of €250,000.

2.2.4.2 R&D tax incentives – importance in the policy mix

In 2015 Belgium was considered by the OECD as the country with the most generous R&D tax incentives relative to GDP.³⁷ This is no longer the case, but Belgium remains well above the OECD average in terms of total government support to business R&D as a percentage of GDP, at a rate equivalent to 0.29% of GDP in 2019. Nearly three-quarters of this business support is provided through tax incentives, growing from 29% of total business support in 2007 to 71% in 2019.

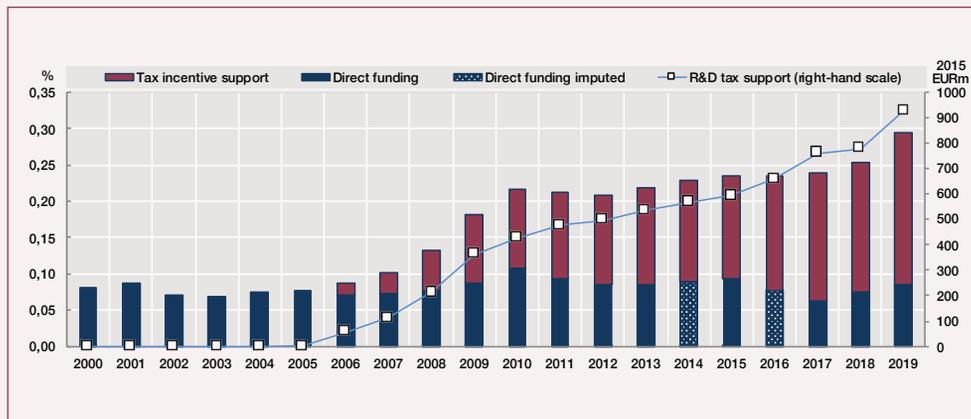
Figure 23: Direct government funding of business R&D and tax incentives for R&D (2019 or nearest year) as a percentage of GDP



The importance of R&D tax incentives has increased significantly since 2000, both in absolute and relative terms, as is shown in the figure below.

37. Dumont, M. (2019), tax Incentives for Business R&D in Belgium, Third Evaluation, Federal Planning Bureau, Working Paper 4-19

Figure 24: Direct funding of business R&D and tax incentives, 2000-2019 as percentage of GDP, 2015 prices (right-hand scale)



According to the FPS Finance, the estimated budgetary value of R&D tax credits in Belgium was €267 million in 2018, compared to €70 million in 2010. The budgetary value of the deduction for patent income was €219 million in 2010 increasing to €782 million in 2018. The budgetary value of the PWHT was €528 million in 2010 rising to €1026 million in 2018³⁸. In 2018, the share of public tax revenue foregone due to R&D incentives was 54.2% due to corporation tax, 45.7% due to the withholding tax reductions and 0.1% from personal income tax reductions. As of 2020, the corporate income tax for all companies is reduced to 25% (and 20% for the first tranche of €100,000 for SMEs). This will lower the budgetary costs of R&D tax incentives based on corporate income tax in the future.

2.2.5 FPS Economy

The FPS Economy has an important role as a facilitator of innovation activities and as coordinator between the EU, federal and regional levels on innovation topics such as digitalisation and energy. The FPS also has the sole mandate to deal with nuclear technologies. The FPS Economy oversees R&I-related activities in four broad clusters:

1. Nuclear energy research including the fuel cycle and nuclear waste
2. Digitalisation and Artificial Intelligence (AI)
3. Intellectual property, standards and metrology
4. The Continental Shelf Service, namely the monitoring by Belgian research vessels and research institutes of offshore sand and gravel extraction.³⁹

The FPS Economy is also the National Focal Point of the European Defence Fund, which funds R&D projects.

38. See: https://finance.belgium.be/en/figures_and_analysis/figures/federal_tax_expenditures_report

39. To monitor sand extraction in the Belgian part of the North Sea, the Continental Shelf Service regularly carries out scientific measurements with multibeam sounders at sea, to assess the impact of this activity on the sea environment and to manage the sand resource in the most sustainable way.

See: <https://economie.fgov.be/en/themes/enterprises/specific-sectors/offshore-sand-and-gravel/monitoring-sand-and-gravel>

2.2.5.1 Nuclear energy research

The FPS Economy has the competence for nuclear energy research in Belgium covering nuclear fusion, fission, the fuel cycle and nuclear waste. While the largest share of this R&D is conducted at the nuclear energy research centre SCK CEN⁴⁰ (see 2.3.2), other entities conduct nuclear research as well, such as the Institute of Radioelements (IRE), the Royal Military Academy, universities, the National Institution for Nuclear Waste (NIRAS/ONDRAF), the Federal Agency for Nuclear Inspection (AFCN/FANC) and the private sector. This research is done in close cooperation with SCK CEN, which has the necessary research infrastructures and facilities for this purpose.

The Federal Energy Transition Fund (ETF), managed by the FPS Economy, aims to stimulate and support R&I in the energy field under the competence of the Federal Government. A November 2020 call for proposals had a budget of €25 million for R&I on renewable energy sources in the Belgian exclusive economic zone in the North Sea, biofuels, nuclear energy applications and the security of energy supply and grid balance. In the field of nuclear energy, 22 R&D projects have been funded since 2017 by a public investment of €12 million on the topics of waste management and dismantling and nuclear safety to a wide set of research performers from the public and private sectors.

In addition to the MYRRHA project (see Figure 29), two large collaborative nuclear research projects funded by FPS Economy are:

- ▶ Through a partnership between the IRE and SCK CEN, the RECUMO project (Recovery of valuable Uranium residues of 99Mo-based radio-pharma in Belgium) aims to provide a structural solution for the management of the irradiated substances from the production of medical radioisotopes that are currently stored at the IRE site in Fleurus.⁴¹
- ▶ IRE, in partnership with the Dutch technology company ASML, is undertaking the SMART (Source of MedicAI RadioisoTopes) project that aims to develop a new method to produce Molybdenum-99 (Mo-99), the most widely used radioelement in nuclear medicine. The new production process of Mo-99 with a linear particle accelerator replaces the current process of irradiation with uranium-235 (U-235) in a research reactor. The new production process with a particle accelerator aims to produce Mo-99 of a quality that is compatible with the type of generator that is already used in hospitals. The total budget of this project, partly funded by the Federal Government, is foreseen to be €52 million.

2.2.5.2 Digitalisation and Artificial Intelligence

The FPS Economy is responsible for the national and European coordination on the topic of **digitalisation and Artificial Intelligence (AI)**. In April 2015, the Minister of the Digital Agenda, Telecommunications and Postal Services presented the 'Digital Belgium' action plan that covered the period 2015-2020. In the autumn of 2021, a renewed Digital Belgium 2.0 was presented by the Minister. The Plan contains a research and innovation dimension and has a focus on the key sectors health and mobility.

40. SCK Studiecentrum voor Kernenergie / CEN Centre d'Étude de l'Énergie Nucléaire

41. See: <https://www.sckcen.be/en/projects/recumo>

In May 2016, the Belgian law on Open Data was approved. It helps to stimulate the reuse of government data across many policy domains. Through [Data.gov.be](https://data.gov.be), it is possible to consult and use more than 15,000 datasets, which vary according to different categories, such as culture and sport, education, public sector, and so on.

For AI topics and the Digital Europe Programme (DEP), there is an inter-federal coordination mechanism hosted by the FPS Economy. The AI files are coordinated between the Federal Government and the regions within the Interministerial Economic Commission AI, while the DEP files are coordinated within the Interministerial Economic Commission DEP. For AI topics under Horizon Europe, the coordination is ensured by BELSPO.

The FPS Economy publishes an annual Digital Barometer, providing an overview of where Belgium stands on digitalisation in households, the economy and government. On the European Digital Economy and Society Index (DESI), Belgium ranks ninth and scored above the EU average in 2020.

To support digitalisation across Belgium, the Federal Government has started the G-Cloud programme. The G-Cloud programme is the result of a joint initiative by several public institutions: federal public services, social security institutions and the healthcare sector. Its practical operation is managed by the 'Cloud Governance Board'. The G-Cloud is a hybrid cloud, which uses services provided by private companies in public cloud environments, and services hosted in government data centres. The G-Cloud is managed by the government, while the private sector is largely used for its expansion and operational functioning.

Another Federal Government initiative is a large awareness-building campaign on Artificial Intelligence for SMEs,⁴² aiming to demystify AI, explaining its possible applications and use in different application areas. The campaign includes a variety of testimonials from entrepreneurs who have introduced AI in their business.

Policy programmes for research and innovation in Artificial Intelligence are predominantly developed at regional and local levels in Belgium. To create a Belgium-wide coordination platform, the Belgian Minister for the Digital Agenda launched the AI4Belgium platform⁴³, bringing together stakeholders across disciplines, domains and policy levels, from both the public and private sectors. The platform aims to be a one-stop shop for information about AI, as well as a hub to broker potential international partners. A central objective is the development of a long-term national strategy for digitalisation and AI, bringing together the many regional and local initiatives in Belgium, and building a Belgian brand around its AI eco-system. Other objectives of the platform are to raise the political attention paid to AI and investment needs, as well as engaging in a dialogue on AI with citizens. The platform spans education and skills development, data strategies including safety and security, data access and transfer and digitalisation of public services, which are all framework conditions for innovation. The AI4Belgium consortium has no financial resources for R&I, however, as a government-wide stakeholder platform, it provides the Belgian authorities with advice on potentially interesting policy experiments or lighthouse

42. See: <https://www.intelligenceartificiellepourpme.be/> in French and in Dutch <https://www.artificieleintelligentievoorkmos.be/>

43. See : <https://www.ai4belgium.be>

projects as well as on the total investments that all layers of government should make to become an international front-runner.

2.2.5.3 Support for Intellectual Property, Standards and Metrology

For the support of Intellectual Property (IP), standards and metrology, the FPS Economy and its partners have several financial, regulatory and operational measures available. These measures have contributed to raising awareness on these topics and helped to reduce the financial and administrative burdens for companies and inventors to engage in IP and standardisation matters. In addition, national and international Strategic Partnerships have contributed to improving the innovation ecosystem in Belgium. The following **financial support measures** are in place:

Budget measure for ordering a search report from the European Patent Office (EPO)

If a company files a Belgian patent application, the procedure for granting this patent consists essentially of checking the formal conditions and providing a search report and a written opinion on the conditions of patentability of the invention concerned. The FPS Economy subsidises around 90% of the procedure (which costs on average €2,350). Annually, a budgetary appropriation of approximately €2.5 million is used for this measure. This grant aims to support innovation by facilitating access to the patent system for innovative companies, in particular SMEs, as well as universities and research centres.

Patent Cells

The Patent Cells (offices) educate and advise SMEs on intellectual property matters, in order to enable them to adopt an IP strategy adapted to their needs and thus better protect their innovations. The Patent Cells are tasked with answering questions from SMEs, carrying out technological watches and organising information sessions. The FPS Economy subsidises up to 75% of the costs of the Patent Cells. The annual budget for this subsidy has been set at €541,000 since 2016. Four Patent Cells exist at a sectoral level.

Figure 25: Patent Cells – advice to SMEs on intellectual property

Sector	Organisation	Link
In the Collective Research Centres:		
Industrial technologies	Sirris	https://www.sirris.be/fr/expertise/propriete-intellectuelle
Textile Industry	Centexbel	https://www.centexbel.be/fr/transfert-de-connaissances/cellule-brevets
Construction	CSTC-WTCB-BBRI	https://www.cstc.be/homepage/index.cfm?cat=services&sub=patent
In a trade association:		
Chemical and life sciences industries	Essenscia	https://www.essenscia.be/fr/priorites/innovation/cellulebrevets/

Standards offices⁴⁴

The Standards offices (*Antennes*) educate and inform SMEs about standards and standardisation. The objective is to help SMEs to make the best use of standards, to inform them of future developments and to collect information on their needs regarding norms. Thirty-six standards offices were created on a thematic basis in eight collective research centres. The FPS Economy subsidises up to 75% of the costs of the Standards offices. Funding is delegated to the Standardisation Bureau (NBN). The budget for Standard offices also covers pre-standardisation support. The budget allocation for the offices has averaged €1,430,000 per annum over the last six years.

Pre-standardisation support

Pre-standardisation is the development of the technical and scientific knowledge necessary for the development of standards on a relevant basis. The standards developed on these bases, and in particular performance standards, help to increase the innovation and competitiveness of Belgian companies. Projects are ranked according to their scientific quality, their economic and societal impact, their normalisation strategy and their capacity to strengthen other research projects.

The FPS Economy financially supports the pre-standardisation through a subsidy of 50% of the costs. Funding is delegated to the Standardisation Bureau (NBN). The budget for pre-standardisation also covers Standards Antennas (see above). The total budget allocation to this programme has been on average €2.8 million over the last five years.

Metrology

Within the FPS Economy, the National Standards Service (SMD-ENS) of the Metrology department manages the national references for the International System of Units (SI-units) of measurement and, through calibrations against those references, ensures confidence in correct measurement results in industry, R&D, transport and the living environment. An additional task of this service is to provide scientific metrology advice for development and innovation. Furthermore, there is intense cooperation at international level between all national metrology institutes, to ensure confidence in measurement results as well as coordinated R&D under the EU R&I Framework Programme.

In addition to financial measures, Belgium has **regulatory and operational measures** that have an impact on innovation:

- ▶ The **removal of the obligation to provide a translation** for European patents designated to Belgium and issued in English, following the provisions of the London Protocol,⁴⁵ whereby contracting parties to the European Patent Convention undertake to limit the translation requirements for the validation of European patents in their territory.
- ▶ **Patent search support.** Since the 1990s, the Belgian Intellectual Property Office has offered users the option of submitting a patent preliminary investigation to test their inventions against the state of the art. In addition, the results of the patent preliminary investigations

44. See : <https://economie.fgov.be/fr/themes/qualite-securite/normalisation/les-antennes-normes>

45. The London Protocol is a patent law agreement concluded in London on 17 October 2000 and aimed at reducing the translation costs of European patents granted under the European Patent Convention (EPC).

provide insight into the freedom of exploitation (FTO) to be able to trade a product or a method to avoid a potential infringement or to invalidate or oppose a patent.

Moreover, the Belgian Intellectual Property Office participates in the establishment of strategic partnerships to exchange information, develop synergies, carry out joint projects to improve information services and IP awareness for innovative companies, in particular SMEs, universities, research centres. These partnerships include:

- ▶ **The Institutional Forum.** The IP Forum, founded in 2019 is a platform that brings together the federal and regional entities involved in the promotion of IPR within the domain of innovation and within the Belgian territory with the aim of a) getting to know their operation and services better, b) exchanging information, and c) working together towards a joint strategy. The aim is to join forces to provide the end-user with the best possible service.
- ▶ **The PATLIB network.** The PATLIB network is an initiative of the European Patent Office (EPO) that consists of patent information centres (PATLIB centres). The PATLIB centres are research centres or university centres that provide information and support for IPR to their respective members. The aim is that users can obtain both technological knowledge and IPR information from the PATLIB centre. For Belgium, the PATLIB network consists of the collective centres: Centexbel, SIRRIS and WTCB, the University of Mons, the LIEU network (see section 4.3.3) and the Belgian Intellectual Property Office.
- ▶ **Cooperation with BOIP and EUIPO**
The BOIP (Benelux Office for Intellectual Property) is responsible for both the promotion and registration of trademarks, designs and industrial drawings, as well as the i-depot scheme⁴⁶. The FPS Economy is competent for Belgian patents. The cooperation is designed to create a synergy in order to convey information and the promotion of the respective competences on IPR to users as best as possible. Support is provided for instruments such as IdeeScan, to determine which IPR qualifies if you have a new idea, or That's IP, a package for students and teachers, as well as Ippreneur, an instrument under development for entrepreneurs.

The EUIPO (European Intellectual Property Office)⁴⁷ has a similar role of raising awareness among SMEs on IPR. Numerous initiatives were launched to this end, such as the SME fund, which enables a Belgian SME to benefit from a reduction when registering a trademark or a design, or to request an IPR audit to examine its potential IPR by an expert, supported by the Belgian DIE.

2.2.6 FPS Health, Food Chain Safety and Environment

The FPS Health, Food Chain Safety and Environment funds R&I activities to support its mission to protect and improve the health of citizens, to be the Belgian promoter of the 'One World, One Health' principle, by placing health and all its components at the heart of our concerns and missions, including human health, the health of the planet, animal and plant health and food.

Each year, this FPS grants subsidies for scientific research in support of food safety and animal and plant health policies. In 2017, €3,662,000 were allocated to research projects (-3.4% com-

46. See: <https://www.boip.int/en/entrepreneurs/ideas/submit-an-i-depot>

47. See : <https://euiipo.europa.eu/>

pared to 2016) and in 2018, €3,585,000 (-2.1% compared to 2017). The Contract Research Unit⁴⁸ manages the design of the research programme, the launch of calls for project proposals and the selection of projects. Grants are awarded to thematic research projects (TR), free research projects (FR) and transnational research projects (IR). The TR projects are based on themes defined by the administration, while the RF projects are proposed by the researchers themselves. The IR projects bring together Belgian researchers with foreign researchers in transnational consortia. These projects also focus on well-defined themes. In this context, the Contract Research Unit participates in the Euphresco⁴⁹ network in the field of plant health and in the STAR-IDAZ network⁵⁰ in the field of animal health. The FPS also participates in the ERA-NET ICRAD⁵¹ (International Coordination of Research on Infectious Animal Diseases), along with the FWO and the FNRS and 19 other funding organisations. In 2021, the FPS Public Health earmarked a budget of €250,000 for projects within the research area 'Improved understanding of animal-human-environment interface' in the framework of the second ICRAD call.

A significant part of the FPS Health's R&I investment is provided as core funding for one of the largest federal research centres: **Sciensano** (see section 2.3.3 for more details). Sciensano is a scientific institute which, working under the slogan One Health, covers animal and human health.⁵² The COVID-19 pandemic in 2020 dramatically boosted the institute's visibility for the Belgian public, as Sciensano is the institute responsible for monitoring the pandemic and providing expert advice to all levels of government in the country (see Figure 26 below).

Figure 26: Sciensano's role in Belgium's response to the COVID crisis

Sciensano has had a strategic and visible role in Belgian society following the outbreak of COVID-19, as the institute is responsible for monitoring COVID related health statistics and created an open data platform with daily updates on infection, hospitalisation, etc. rates at municipal and regional levels. It is one of the key advisory bodies for the Belgian government on how to respond to the pandemic. The institute coordinated the national Risk Assessment Group to assess the risks of government measurements based on epidemiological research and it plays a central role in the Scientific Advisory Committee on Corona.

Based on its scientific research, Sciensano developed the protocols and procedures for Belgian health professionals on how to deal with COVID treatment and disease prevention. It supported laboratories that handled clinical samples or cultures of the virus on biosafety. For Sciensano to play this coordinating role, the institute was given the task to develop and manage the national contact tracing database and to collect health data from patients with a confirmed or suspected diagnosis of COVID-19. This is in addition to its activity to standardise and homogenise Belgian health data in the national Health-data.be IT platform, which Sciensano and its predecessors have set up since 2015. With the nationwide COVID vaccination campaign in place, Sciensano will keep on conducting post-vaccination monitoring and research.

48. See: <https://www.health.belgium.be/fr/recherche-contractuelle>

49. See: <https://www.euphresco.net>

50. See: <https://www.star-idaz.net/>

51. See: <https://www.icrad.eu/>

52. See: <https://www.sciensano.be/en/health-topics/one-health-0>

The role of Sciensano in the government's communication about COVID has raised the profile of the organisation into a highly visible and well-known federal scientific institute to Belgian citizens.

2.2.7 FPS Foreign Affairs, Foreign Trade and Development Cooperation

The FPS Foreign Affairs, Foreign Trade and Development Cooperation is responsible for Belgian foreign policy, relations with the European Union, development cooperation policy and certain aspects of foreign trade policy. Its Directorate-General for Coordination and European Affairs (DGE) and the Permanent Representation are responsible for the preparation, definition, representation, management and monitoring of Belgium's European policy. Across all policy domains, the DGE coordinates the Belgian position in international affairs, such as in the Coordination Committee for International Environmental Policy (CCIEP). This includes the Competitiveness Council meetings with a research agenda and the negotiations on Horizon Europe, in cooperation with BELSPO.

The FPS engages in broad bilateral cooperation agreements that may include scientific cooperation. It also supports BELSPO in the management of specific bilateral agreements in science, technology and innovation: these agreements are currently with China, India, South Africa and Vietnam. There is also collaboration between the FPS and BELSPO on development cooperation, including through a cooperation agreement that grants financial support to some federal scientific institutions.

2.2.7.1 Research on development cooperation

The Directorate-General for Development Cooperation maintains strong relations with Belgian research institutions that are structural partners of Belgian development cooperation. The amounts of subsidies allocated over the past 10 years to these research institutions, excluding amounts specifically linked to grants, is presented below. This covers specific research in the priority areas of Belgian development cooperation, namely health, agriculture, the environment, public finances, etc., as well as partnerships between Belgian universities or faculties and universities or faculties in partner countries, with educational or institutional purposes.

Figure 27: Allocation of funding in million euro from FPS Foreign Affairs

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Flemish Inter-University Council (VLIR-UOS)⁵³	19.6	22.0	22.7	21.0	22.4	21.5	21.0	33.5	34.1	32.0	34.7
ARES – Académie de Recherche et d'Enseignement supérieur⁵⁴	16.6	16.4	17.1	17.2	16.8	14.3	16.7	26.4	29.0	32.8	31.2
Institute of Tropical Medicine (ITM)⁵⁵	12.6	12.8	12.8	12.8	14.7	15.1	15.1	14.2	14.1	16.0	19.1
Royal Belgian Institute of Natural Sciences (KBIN/IRSCN)	0.9	0.8	0.8	0.8	1.2	1.2	1.2	1.2	1.2	1.0	1.4
Royal Museum for Central Africa (MRAC/KMMA)	4.2	3.0	2.7	2.9	2.6	2.9	3.1	2.7	3.1	3.0	3.3

53. See: <https://www.vliruos.be/en/home/1>

54. See: <https://www.ares-ac.be/fr/cooperation-au-developpement>

55. <https://www.itg.be>

2.2.7.2 Research in relation to European and Multilateral Affairs

The Directorate-General for Coordination and European Affairs (DGE) is responsible for the preparation, definition, representation, management and monitoring of Belgium's European policy. This includes for instance the meetings of the Competitiveness Councils with a research agenda. That work is done in cooperation with BELSPO. The Directorate-General for European Affairs does not conduct any research activities itself, but funds two European education and research centres:

- ▶ The annual contribution to the European University Institute (EUI, Firenze). There are four research areas at the EUI: economics, law, political and social sciences and history. The legal basis for the payment of this contribution is the agreement establishing the EUI, signed in Florence on 19 April 1972. Belgium's contribution in 2021 amounted to €1,668,641 and is based on a distribution key agreed by the EU Member States to this Convention.
- ▶ The DGE also pays the annual subsidy from the Belgian Federal Government to the College of Europe in Bruges. There are five research domains at the College of Europe: economics, law, political/administrative sciences, international relations and diplomacy and interdisciplinary sciences. The subsidy to the College of Europe was €1,916,000 in 2021.

Until 2020, the Directorate-General for Multilateral Affairs (DGM) had a budget line for science policy from which compulsory contributions were funded for the Organisation for Economic Co-operation and Development (OECD) and some projects were funded on a voluntary basis of the International Atomic Energy Agency (IAEA). In accordance with the activities of both organisations, these contributions directly or indirectly benefit projects that promote scientific research. Within this framework, the contribution to the OECD (2020 figures) was €273,783, including the contribution to the OECD-Nuclear Energy Agency and the Global Science Forum.

For the IAEA, a total of €1,608,768 was funded to projects developing civil nuclear applications, including in the fields of agriculture and health (figures for 2020).

From 2021, this separate budget line for 'science policy' will no longer exist but has been integrated into the DGM's budget line for international organisations. For 2021, a similar expenditure is foreseen as in 2020, for both the OECD and the IAEA: either because Belgium, as a member of these organisations within the OECD, is obliged to contribute, or because it has long been government policy to support research into civil nuclear applications of the IAEA.

2.2.8 Ministry of Defence

The Belgian Ministry of Defence (MoD) conducts or funds scientific research necessary for the exercise of its competencies, including for the implementation of international or supranational agreements. Scientific and technological research is essential to allow the MoD to keep abreast of and implement the latest technological advances and to adapt to a rapidly changing environment and thus preserve and strengthen the security environment of Belgium and its partners. Therefore, the MoD funds scientific and technological research programmes, responding to a set of strategic objectives and developed in 12 focus areas in the field of security and defence.

The strategic objectives of scientific and technological research are:

- ▶ contributing to the Defence-related skills base by supporting military academic education;
- ▶ contributing to short- and long-term capacity development, in line with the Integrated Capability Development Plan (ICDP) and the Strategic Vision;
- ▶ contributing to the culture of innovation planned within Defence, both in terms of technology and process improvement;
- ▶ contributing, in accordance with the Defence, Industry and Research Strategy (DIRS), to the development of a competitive and credible national industrial and technological base in the field of security and defence, within the framework of the European Defence Technological and Industrial Base (EDTIB), in particular by implementing the triple helix model, a pragmatic partnership between the MoD, research institutions and industry.

The MoD's **focus areas** include:

- ▶ Cybersecurity
- ▶ Big data
- ▶ Sensor data processing and sensor fusion
- ▶ Communications
- ▶ Space technologies
- ▶ Novel weapon systems
- ▶ Intelligent autonomous systems and platforms
- ▶ Protection of personnel, systems and infrastructure
- ▶ Sustainable new generation energy systems
- ▶ Advanced military health
- ▶ Human systems and behaviour
- ▶ Security and defence policy

The department Scientific and Technological Research of Defence (STRD) of the Royal Higher Institute for Defence (RHID)⁵⁶ manages the key scientific and technology domains, as well as the collaborative research activities at national and international level. The latter is of increasing importance, particularly at European level.

For 2021, the budget allocated to the Defence research programmes is €8.8 million. For subsequent years, there are plans to gradually increase this amount to reach more than €30 million in 2024 and a global R&I contribution⁵⁷ of 2% of defence spending in 2030. Research and technological development are supported through two main research programmes.

First, an internal multi-annual programme designed and managed by RHID-STRD and mainly executed by the defence research centres (see 2.3.4), although collaboration with external partners is encouraged. The projects, currently 95 are running,⁵⁸ are selected each year following an internal call for projects and after evaluation are approved by the RHID's Scientific

56. See: <https://www.defence-institute.be/en/about-us/strd/>

57. As defined by the European Defence Agency, R&T expenditure is limited to basic research, applied research and technology demonstration and is a subset of R&D expenditure. There is no dedicated budget for other R&D expenditures. See <https://eda.europa.eu/publications-and-data/defence-data>

58. See: <https://www.defence-institute.be/en/about-us/strd/research-programme/research-programme-db/>

Committee and Board of Directors, and then submitted to the Minister of Defence and the Council of Ministers for approval.

The second programme, called Defence Research Action (DEFRA),⁵⁹ was launched in 2021, in collaboration with BELSPO, and aims to encourage participation of a wider set of Belgian research institutions as well as industrial partners. The indicative budget for the first call of projects, for a maximum of two years, is €1 million. Providing there is a positive evaluation of this first programme, it will be enlarged considerably in the coming years.

2.3 MAIN RESEARCH AND INNOVATION ORGANISATIONS

2.3.1 Federal Scientific Institutes

The Federal Scientific Institutes (FSI) cover a range of functions, from scientific research to archives and collections and repositories of cultural and scientific heritage and museums open to the general public. Together these institutes employ approximately 2,000 people and have vast collections ranging from 38 million specimens in the museum of natural sciences of the Royal Belgian Institute of Natural Sciences (RBINS), more than 20,000 pieces of art in the various art museums, and over a million photographs in the Cultural Heritage Museums and so on. These collections form an important basis for scientific research in some of the FSI, but also for other researchers. Institutions like the Africa Museum and the RBINS often host foreign researchers. These institutes have a two-fold mission:

- ▶ A 'public service mission': development, maintenance and dissemination of scientific, technical and cultural information and documentation, collection conservation and education in these areas.
- ▶ A research mission: performance of basic and applied research, often in partnership with other institutions-. They participate, and are sometimes leaders, in international research projects and exchange programmes.

The FSI receive core funding from the BELSPO budget (see also section 2.2.3) and have their own revenue. They also have a relative autonomy to decide on their operational and scientific priorities. The FSI have access to competitive funding to support R&I activities through calls of the BELSPO programmes as well as in European programmes, and to a limited extent in the funding programme of other Belgian authorities.

Figure 28: Federal Scientific Institutes (2019)

Name of FSI	Research focus	Funding from BELSPO budget 2021 in € million	# Re-search staff FTE*	Annual R&D expenditure ⁶⁰ in € million*
Royal Belgian Institute for Space Aeronomy	This FSI conducts research and public service in the physics and chemistry of the atmosphere of the Earth and other planets, and of outer space. https://www.aeronomie.be/	5	135	17
Royal Meteorological Institute of Belgium	In addition to Belgium's main meteorological service provider, the FSI conducts research on weather, climate and geomagnetism (through its Geophysical Centre at Dourbes). https://www.meteo.be/	9.4	82	7.7
Royal Observatory of Belgium and Planetarium	The Observatory's research domains include seismology, planetology, astronomy, astrophysics and solar physics. The Planetarium has a predominantly educational function. www.astro.oma.be www.planetarium.be	9.3	156	14
Royal Belgian Institute of Natural Sciences	This FSI covers a wide range of disciplines from biology to geology, oceanography to taxonomy and palaeontology to ecology. Researchers can use its extensive collections of specimens at the Institute. www.naturalsciences.be	21.6	169	25
Royal Museum for Central Africa	Research at this FDI covers society (historical research and contemporary anthropology), biodiversity and geology of Africa. www.africamuseum.be	10.6	127	8,4
Royal Museums of Art and History	Research activities focus on the collections in the group of museums that are part of this Institute and the digitalisation of collections. http://www.kmkg-mrah.be/	13.3	53	3.9
Royal Institute for Cultural Heritage	The Institute is a multi-disciplinary resource for scientific, photographic and technical documentation of the cultural heritage of the country. http://www.kikirpa.be/	6	122	3

*R&D survey 2020, conducted by BELSPO in collaboration with the communities and regions

60. R&D expenditure is defined as the amount of money spent on research and experimental development*, Frascati manual 2015, p. 110

Name of FSI	Research focus	Funding from BELSPO budget 2021 in € million	# Re-search staff FTE*	Annual R&D expenditure ⁶⁰ in € million*
Royal Museums of Fine Arts of Belgium	Research in art history, conservation, restoration and other cultural heritage studies. https://www.fine-arts-museum.be/nl	11.3	20	3
State Archives of Belgium	The Archives are a source of academic research about history in the disciplines of art history, geology, literature and exact sciences. The Archives provide support to researchers to identify relevant sources. The Archives are progressing towards a digitalisation of their sources. www.arch.be	14.4	90	5.6
Royal Library of Belgium	Researchers at this FSI conduct research on a wide variety of topics related to the Library collections including art history, literature, archiving of digital heritage and various forms of cultural heritage. www.kbr.be	15.3	39	1.3

All the institutes were subject to a peer review process in the period 2015 to 2017. A meta-evaluation⁶¹ (synthesis of the individual peer reviews) concluded that the FSI had a generally good quality of scientific outputs: While the quality of outputs varies, the majority of reviews found that the research of the FSI was generally of good to very good quality. The staff of the 10 FSI published quite regularly in prominent scientific journals. It was noted that that this was rather impressive, given that each scientist's workload includes research, grant writing and management, cooperation projects and training, and collection management. The report noted that the FSI use their scientific knowledge and results to advice policy makers at federal and other levels of government.

2.3.2 Nuclear energy research institutes

The Belgian Nuclear Research Centre (SCK CEN) was founded in 1952 and today it hosts several large research infrastructures. The Centre's annual budget is nearly €200 million, of which approximately 45% is from core funding from the FPS Economy. It has a workforce of more than 900 employees, of which 375 conduct research. SCK CEN has its own PhD-programme, hosting 10-20 PhD students per year, in cutting-edge research topics that are additional to the core research programme of the institute. Currently the Centre's research domains are:

- ▶ **Health:** the damage of radiation and the development of less-invasive cancer treatments, dosimetry;
- ▶ **Environment:** the effects of nuclear waste and radioactivity on the environment;
- ▶ **Materials:** the use of structural materials in the construction of nuclear reactors;

- ▶ **Technologies:** the technologies used for the dismantling of reactors and technologies used for nuclear research infrastructures;
- ▶ **Safety:** the safe operation of nuclear plants, the monitoring of radioactivity, crisis management and radiation in space exploration.

Among the research facilities available at SCK CEN, the Belgian Reactor 2 (BR2) is one of the most powerful research reactors in the world. It is used for the testing of fuels and materials for different reactor types and for the European fusion programme (ITER). BR2 is also an important instrument to produce radioisotopes for medical and industrial applications and for silicon doping for the electronics industry. The underground laboratory HADES, at a depth of 225 metres, allows the study of clay as a potential geological host formation for long-lived and high-active nuclear waste. Recently this laboratory has been substantially expanded to perform large-scale tests to demonstrate the feasibility and safety of the disposal of heat-generating nuclear waste. A new facility, MYRRHA, is now under construction (see Figure 29).

Figure 29: MYRRHA

On 7 September 2018, the Belgian Federal Government decided to build the MYRRHA project on the SCK CEN site in Mol. MYRRHA is the world's first large-scale Accelerator Driven System project. This infrastructure will study an innovative solution for nuclear waste management. By designing a technology able to reprocess high-level radioactive waste, MYRRHA will reduce the waste volume by a factor of 100 and their radiotoxicity by a factor of 1,000. Another huge challenge met by MYRRHA is the research and development in nuclear medicine. MYRRHA will contribute to producing new radioisotopes and to developing less-invasive therapies to fight against cancer. MYRRHA was included in the ESFRI Roadmap in 2010. In September 2021, the MYRRHA AISBL (a not-for profit international organisation) was established and in which international partners are invited to join bringing MYRRHA a step closer to become an ESFRI landmark research infrastructure. In future, SCK CEN will be the main service provider to operate the infrastructure, while partner countries will participate in MYRRHA development.

Of a total budget of €1.6 billion, the Belgian government committed €558 million for the period 2019-2038, towards the project's three-phased approach. The budget is 50% funded by the FPS Economy and 50% by BELSPO. The first phase, building a long linear accelerator (100MeV), is scheduled to be completed in 2026-2027, with an investment of €287 million and an additional €156 million for operational costs until 2038. In the second phase, the accelerator will be upgraded to 600 MeV, while the third and last phase, the building of a nuclear reactor, is scheduled to be commissioned in 2036. A stage-gate decision will be taken in 2026 on whether to proceed with phases 2 and 3, either sequentially or in parallel.

Belgium has a second large research institute that conducts nuclear research: the national Institute for Radio Elements (IRE) and its prevention unit IRE Lab, a public utility foundation whose main activity is the production of radioisotopes for diagnostic and therapeutic applications in nuclear medicine. It is a global leader in the production of Molybdenum-99, the 'parent' isotope of metastable Technetium-99 and the most widely used isotope in nuclear medicine for numerous examinations (heart, bones, lungs, thyroid, brain, kidneys, etc.). IRE ELiT is the innovation subsidiary of IRE and was created in 2010 to develop radiopharmaceuticals used in imaging and treatment of some cancers as well as for palliative care. In 2017, IRE ELiT allocated 18% of

its turnover to R&D. This percentage has been steadily growing ever since the company was created. IRE and IRE ELiT produce several medical devices and products and they work in close cooperation with industry in Belgium and abroad. IRE and IRE ELiT currently employ 230 people and their turnover was €100 million in 2019.

2.3.3 Sciensano – health research institute

In 2018, Sciensano⁶² was established as the result of the merger of two institutions, the ISP (Scientific Institute of Public Health) and the CERVA (Veterinary and Agrochemical Research Centre). The Centre's annual budget in 2020 was nearly €82 million, an increase compared to 2019 of 8%. In 2019, the centre had a workforce of over 700 employees, of which 46% were scientists and 26% lab technicians. The key research topics of the Institute are:

- ▶ Animal health, in particular (epizootic and enzootic) diseases that form a socio-economic threat as well as animal diseases that form a threat to public health (zoonoses).
- ▶ The quality and effectiveness of vaccines, medicines and medical laboratories.
- ▶ Food consumption and food safety, including issues around a healthy diet.
- ▶ Health and diseases monitoring, using nationwide surveys to collect information on the health of the population as well as the monitoring of infectious diseases.
- ▶ Health and environment, which uses an integrated approach to the health of humans, closely related to the health of animals as well as to the environment. Sciensano monitors eco-systems mostly with respect to the possible threats to public health.
- ▶ The performance of the healthcare system to ensure its quality, effectiveness and equal access.

The Institute provides scientific advice to the public authorities, mostly the Agency for the Safety of the Food Chain and the Federal Public Service Health, Food Chain Safety and Environment, and the Federal Agency for Medicines and Health Products as well as regional food and health agencies.

Sciensano coordinates public health issues for Belgium and maintains relations with international organisations such as the World Health Organization (WHO), the European Centre for Disease Prevention and Control and the European Medicines Agency.

2.3.4 National Institute of Criminalistics and Criminology (NICC/INCC)

Funded by the FPS Justice, the NICC/INCC⁶² is a federal scientific institute that conducts scientific research on forensics, criminology, and the societal aspects of crime. Within the NICC/INCC, the Forensic Science Department conducts scientific research to track down the perpetrators of crimes and establish the burden of proof. The Criminology Department studies criminal phenomena, and possible ways of dealing with them. The Criminology Department employs 25 researchers to carry out long-term criminological studies. A wide range of topics is covered: youth, victim policies, enforcement of sentences, functioning of law enforcement institutions, etc. The researchers analyse available data, but also carry out qualitative studies based

62. See: <https://www.sciensano.be/>

63. See: <https://incc.fgov.be/>

on interviews with key actors, observations, group analyses, etc. The results of the research are intended to provide a better understanding of criminal phenomena and the functioning of the Belgian State apparatus. Research into cyber-crime is in an early phase and will be developed further in the future.

2.3.5 Defence research institutes

The Royal Military Academy (RMA) is a military university charged with the basic academic, military and physical education of future officers, and with the continued training of officers during their career. It is organised in several academic departments that each conduct research and expertise. Research performed at RMA is supported by a number of laboratories hosting cutting-edge equipment and grouping high-level scientific and technical expertise. These laboratories are available to RMA researchers, the Belgian Defence and third parties.⁶⁴ The Royal Military Academy, as a federal university, is entitled to participate in research programmes set up and financed by other federal, regional or supranational entities and by industry, and it is successful in this respect.

The Military Hospital Queen Astrid (MHQA)⁶⁵ delivers support to military personnel in operations everywhere in the world with medical specialists and material: from small teams to a field hospital. The hospital watches over the health of military personnel, in order for them to stay operational and ready. Its 600 staff members offer specialised care in different areas. It also has an expertise centre to examine military candidates and specific groups (pilots, divers or para-commandos) and improve their physical condition. The Military Hospital offers specialised medicine in a number of areas such as emergency medicine and disaster medicine, acute and chronic treatment, and rehabilitation of people with severe burns, etc. The MHQA aims to develop further the medical activities around these expertise poles and to remain or become a reference centre in a number of domains at national and even European level.

The Defence Laboratories (Defensielaboratoria – Laboratoires de la Défense, DLD) in Peutie consist of several laboratories specialised in the fields of protection against chemical, biological, radiological and nuclear agents (the so-called CBRN area) as well as in petroleum (called POL) and textile products. As an expertise and competence centre in these various fields, the DLD have as their main mission to provide technical and scientific support to military operations, both abroad and on Belgian territory.

64. See: <https://www.rma.ac.be/node/339>

65. See: <https://www.hopitalmilitaire.be>

2.3.6 Royal Institute for International Relations

The Egmont Institute (also called the Royal Institute for International Relations⁶⁶) is an independent think-tank based in Brussels. Its interdisciplinary research draws on the expertise of its own research fellows, as well as that of external specialists, both Belgian and foreign. It provides analysis and policy options that are as operational as possible. It is part-funded by the FPS Foreign Affairs, Foreign Trade and Development Cooperation, Directorate-General for Bilateral Affairs. This Institute is essential to the policy research activities on international relations of the FPS Foreign Affairs and FPS staff are frequently involved in the Institute's activities. The FPS Foreign Affairs allocated an annual recurring subsidy of €250,000 to the Institute, which is devoted to the training of diplomats, officials and members of delegations from third countries. In addition, in 2021 the Institute was awarded €960,000 to maintain its role as a knowledge centre.

2.3.7 Other federal research organisations

Several other federal-level or funded organisations are important in the Belgian R&I system and are listed in the table below.

Figure 30: Other Belgium-wide research organisations

Institute	Main activities	Annual budget
Von Karman Institute for Fluid Dynamics⁶⁷	VKI is a non-profit international educational and scientific organisation, hosting three departments (aeronautics and aerospace, environmental and applied fluid dynamics, and turbomachinery & propulsion) with a permanent staff of over 130 and almost 250 research students (year 2020).	In 2020, the budget was €14 millions, of which 15% came from federal funding (BELSPO), 28% from international funding (e.g. NATO) and 54% from contract funding.
Fondation Biermans-Lapôte⁶⁸	This foundation located in Paris hosts students, researchers and professors from Belgium and Luxembourg and it supports scientific events.	In addition to a subsidy from BELSPO and the French government, this foundation receives donations, for example from the Brussels and Walloon Regions and the City of Antwerp.

66. See: <https://www.egmontinstitute.be>

67. See: <https://www.vki.ac.be/>

68. See: <https://fbl-paris.org/en/>

Institute	Main activities	Annual budget
Academia Belgica ⁶⁹	This foundation is the Centre for History, Arts and Sciences based in Rome, with an extensive library with a focus on history, art history, archaeology, theology and the history of science.	The FWO and the FWB provide visiting grants to scientists.
Euro Space Center ⁷⁰	This public theme park on space and space travel focuses on children, schools, families and other groups and it helps to raise science awareness.	Partly funded by BELSPO.

2.4 FUTURE R&I POLICY PERSPECTIVES

As mentioned in section 1.3, Belgium's overall R&I performance has improved over the last decade, thanks particularly to the strong growth in business R&D, which has strengthened Belgium's position as one of the EU's 'Innovation Leaders'. For the federal authorities, a key priority is to keep Belgium at the forefront of science and technology and to improve the competitiveness and innovation of Belgian industry.

Innovation is mostly the remit of the Belgium's regions. Nevertheless, the federal level has a strong role to play maintaining an effective range of fiscal incentives for R&I, and by facilitation, for example awareness-raising of IP, standards and norms. The 2021 European Semester report states that the administrative burden on firms is high in Belgium, particularly due to complying with tax and labour law and because of the many tax expenditures.⁷¹ A comparative review of the additionality of the nation's complete set of fiscal measures for R&I could contribute to simplification of the system for Belgian firms.

Upcoming international trends in the R&I context will bring both challenges and opportunities to the federal policy level. The shift of attention in R&I towards addressing (global) societal challenges (e.g. the European Green Deal, digitalisation, responding to the COVID-19 pandemic, climate change) will require even greater horizontal and vertical policy coordination. Belgium faces the challenge to develop more joined-up strategies across its different authorities and communities. In addition, there are added barriers to launching multi-disciplinary and multi-stakeholder research initiatives, due to the Federal Government's responsibility for thematic research programmes, institutes and initiatives allocated across multiple Federal Public Services (e.g. health, nuclear research and environmental research).

69. See: <https://www.academibelgica.it/>

70. See: <https://www.eurospacecenter.be/en/>

71. European Commission, Recommendation for a Council Recommendation on the 2020 National Reform Programme of Belgium and delivering a Council opinion on the 2020 Stability Programme of Belgium, COM (2020) 501 Final

72. Duchêne, V., W. van der Beken, J-F Romainville, A. Reid, Audit POD Wetenschapsbeleid, IDEA Consult, 2016.

In this context, the decision to create a ‘Centre of Excellence for Climate Research’ was confirmed in the Federal Government’s 2022 budget. Two million euro per year in funding will, in a first stage, be made available for the climate centre for the period 2022-2024, an increase of 20% on top of the €10 million per year already allocated to climate research at federal level. The centre will be located on the Uccle plateau in Brussels, which already hosts the Royal Meteorological Institute, the Institute for Space Aeronomy and the Royal Observatory of Belgium. This funding will support the development of a more coordinated research effort on climate-related topics in order to enhance synergies between the Federal Scientific Institutes, universities and regional research institutes and to provide input to the development of climate policy initiatives in Belgium.

The federal policy level already fulfils an important role as coordinator between the international and regional policy levels, as illustrated in previous paragraphs by the many coordination platforms in place in the R&I domain. Earlier studies⁷² have shown that there are currently too many coordination platforms in Belgium that have been inactive and have no clear ownership. In order to keep up with the growing need for (efficient) policy coordination and transversal policy approaches, there is a need for sustained financial and human resources and ownership. Yet this has been hampered by financial and staffing restrictions in federal science policy in the previous years. The new Federal Government in place since 2020 has stated that these restrictions will be relaxed.⁷³ This will enable a rethink of the role of BELSPO as a science policy knowledge hub for the Belgian R&I system and in relation to European programmes. In particular on emerging topics (e.g. cybersecurity or quantum communication) where a critical mass of knowledge is not yet available at regional level, BELSPO could play a pioneering role on behalf of the Belgian R&I community.

The trend towards broader multi-disciplinary research approaches will also be fostered by greater cooperation between the Federal Scientific Institutes and universities in all Belgian regions and communities. The FED-tWin programme has made a good start to reinforce these inter-institutional networks of researchers. This type of scientific cooperation has the potential to grow much stronger in the future, in order to build stronger Belgian R&I eco-systems, acting as leading partners in European and international R&I landscapes.

73. In November 2020, the new Federal Government under Prime Minister De Croo published its Policy Statements for the Federal science policy

74. European Commission, Digital Economy and Society Index (DESI) 2020, Thematic chapters, <https://digital-strategy.ec.europa.eu/en/policies/desi>

In a country where responsibilities are so fragmented, another policy challenge for Belgium is to achieve a coherent digitalisation policy across relevant societal and economic domains. The 2015 Federal Government strategy Digital Belgium set the ambition for Belgium to be in the top three of the European Digital Economy and Society Index (DESI) by 2020. Nevertheless, in the 2020 DESI, Belgium ranks ninth, showing only average progression in the last five years.⁷⁴ A new federal Digital Agenda was to be published in 2021, alongside Digital and Artificial Intelligence strategies in place in the regions. In the digital R&I domain, connections to large international initiatives such as the European High Performance Computing Joint Undertaking (EuroHPC) and the European Open Science Cloud (EOSC) and the European Quantum Computing Infrastructure (EuroQCI) require a coordinated approach. A strong federal coordination role here is clearly important.



**OVERALL POLICY FRAMEWORK
AND PRIORITIES**

**ACTORS AND INSTRUMENTS
OF R&I POLICY**

**MAIN RESEARCH
AND INNOVATION ORGANISATIONS**

**FUTURE R&I POLICY
PERSPECTIVES**

3 FLANDERS

As mentioned in section 1, the Belgian constitutional reform process resulted in a merger of the regional and community competencies into a single Flemish Parliament and Flemish Government. The Flemish Parliament debates and approves all legislative proposals pertaining to both community and regional competence, whilst the Flemish Government is charged with policy decisions and execution in both competencies. The Flemish Parliament and Flemish Government are assisted by consultative bodies and an administration, consisting of departments and agencies, responsible for respectively policy preparation and implementation.

In 2020, the overall policy budget of Flanders' government was €47.9 billion, of which €401 million is used for economic policy and €3.64 billion is allocated to science and innovation policy. Following the Frascati Manual definitions, the latter budget can be broken down as Research & Development (R&D, €1.85 billion), Scientific and Technical Education & Training (STET, €1.66 billion) and Scientific and Technological Services (STS, €132 million).

In the 2021 edition of the EU's Regional Innovation Scoreboard (RIS), Flanders is classified among the 38 innovation leader regions out of 240 regions in the EU. Some of the region's most noteworthy strengths relative to other EU regions include the strength of its science system (in terms of most cited publications as well as international and public-private co-publications), the R&D expenses in the business sector and innovative SMEs collaborating with external partners (as a share of all SMEs). The region scores below the EU average on lifelong learning. In the 2016 Community Innovation Survey, Flanders ranked third during the period 2014-2016 in the list of individual indicators, with the highest proportion of enterprises with innovation activity (product, process, organisational or marketing innovation) with a score of 68.5% (versus 68.1% for Belgium), behind Switzerland (72.1%), Norway (71%) and ahead of Portugal (66.9%), and Finland (64.8%). The EU average is 50.6% of enterprises of 10 employees or more that reported innovation activity during the period 2014-2016. In 2019, Flanders attained an R&D intensity of 3.35% (up from 2.93% in 2018), reaching the 3% target for the first time and ranking the region in second place in Europe. Of this total, 2.55% was privately funded while 0.8% came from public sources.⁷⁶

3.1 OVERALL POLICY FRAMEWORK AND PRIORITIES

In recent decades, the Flemish Government has developed, in consultation with the social partners, a broad-based R&I strategy that is implemented through a diverse policy set of policy instruments and budgetary allocations. Since the mid-1990s, Flanders has increased, in absolute and relative terms, government budgetary appropriations to R&D. Consequently, in 2018, the direct public R&D-support of the Flemish Government (GBARD) represented 55.02% of the total public R&D budget of all the Belgian authorities. Flemish R&I policy development is laid down, together with economic competence domains, in the coalition agreement, policy initiatives and notes, including:

- ▶ A government coalition agreement in which the various political parties that are part of the

76. See: <https://www.ewi-vlaanderen.be/nieuws/vlaanderen-doorbreekt-voor-het-eerst-3-norm-oo-bestedingen>

- governing coalition define their priorities for the five-yearly parliamentary term;
- ▶ The policy note of the minister responsible with scientific research and innovation for the five year period (part of an overall policy document for Economy, Science and Innovation);
 - ▶ The annual policy letter of the minister, that further introduces the initiatives as announced in the policy note (part of an overall policy letter for Economy, Science and Innovation). Since 2021, the yearly policy letter is integrated in one document, the yearly Policy and Budget Explanatory note for the policy domain Economy, Science and Innovation.

In addition, several multi-annual strategic plans and targets are agreed with a broad group of stakeholders from government, civil society and industry. These plans set out visions, ambitions and targets across a range of policy fields, amongst which R&I is clearly a cross-cutting priority. These plans include *Flanders 2050 (VISIE 2050: a long-term strategy for Flanders)* and *Vizier 2030* (the translation of the Sustainable Development Goals to the Flemish context) and, in 2020, *'Vlaamse Veerkracht (Resilience Flanders)'*. The Flemish Reform Programme for the Europe 2020 strategy (under the European Semester) recaps the main policy intentions of the government as elaborated in the above-mentioned documents. To support recovery from the COVID-19 pandemic, the National Reform Programme 2021 was integrated into a single document with the recovery and resilience plan. This document sets out the reforms and public investment plans for Flanders and Belgium to use the €5.96 billion allocated by the EU for Belgium, of which €2.26 billion is provided for Flanders via the EU Recovery and Resilience Facility – NextGenerationEU (see also 3.4).

In its government coalition agreement 2019-2024, the Flemish Government states the ambition to become one of the top five innovative knowledge regions in Europe, as measured by the Regional Innovation Scoreboard indicators. International excellence remains the most important goal of its research policy, both in basic and applied research. The Flemish Government has committed to reach the target of spending 3% of GDP on R&D by 2024. This commitment is translated into €195 million one-off investments in R&D-infrastructure during this period, and an increase of €250 million in the annual R&I-budget. The government will also focus on continued implementation of the quadruple helix model.

The policy priorities on scientific research and innovation in the policy document 2019-2024 tie into six cross-cutting strategic ambitions:

1. Allow local entrepreneurship to flourish
2. An integrated industrial policy for the future
3. Regional specialisation in regions and provinces
4. Successful entrepreneurship in the digital society
5. Innovation for climate-neutral solutions in industry
6. Sustainable growth through a knowledge-driven circular economy

Achievement of these cross-cutting ambitions is supported by measures that cover the economy, scientific research, innovation, and science communication categories. Apart from the above-mentioned (further) implementation of the quadruple helix model (see 3.3), another characteristic of Flanders' policy for the coming years is focusing more on mission-oriented approaches (see section 3.4).

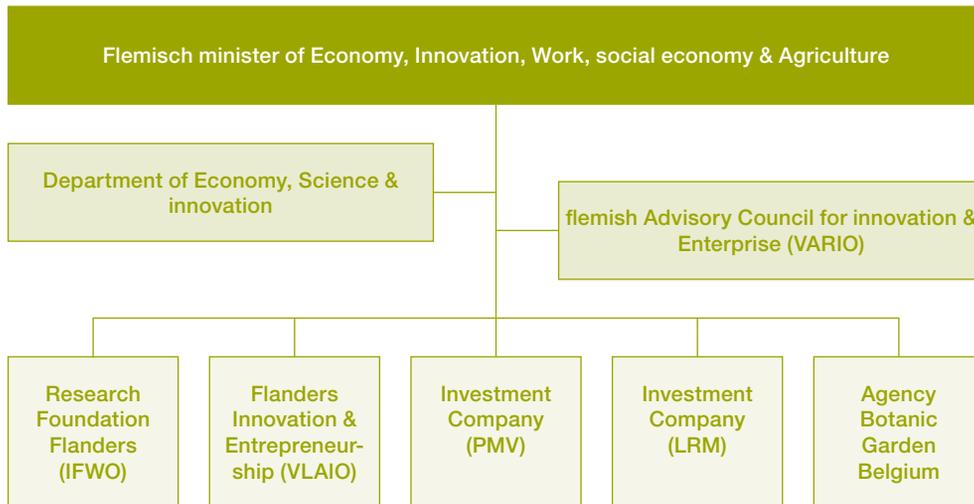
3.2 ACTORS AND INSTRUMENTS OF R&I POLICY

A wide range of actors and stakeholders are involved in the Flemish R&I system: public administrations and funding agencies, knowledge institutes and centres, universities and university colleges, scientific institutes, public research organisations (PROs), university hospitals, various collective research centres, incubation centres, cluster and network organisations, private companies, professional (technology and other) intermediaries, etc.

Science and basic research (community competencies) and innovation and applied research (regional competencies) are discussed in one specific commission in the Flemish Parliament: they are managed by a single minister responsible for scientific research and innovation and economy, assisted by an advisory council (VARIO) and a single administration department EWI responsible for preparing all related policy issues. At implementation level, Flanders Innovation & Entrepreneurship (VLAIO) manages the regional innovation and economic support competencies; while for the community competencies, the Research Foundation Flanders (FWO) support research at universities, university colleges, scientific institutes, etc. of the Flemish Community located in Flanders and in the bilingual Brussels-Capital Region.

Figure 31 provides an overview of the public bodies that are active in the R&I policy area in Flanders.

Figure 31: Main public bodies in the R&I policy field in Flanders



Source: EWI Department

3.2.1 Policy advice

The Flemish Advisory Council for Innovation and Enterprise (Vlaamse Adviesraad voor Innoveren & Ondernemen, VARIO) advises the Flemish Government and the Flemish Parliament on its R&I industry and entrepreneurship policy. The VARIO has existed since 2017⁷⁷ and issues opinions on its own initiative or on request. It works independently from the Flemish Government and the Flemish stakeholders in the field of R&I, industry and enterprise. It is formally an entity of the Flemish policy department of Economy, Science and Innovation (EWI). The Social and Economic Council of Flanders (SERV) is formally part of the policy department Public Governance and the Chancellery. Various Flemish employer organisations and trade unions are represented in the SERV, which provides policy advice on socio-economic topics

3.2.2 Government departments

3.2.2.1 The Department of Economy, Science and Innovation (EWI)

The role of the EWI Department is to prepare, develop, evaluate and monitor public policy in the field of science and innovation, economic support and entrepreneurship, thereby contributing to greater wealth and well-being in Flanders. Its levers are the promotion of:

- ▶ Excellence in scientific research;
- ▶ An attractive and sustainable business climate;
- ▶ A creative, innovative and entrepreneurial society.

The strategic aims of the EWI Department for R&I are to:

- ▶ Create a sustainable economic tissue and facilitate entrepreneurship;
- ▶ Stimulate innovation and creativity;
- ▶ Stimulate knowledge creation and knowledge valorisation;
- ▶ Put Flanders on the map internationally in the field of economy, science and innovation;
- ▶ Develop itself as a knowledge centre within the Flemish authority for delivering and use of insights in the field of economy, entrepreneurship, scientific research and innovation.

More specifically, within the R&I field and economic support field, the EWI Department:

- ▶ Prepares legislative initiatives or position papers in the field of science, research and innovation;
- ▶ Stimulates cooperation between research institutions, higher education institutions and companies;
- ▶ Prepares multi-annual management agreements with several organisations, such as the four Flemish strategic research centres, the Research Foundation Flanders (FWO), the Flanders Marine Institute (VLIZ), etc.;
- ▶ Evaluates management agreements, policy instruments and organisations receiving public support;

77. Previous versions of the council were the 'Vlaamse Raad voor Wetenschap en Innovatie' (VRWI, or Flemish Council for Science and Innovation, 2010-2016) and the 'Vlaamse Raad voor Wetenschapsbeleid' (VRWB, or Flemish Science Policy Council, 1985-2009).

- ▶ Coordinates all R&D&I topics in Flanders, and is represented in the governance activities such as expert groups and committees of the EU Framework Programme for R&I (Horizon 2020/Horizon Europe), Digital Europe Programme (DEP) and COSMEplus in the Single Market programme;
- ▶ Has a representative in the General Representation of the Flemish Government to the EU within the Permanent Representation of Belgium to the EU, following up on European Council activities;
- ▶ Participates in advisory groups of the European Commission (e.g. the European Research Area and Innovation Committee) and OECD (e.g. the Committee for Scientific and Technological Policy, CSTP);
- ▶ Monitors the implementation of strategies (e.g. smart specialisation), policy measures and reports on policy developments in the R&I domain to the Flemish, federal and international (mainly EU and OECD) policy level;
- ▶ Directly follows up the implementation of several policy (support) instruments, specific on-off initiatives, participates in network organisations and takes a representational role.

Examples of these are the support for the BOF (Special Research Fund), the IOF (Industrial Research Fund), and the PWO (practice-oriented scientific research at university colleges), governmental representatives in strategic research centres or public knowledge organisations, fee-based membership, e.g. of EMBRC (European Marine Biology Resource Centre).

In the Council of the European Union meetings on European research and innovation policy, Flanders is one of the authorities directly involved in the preparation of decisions within the Council, and takes its turn to represent Belgium according to a rotation system agreed with the other authorities. The meetings of the Council Working Group are attended by the Flemish attaché for research and innovation, who is assigned to (and is an integral part of) the Belgian Permanent Representation to the EU. Principal fields of action include the Framework Programme for Research and Innovation, the European Research Area (ERA) and all related R&D&I matters in the broadest possible sense (e.g. Widening Participation (the former SFIC), ESFRI/IRI, etc.).

Active involvement in the EU research and innovation policy development includes:

- ▶ Preparation and follow-up of the Flanders/Belgian ministerial positions within the EU Competitiveness Council (Research);
- ▶ Preparation and participation in the meetings of the ERA Committee (ERAC), the entity that advises the European Commission, the Council and the EU Member States on the European Research Area, such as the Belgian representation in the new ERA Forum for Transition;
- ▶ Contributions to policy reporting, such as various ERA working group reports, the report of the Research and Innovation Observatory (RIO), the EC/OECD publications, etc.;
- ▶ Active involvement in the discussions of the expert groups/programme committees of the programmes under the new EU Multiannual Financial Framework 2021-2027, such as the Digital Europe Programme, Connecting Europe Facility 2, Horizon Europe, and ERDF/interreg;
- ▶ Participation in open public consultations and new working groups launched by the European Commission involving stakeholders to give their views on new EU initiatives in the field of scientific research and innovation;
- ▶ Horizon EU and COSME programmes (2021-2027): preparation of the programme themes,

- Belgian representation as programme committee members in Horizon 2020 and its successor Horizon EU, COSME, Digital EU, the ERA networks, and other initiatives;
- ▶ Participation in policy development of various Horizon EU initiatives (such as Missions), in States Representative Groups of Partnerships (the former Joint Technology Initiatives (JTI) and Joint Programming Initiatives (JPI) under Horizon 2020 in 2014-2020), ESFRI/IRI (international large research infrastructure), the European Institute for Technology (EIT), European Research Council (ERC) and the EIC forum of the newly established European Innovation Council (EIC) under the Horizon EU programme, etc.;
 - ▶ Participation on a bilateral basis (between the Commission and Belgium) in the European Semester reporting (e.g. Flanders/Belgian Recovery and Reform Plan).

In addition to its work at EU level, EWI also has a representation role for Belgium or Flanders for the preparation and follow-up of the policy recommendations of various international organisations. This includes the Organisation for Economic Co-operation and Development (OECD) and the United Nations (UN). For the OECD, this involves among others participation in the Global Science Forum, the Steel Forum, the Committee on Science and Technological Innovation Policy (CSTP), the Technology and Innovation Policy (TIP), National Experts on Science and Technology Indicators group (NESTI), the Working Party on Biotechnology, Nanotechnology and Converging Technologies (BNCT) and in thematic subgroups on, for example, ICT, biotechnology, and researchers' mobility. It makes a substantial contribution to the OECD's STI Outlook report (as of 2016: the STI Policy (STIP) report).

At UN level, the EWI Department manages the Flanders UNESCO Science Trust Fund (FUST: capacity building in development countries), the Flanders UNIDO Science Trust Fund for Industrial Biotechnology (FUSTIB), the United Nations University Institute on Comparative Regional Integration Studies (UNU-CRIS) and the project office of the Intergovernmental Oceanographic Commission (IOC) of UNESCO for IODE (International Oceanographic Data and Information Exchange) at Ostend.

Furthermore, the EWI Department prepares and monitors memoranda of understanding (MoU) to be officially signed and concluded with administrations or ministers charged with R&D&I during ministerial missions abroad, official visits of foreign delegations to the Flemish minister or to public EWI entities, etc. The EWI Department also hosts, or takes part in, the Flemish and multilateral delegations in visits to Flanders. Conversely, it can be a part of, or represented in, Flanders' delegations for a mission abroad. Through initiatives like the 'Flanders Inspires International Visitors Programme' (FIIVP), the EWI Department presents Flanders' investment priorities and strengths in the fields of economy, science and innovation, and it learns from best practices of other countries and regions. The FIIVP has been on-going since 2010 and is inspired by the US 'International Visitor Leadership Program'.

3.2.3 Other bodies of public interest in the field of science and innovation

Long-standing public institutions of the Flemish Community play an important promotional, advisory and societal dissemination role with regard to their academic activities.

The Koninklijke Vlaamse Academie van België voor Wetenschappen en Kunsten (KVAB, Royal Flemish Academy of Belgium for Science and the Arts), established in 1772, is an independent learned society for the practice and promotion of science and arts. To achieve this goal, the Academy organises an array of scientific and cultural activities. It also encourages collaboration between the Flemish universities, it delegates representatives to international organisations and discussion meetings (contact-forums), and it attracts foreign scholars to develop research activities. The KVAB advises on matters of social importance on behalf of the government, industry, educational institutes and research centres. Finally, the Academy awards prizes to talented and promising researchers and artists.

The Koninklijke Academie voor Geneeskunde van België (KAGB, Royal Academy of Belgium for Medicine), active in the field of medicine, pharmacy, animal medicine, and related sciences. It aims to promote scientific research through the award of scientific prizes, organise lectures and meetings, and scientific publications. Moreover, it provides advice to the Flemish and Federal Governments on scientific practice, education and training, and professional practice in the health field.

The Koninklijke Academie voor Nederlands Taal- en Letterkunde (KANTL, Royal Academy for Dutch Language and Literature) was established in 1886. It promotes Flemish culture and literature, as well as research on the Dutch language, culture and literature.

Stichting Technologie Vlaanderen voor Innovatie en Arbeid (STV voor Innovatie en Arbeid, the Flanders Foundation for Technology Assessment in Innovation and Work), which is a part of the SERV (see 3.2.1) and acts as a knowledge centre in the field of organisational and technological changes related to employment. It conducts policy-related research for the Flemish employers' and unions' associations and it advises the Flemish Government.

The Vlaamse Academische Stem (VLAST, Flemish Academic Centre for Science and the Arts) is a non-profit organisation supported by both the KVAB and the KANTL. It promotes science and culture in Flanders through lectures and congresses, awarding prizes, etc.

Since 1994, the popularisation of science, technology and innovation has been considered an essential part of the Flemish R&I policy and was until recently implemented in a Science Communication Policy Plan 2015-2020. The objectives were to strengthen the scientific and technological potential of all citizens, and in particular of youngsters. Too few young people opt for science and technology disciplines in education. Increasing the scientific literacy of society at large is also an important goal.

A number of research actors contribute to science communication: the Science Centre Technopolis (www.technopolis.be), the Science Communication Expertise Centres at the Universities and Colleges, RVO-society (www.rvo-society.be), and several others are involved. Their specific areas of interest and their activities are posted on the digital platform 'Science information Network' (Wetenschapsinformatienetwerk). Media such as the Flemish Radio and Television Broadcasting (VRT), and the science popularisation publisher EOS (www.eos.be) are also involved in reaching out to citizens (see 3.3.5).

3.2.4 Implementing agencies

3.2.4.1 Flanders Innovation & Entrepreneurship (VLAIO)

Flanders Innovation and Entrepreneurship (Agentschap Innoveren en Ondernemen) is a public funding agency, charged with implementing the research, innovation and economic support programmes for enterprises in Flanders. It helps to start-up companies, not only by supporting growth through innovation but also by providing information and advice for location decisions, permits, IP, financing, sustainable and innovative technological investments, and other topics. VLAIO is a partner in the COSME-funded FIT-VLAIO Enterprise Europe Network (EEN) Flanders partnership. It also acts as the National Contact Point (NCP) for the EU R&I Framework Programme and is the managing authority for the Flanders ERDF/Interreg operational programmes. VLAIO manages all economic and innovation support measures for Flemish companies and innovators. Since 2021, it has also provided support for companies affected by the UK withdrawal from the EU and by the COVID-19 restrictions. In 2019, VLAIO had a staff of 335 and administered a budget of €775 million.

VLAIO is the managing authority for the Flemish regional operational programme (ROP) co-financed by the European Regional Development Fund (ERDF). During 2014-2020, the ROP was implemented across the whole of Flanders, with specific strategies for certain sub-regions (Limburg, West-Flanders, Kempen) or cities (Antwerp, Ghent). The ERDF budget of €175 million for the programme period 2014-2020 was complemented by the regional contribution with the total financing of approximately €415 million, distributed over four priority axes:

- ▶ Axe 1: Strengthening research, technological development and innovation;
- ▶ Axe 2: Enhancing the competitiveness of small and medium-sized enterprises;
- ▶ Axe 3: Supporting the shift towards a low-carbon economy in all sectors;
- ▶ Axe 4: Sustainable urban development.

Research and Innovation Strategies for Smart Specialisation (RIS3) was in 2014-2020 an *ex-ante* conditionality document for the ERDF programming. Figure 32 shows the smart specialisation domains that formed the basis for Flanders' R&I policy (first column) and the cluster domains specified in the ERDF *ex-ante* document (second column).

Figure 32: Correspondence of Flanders smart specialisation domains and ERDF programme (2014-2020)

Flanders Smart Specialisation Priorities	Flanders ERDF programme
▶ Sustainable chemistry	▶ Sustainable chemistry
▶ Advanced materials	▶ Manufacturing industry and materials
▶ Smart manufacturing	
▶ Health and life sciences	▶ Healthcare
▶ Specialised logistics	▶ Specialised logistics
▶ Agro-Food	▶ Agro-Food
▶ Electronic systems, IoT and photonic systems	▶ Electronic and photonic systems
▶ Energy	▶ Energy, environment and construction
▶ Environment & cleantech	
▶ Blue economy	
	▶ Creative industries

The second strand of the ERDF aims to foster cross-border, transregional and interregional cooperation (ERDF/Interreg). Flanders is involved in cooperation with bordering regions in the programmes Flanders-Netherlands, Euregio Meuse-Rhine, France and 2 Seas; as well as transnational programmes (North Sea Region and North-West Europe) and interregional programmes thematic cooperation such as the URBACT and INTERACT programmes.

VLAIO was established in 2016 after a merger of the Agentschap Ondernemen (AO, Enterprise Flanders) with the ‘Agentschap voor Innovatie door Wetenschap en Technologie’ (IWT, Agency for Innovation by Science and Technology). As of 2016, VLAIO acts as the one-stop-shop for companies. In 2020, the entrepreneurship training activities of Syntra Vlaanderen were integrated into VLAIO.

In the field of innovation support, VLAIO assists companies, research centres and knowledge centres in realising their research and development projects, by offering funding, training and advice and a network of potential partners in Flanders and from abroad. To achieve this, it has different types of instruments at its disposal:

- ▶ Direct funding: supporting the innovative projects of companies, research centres, collective research initiatives, organisations and individuals.
- ▶ Advice and services: offering support to all Flemish SMEs and large companies and research centres by helping them with their project applications or by providing technological advice during their innovative projects.
- ▶ Coordination and networking: stimulating cooperation by bringing innovative companies and research centres into contact with Flemish intermediate organisations that stimulate innovation; to this end, VLAIO manages a broad network of partner organisations and works closely with ‘Team Bedrijfstrajecten’ (a merger of the former five provincial innovation centres under VLAIO).

- ▶ Policy development: supporting the Flemish Government in its innovation policy; e.g. by studying the effectiveness of their innovation initiatives and different support programmes.

VLAIO supports all types of innovators in Flanders:

- ▶ Companies that are actively innovating, from small start-ups to multinationals with a branch in Flanders. Specific attention is paid to SMEs, although partnerships between companies and knowledge centres are also eligible for innovation support.
- ▶ As of 2016, VLAIO supports cluster initiatives, including several 'innovative business networks' as well as a few spearhead cluster organisations (see 3.2.5.3).
- ▶ Individual researchers and research centres can apply to VLAIO for support and they can also receive funding, advice and contacts with potential partners for innovative scientific research, applied research and technology transfer.
- ▶ Organisations of various types (e.g. collective research centres) that stimulate innovation in Flanders can receive financial support.

The agency basically applies a bottom-up approach in its programmes: any project idea proposed by the actors themselves and including an innovation component from any technological area, is eligible for funding and advice. VLAIO monitors its bottom-up policy instruments to broaden and deepen the innovation trajectory, as well as to adapt this trajectory to specific needs.

The support schemes are aimed at businesses (both SMEs and large companies), research organisations, service providers, non-profit organisations, and individuals. The main support instruments for R&D and innovation are:

- ▶ R&D business projects provide direct support for research or development projects to companies, non-profit or public organisations that are active in the Flemish Region. In 2020, the budget for research projects was €130 million while development projects received €87 million in subsidies. In 2019, 159 applications for research projects were submitted: 86% of those evaluated receiving funding, while out of 498 submitted development projects 87% of those evaluated were subsidised.⁷⁸
- ▶ Both Baekeland and Innovation mandates fund researchers to conduct research with a specific business-oriented purpose, closely linked to a company (€16.8 million in 2020).
- ▶ COOCK (Projecten 'Collectief Onderzoek & Ontwikkeling en Collectieve Kennisverspreiding/-transfer), focuses on groups of companies with the aim of valorising (basic) research results by accelerating the introduction of technology and/or knowledge (€9.6 million in 2020).
- ▶ Support for cooperation and the dissemination of knowledge, e.g. through the TETRA fund aimed at applied research projects (€9.6 million in 2020) or Agricultural Innovation Projects (€10.3 million in 2020).
- ▶ Co-financing in European projects (ERA-Net, JTI/partnerships, Eurostars, EUREKA) (see 3.3.6).
- ▶ Spearhead clusters and Innovative Business Networks (see 3.2.5.3).
- ▶ Living labs are structured pilot environments in which organisations can test innovative technologies, products, services and concepts, using a representative sample of individu-

als, who act as test users. Current Living Labs are active in the fields of Industry 4.0 and Smart Cities.

3.2.4.2 Research Foundation Flanders (FWO)

The Research Foundation Flanders (Fonds voor Wetenschappelijk Onderzoek Vlaanderen, FWO) is an EWI agency that supports ground-breaking basic and strategic research at the universities of the Flemish Community. The FWO also stimulates cooperation between the Flemish universities and other research institutes and it promotes equal opportunities (e.g. gender). The FWO funds both excellent and promising researchers, as well as research projects, following an interuniversity competition and an evaluation by national and international experts. The only criterion is the outstanding quality of the researcher and the research project proposal. Researchers can apply to FWO for support in a broad range of funding instruments.

A system of peer review by the scientific community is used to assess all applications and scientific activity reports. To this end, the FWO has organised several scientific committees, including top researchers from Belgium and abroad. The FWO's scientific committees, called 'FWO Experts Panels', are crucial to ensuring the excellence of FWO-funded activities. Expert Panels are specialised committees for a specific scientific research discipline. There are also interdisciplinary committees, which cover all the scientific research disciplines of Flemish concern. Each committee consists of several experts, the majority always being affiliated to a non-Flemish university.

The main support instruments of the FWO are fellowships (PhD students, post-doctoral researchers, etc.) and research and project grants. Furthermore, extensive budgetary means are available for research infrastructure,⁷⁹ promoting international cooperation and mobility, including participation in multilateral initiatives or in 'big science' research facilities, such as CERN. The latter is covered in the International Research Infrastructure (IRI) programme, which supports the Flemish participation in and/or funding of international investment initiatives that are carried out at large-scale international or supranational facilities to which the Flemish Government contributes and/or whose strategic importance for Flanders can be demonstrated. Besides the IRI, the FWO supports medium- (from €150,000 to €1 million) and large-scale (above €1 million) infrastructure, which comprises all facilities and sources that promote the performance of cross-border and strategic basic research across all scientific disciplines. In addition to scientific infrastructure in a strict sense, these disciplines includes collections, natural habitats, corpora and databases. The FWO also manages the Flemish Supercomputer Centre (Vlaams Supercomputer Centrum – VSC), a virtual partnership between the five Flemish universities and their university associations. This consortium brings together know-how in scientific and technical computing (including high-performance computing, high-throughput computing, cloud computing and data processing) in Flanders, and hosts infrastructure in four hubs: the data centres of the universities of Antwerp, Brussels, Ghent and Leuven. Finally, the FWO also awards scientific prizes to distinguished researchers, often in collaboration with private companies.

79. A list of regional as well as international large-scale research infrastructures has been compiled by EWI and can be found at <https://www.vlaanderen.be/publicaties/large-scale-research-infrastructure-in-flanders-flemish-participation-in-international-research-infrastructures-2020>.

Since 2019, a new Governing Agreement between the FWO and the Flemish Government has been concluded. This Governing Agreement 2019-2023 sets out the strategic and operational goals for the coming period. New elements in this Governing Agreement include the specific attention to and monitoring of open science (Open Access and Open Data), the expansion of international and intersectoral mobility, the monitoring of output and impact of the different programmes, more attention for breakthrough, inter- and transdisciplinary research and research collaboration and the audit of the panel structure. The overall part of the annual budget of the FWO is granted by the Flemish Government and amounts to approximately €335 million.

FWO acts as National Contact Point (NCP) in Horizon 2020 and for the EU (along with VLAIO) and for COST (along with the EWI Department). FWO also participates in joint calls for ERA-Nets, it funds excellent ERC-applicants who have obtained a Seal of Excellence, and provides a ‘top-up’ budget for participation (of on-going FWO projects) in joint calls for Joint Programming Initiatives. The FWO cooperates with its European and international sister organisations in various networks and with other European research organisations or similar institutions, such as the European Science Foundation (ESF), Science Europe, Centre Européen de Calcul Atomique et Moléculaire (CECAM), and the European Centre for Theoretical Studies in Nuclear Physics and Related Areas (ECT).

3.2.4.3 PMV – Flanders Holding Company

PMV (ParticipatieMaatschappij Vlaanderen) is an investment company that provides funding for promising businesses in Flanders, from their very start, through their various growth stages and even on to operating internationally. PMV also provides financing and expertise for the transition to sustainable energy, the renovation of immovable heritage (historical and cultural important buildings, etc.), investment in infrastructure and the efficient (re)use of space in Flanders. PMV also functions as the National Promotional Bank (NPB) for Flanders under the InvestEU programme. To lower the hurdle for entrepreneurs to find financing, PMV no longer communicates about its different ‘products’. Instead, it now invites companies to come and discuss their financing needs, on the basis of which PMV will offer them the right financing mix. PMV can provide capital, loans or guarantees or a combination of these, while also having a fund-of-funds activity. With these instruments, PMV offers tailor-made solutions as well as standard instruments such as the Waarborgregeling (guarantees), Startlening (starting loan), Win-winlening (a loan provided by friends or family, but partially guaranteed by the region) or Cofinanciering (co-financing). PMV will always investigate whether co-investment of other private parties is possible.

PMV also provides fiduciary management of some assets of the Flemish Government. One recent example is the Flanders Future Tech Fund (FFTF). This fund, set up in 2019 with an initial €75 million injection by the Flemish Government, aims at addressing the market failures surrounding new platform technologies that are being developed within Flanders’ strategic research centres (see 3.3.2), universities (see 3.3.1) and spearhead clusters (see 3.2.5.3). As the name ‘platform technologies’ suggests, these technologies can be used in a vast array of applications. The development towards different applications, however, is highly capital intensive. Consequently, and in order to attract private investments, researchers tend to focus on single applications that can reach the market the fastest, thereby giving up on the other possible ap-

plications. The Flanders Future Tech Fund supports the ‘multi-valorisation’ of these technology platforms, rather than their development into a single application.

In 2019, €65.3 million in loans, €172.6 million in capital and €348.2 million in guarantees were granted through PMV, and €241 million in capital was committed through 25 investment funds. To support companies affected by the COVID-19 pandemic, PMV has increased the financial capacity of its measures and launched new crisis measures.

3.2.4.4 Limburg Reconversion Company (LRM)

LRM is an investment company that develops and stimulates economic growth in the Flemish province of Limburg. LRM targets all sectors and companies, from starting companies to growing SMEs and larger businesses. LRM provides lending and venture capital to companies that have a link with Limburg and it is a catalyst for the transition towards an innovative and technological economy. LRM is developing qualitative clusters within the spearhead sectors in Limburg. In addition, LRM develops infrastructure, such as campuses and incubators, and gives former mining sites a make-over. LRM focuses on the following four investment domains: sustainable societies, health & care, smart services & manufacturing, and leisure & heritage experience. In 2021, LRM has invested 73.9 million euros in 80 Limburg companies and projects.

3.2.5 Innovation intermediaries

There are several intermediaries, facilities and network structures that link government agencies, research organisations and companies with a view to stimulation of networking and cooperation.

3.2.5.1 Infrastructure: science parks and incubators

In Flanders, many science parks, research parks and incubator facilities are available for research-based young companies and innovative enterprises: these are often spin-off companies from a university or a public research organisation located close to the knowledge centre. In some cases an incubator is specifically oriented towards a particular scientific area. These sites provide an excellent environment for high-tech, R&D-intensive start-up firms, often cooperating with university laboratories. Universities and strategic research centres are increasingly able to professionally guide spin-off companies, e.g. on their financial structure, administrative support issues, or finding the right CEO. An important trend is the establishment and development of different types of incubators. Examples include the Zwijnaarde technology park⁸⁰ near Ghent, hosting the incubation and innovation centre of Ghent University (UGent) and the bio-incubator of the VIB (biotechnology). Leuven hosts the bio-incubator at the Arenberg Science Park, the Innovation and Incubation Centre (I&I), and the Haasrode Business and Research Park.⁸¹ The VLAIO agency supports these science parks and incubators through both regulatory and financial means.

80. See: <http://www.techlane.be/about/>

3.2.5.2 Financial intermediaries

Gimv (Flanders Investment Company) established by the Flemish Government in 1980 is a European-oriented investment company focused on promising high-tech companies. It has 40 years of experience in equity and venture capital and has been listed on Euronext Brussels since 1997. It manages approximately €1.2 billion in investments in 50 portfolio companies with high growth potential. Its four investment platforms are: Connected Consumer, Health & Care, Smart Industries and Sustainable Cities. With 26.8% of its shares, the Flemish Government is the largest reference shareholder of Gimv. Other private risk capital providers in Flanders include the large banks in Belgium as well as specific funds such as Capital@Rent, Capricorn, Down 2 Earth Capital, Falcon Fund and Hummingbird Ventures.⁸² In addition, there are funds linked to the Flemish universities or the strategic research centres (see 3.3.2). Examples of these are:

- ▶ the Gemma Frisius seed capital fund (KU Leuven);
- ▶ the multi-sector Qbic Fund (UGent VUB, UA and VITO);
- ▶ Imec.xpand, aimed at start-up companies in the sector of Internet of Things (IoT);
- ▶ Imec.iStart offering coaching, support and infrastructure to technology start-up companies (ranked in the top five of UBI Global rankings);
- ▶ V-Bio Ventures Fund (VIB) investing in European start-up companies and young companies in biopharmaceuticals, diagnostics, and agricultural improvements. It was initially set up by the Flemish Government, which still holds a minority stake in the company.

Business Angels Network Flanders (BAN Vlaanderen) is a platform in which starting or growing entrepreneurs seeking risk capital are matched with informal private investors. The business angels offer not only money but also their own know-how, experience and contacts. BAN Vlaanderen is a marketplace where demand and supply meet, rather than an investment fund.

FINMIX is a VLAIO programme for companies with innovative growth ambitions or take-over plans, that aim for capital financing. It helps these businesses to pitch their financial plan to an expert panel that will provide advice on the best finance mix.

3.2.5.3 Clusters and Networks

On 4 March 2016, the Flemish Government approved the decree regulating support for innovation clusters in Flanders. The objective of the cluster policy is to unlock untapped economic potential and to increase the competitiveness of Flemish companies through active and sustainable cooperation between actors. The policy, which falls under the responsibility of the agency VLAIO (see 3.2.4.1), focuses on partnerships between Flemish companies and knowledge centres. These companies are characterised by their growth ambitions, a high level of innovation awareness and their international outlook. In addition, they must be open to cooperation with other companies and knowledge centres, both for the achievement of their individual business objectives and for contributing to an increase in the competitiveness of a large group of Flemish companies through innovation.

81. An overview of business centres and incubators in Flanders can be found at <https://www.vlaio.be/nl/andere-doelgroepen/foreign-investors/informationforeign-investors/finding-right-location>.

82. An overview of risk capital providers in Flanders can be found at <https://www.vlaio.be/nl/publicaties/overzicht-van-de-risicokapitaalverschaffers-vlaanderen>

Within the cluster, a cluster organisation acts as the facilitator of the network and the representative of the cluster members. Cluster organisations can be financially supported by VLAIO agency for the implementation of their role as facilitators. With a support percentage of 50%, the companies should annually collect an equivalent amount of co-financing for the operation of the cluster organisation. In addition to the financial support, VLAIO offers operational support, so that the cluster organisations can optimise their operations and become better at what they already do.

The Flemish cluster policy distinguishes two types of clusters: first, the **innovative business networks**, which are typically smaller initiatives. They often arise bottom-up from companies that want to focus on a specific domain that has opportunities to increase their competitiveness. Innovative business networks are therefore initiatives that derive from the exploration of new, emerging domains. These networks receive support from the Flemish Government for three years. Second, the **spearhead clusters**, which tie into strategic areas that are important for Flanders' smart specialisation strategy. These are large-scale initiatives that receive funding of a maximum of €500,000 per year for 10 years to expand their operations. Flanders has seven spearhead clusters:⁸³

- ▶ *Catalisti* in the domain of sustainable chemistry. The cluster has four main innovation programmes: 'Renewable Chemicals', 'Sidestream Valorization', 'Process Intensification and Optimization' and 'Advanced Sustainable Products'.
- ▶ *Flanders' Food* in the domain of agro-food. The cluster has two knowledge-driven strategic objectives (lead in knowledge and lead to knowledge) and two business-driven strategic objectives (accelerating efficient & effective innovation and creating value chains). The knowledge-driven strategic goals will focus on (1) World Class Food Production, (2) Resilient & Sustainable Agrifood Systems, and (3) Personalized Food Products & Healthy Diets.
- ▶ *SIM (Strategic Initiative Materials)* in the domain of advanced materials. SIM aims to further strengthen the favourable position of the Flanders materials-related eco-system, with strengths such as materials for 3D printing, nanoparticle production, handling and encapsulation.
- ▶ *Flanders Logistics Cluster (VIL, Vlaams instituut voor Logistiek)* in the domain of specialised logistics. Its programming is centred around four main themes: (1) digitalisation with three sub-themes: smart technology, business models and data management, (2) sustainability themes like CO₂ reduction and energy efficiency objectives for logistics in smart cities, circular and sharing economy, infrastructure, (3) the 'Flanders gateways' ambition, i.e. Flanders as a global connected trading partner, and (4) omni-channel distribution systems for various applications.
- ▶ *Flux50* in the domain of energy (smart grids). Five innovator zones have been selected: energy harbours, micro-grids, multi-energy solutions for districts, energy cloud platforms, and intelligent renovation.

83. In 2021, the Flemish Government recognised *flanders.healthTech* as the seventh spearhead cluster. It is an initiative of *flanders.bio* (life sciences) together with *DSP Valley* (digital technology) and *MedTech Flanders* (medical devices). It will foster collaboration on themes such as personalised and digital medicine, efficient healthcare and groundbreaking healthcare innovations in order to create a leverage effect for the Flemish economy, with an important impact on human well-being.

- ▶ *Blue cluster* with an emphasis on sustainable blue economy activities related to the North Sea and beyond. The cluster is active in (1) coastal protection and mineral resources, (2) renewable energy and freshwater production, (3) maritime connectivity, (4) sustainable food production and marine biotechnology, (5) blue tourism, and (6) ocean pollution.
- ▶ *flanders.healthTech*:⁸⁴ in 2021, the Flemish Government recognised *flanders.healthTech* as the seventh spearhead cluster. It is an initiative of *flanders.bio* (life sciences) together with DSP Valley (digital technology) and MedTech Flanders (medical devices). It will foster collaboration on themes such as personalised and digital medicine, efficient healthcare and groundbreaking healthcare innovations in order to create a leverage effect for the Flemish economy, with an important impact on human well-being.

Besides the spearhead clusters, there are a number of **geographic and/or thematic networking initiatives**. Examples of place-based initiatives, driven by one or more knowledge actor(s), and supported by various public stakeholders are *Leuven Inc.*, *Leuven Mindgate*, *Ghent Bio-Energy Valley* (GBEV), *BBEU* (Bio Base Europe pilot plant in Ghent) and the *ELAt triangle* (Eindhoven – Leuven – Aachen). There is a broad range of thematic or sector-oriented organisations and networks (digitalisation, circular and bioeconomy, biotech, health, creative industries, etc.). Examples include the *FlandersBio* network (life sciences – biopharmaceuticals, medical technologies or agricultural / industrial biotech products), and *MedTech Flanders* (medical technology). *Agoria International Business* helps technology companies increase their international market share and profitability by identifying business opportunities abroad, in close collaboration with Flanders Investment & Trade (see 3.3.6). *Flanders District of Creativity* is the single point of contact for entrepreneurs in the creative industries in Flanders. It's a non-profit organisation, supported by the Flemish Government, that informs and coaches creative entrepreneurs who want to build or grow their business. NeuroElectronics Research Flanders (NERF) is a basic research initiative and a collaborative venture between Imec, VIB and KU Leuven (see 3.3.2). It aims to unravel the neuronal circuitry of the human brain through research that combines nano-electronics and neurobiology. Finally, WaterstofNet is the knowledge and collaboration platform of the hydrogen industry in Flanders and the Netherlands: this platform ties into the Innovative Business Network 'Power-to-Gas'.

84. <https://flandershealth.tech/>

85. Research staff in full-time equivalents (FTE) in parentheses. The cited numbers include senior academic staff (professors or 'ZAP'), PhD students and post-docs. Source: Flemish Interuniversity Council (VLIR) personnel statistics 2020.

3.3 MAIN RESEARCH AND INNOVATION ORGANISATIONS

3.3.1 Higher education institutions

The **universities** play a major role in Flemish R&D: they generate almost 90% of all public scientific output in Flanders. The five universities of the Flemish Community are:⁸⁵

- ▶ Katholieke Universiteit Leuven (KU Leuven; 6,719 FTE);
- ▶ Universiteit Gent (UGent; 4,743 FTE);
- ▶ Universiteit Antwerpen (UA; 1,822 FTE);
- ▶ Vrije Universiteit Brussel (VUB; 1,753 FTE);
- ▶ Universiteit Hasselt (UHasselt; 673 FTE).

In 2019, KU Leuven topped the Reuters ranking of Europe's most innovative universities for the fourth year in a row, with UGent, VUB and UA also in the top 100. KU Leuven earned its first-place rank, in part, by producing a high volume of influential inventions. Its researchers submit more patents than most other universities, and outside researchers frequently cite KU Leuven inventions in their own patent applications. In the Times Higher Education (THE) World University Rankings 2020, KU Leuven ranked 45th (the highest ranked Benelux university), followed by UGent (123), UA (198), VUB (in the section 201-250) and UHasselt (351-400, and 46th in the THE ranking of best young universities worldwide). All information about on-going research of the five Flemish universities can be consulted via www.researchportal.be.

'Flemish universities. A study by the European University Association' in 2017 showed that Flemish universities enjoy substantial autonomy compared to many of their counterparts in Europe. They scored 'medium-high' on three autonomy dimensions, namely *organisational* (e.g. selection procedures for administrators and the capacity to decide on governing bodies and academic structures); *financial* (e.g. the length and type of public funding, the capacity to borrow money or the ability to set tuition fees); and *staffing* autonomy (e.g. recruitment and promotion procedures, the ability to set salaries). Flemish universities score relatively low on *academic* autonomy due to their limited control over student admission procedures and over the ability to introduce, design and terminate study programmes or to choose the language of instruction.

Flanders' academic and other knowledge actors are bundling knowledge and R&D forces in five **university associations**. Each association brings together one of the five universities with one or more university colleges. University colleges provide higher education and advanced vocational training, and their mission also includes research and the provision of other services to society. The bachelor qualification is the highest obtainable at the university colleges; master diplomas (and higher) remain the preserve of the universities. The five university associations of the Flemish Community are:⁸⁶

- ▶ *Antwerp*: UA and three university colleges in the city of Antwerp (47,941 students);
- ▶ *Brussels*: VUB and Erasmushogeschool Brussel (Erasmus University College Brussels), and a cooperation agreement with the Royal Military School (26,176 students);

86. The number of students in academic year 2019-2020 in all institutions of the association is mentioned in parentheses. Source: Flemish database tertiary education, DHO 2.0.

- ▶ *Ghent*: UGent and three university colleges, two in East Flanders and one in West Flanders (89,129 students);
- ▶ *KU Leuven*: KU Leuven and campuses of five university colleges spread over various locations in Flanders and Brussels (118,628 students);
- ▶ *Limburg*: UHasselt and university college PXL, along with the Transnational University Limburg (TuL), a cooperation between UHasselt and Universiteit Maastricht (16,335 students).

Only statutory registered universities and university colleges can use these designations⁸⁷ and receive government funding to support education and research activities. Apart from universities and university colleges, there are a few other institutions and several other officially registered institutions: Vlerick Business School, Antwerp Management School, the Orpheus Institute (artistic research in music, Ghent), the Institute of Tropical Medicine (Antwerp, see 3.3.3.2), etc. Universities and university colleges each have their organisation that promotes dialogue and cooperation amongst them and defends their interests in a concerted way. Universities are united in VLIR (Flemish Interuniversity Council), while the university colleges come together in VLHORA (Flemish Council of University Colleges).

Funding for the universities can be categorised into three budgetary flows:

- ▶ a basic subsidy from the Flemish Government's department Education and Training, amounting to €1,136.8 million in 2019, of which €394.5 million was allocated to R&D-related initiatives;
- ▶ support granted on an interuniversity competitive basis;
- ▶ a variety of external public and private sources, donations, revenues from IPR, from projects, etc.

The latter two budgetary flows are explained in more detail below.

First, for competitive funding, the *Research Foundation Flanders* (see 3.2.4.2) and the *Special Research Fund* (Bijzonder Onderzoeksfonds, BOF) mainly support basic research. Both have an array of different funding schemes. Two complementary programmes are aimed at attracting (*Odysseus*, FWO) and retaining (*Methusalem*, BOF) top researchers. FWO support is granted based on competition between the different universities, while BOF support is a performance-based research funding system of which the funds are allocated to the Flemish universities based on fixed competitive parameters.

VLAIO and the *Industrial Research Fund* (Industrieel Onderzoeksfonds, IOF) mainly support industrial and applied research. VLAIO support is granted on a competitive basis, where applicants are evaluated on several criteria. VLAIO support also includes research conducted at the request of companies; e.g. through *innovation mandates* and *Baekeland mandates* (see also 3.2.4.1). IOF support is a targeted subsidy for applied and strategic basic research (SBO), allocated to the universities based on fixed criteria and then granted based on intra-university competition.

87. In Flanders, accreditation as a HEI requires a formal decision of the 'Accreditation Organisation of the Netherlands and Flanders' (www.nvao.net) that a programme meets the predefined quality criteria. The NVAO is an independent accreditation body established by an international treaty.

Extra support is granted to the further strengthening of academic working conditions and research excellence, e.g. through the research infrastructure programme at FWO (see 3.2.4.2). The major budget sources for 2019 were:

- ▶ FWO (€352.8 million), of which €77.6 million was for strategic basic research including doctoral grants, and €13.9 million for research infrastructure;
- ▶ BOF (€220.3 million);
- ▶ IOF and interface activities (€56.39 million).

Second, higher education institutions also receive support from private partners (to conduct contract research), donations and bequests from private persons or institutes, the federal authorities, other Flemish public bodies (mainly the *Department for Education and Training*) and the EU (mainly through the Horizon 2020 programme, and to a limited extent from other EU programmes such as ERDF-Interreg). Income from commercialising research results has also increased in recent years. In 2017, 15.5% of Higher Education R&D expenditures (HERD) was financed by domestic and foreign private firms, which is distinctly above the EU28 average of 6.5% (2016 data), with only Germany reporting a similar number (13.8%).⁸⁸

3.3.2 Strategic Research Centres

Apart from the universities, the leading Flemish research and innovation actors are the four strategic research centres (SRC, or 'Strategische Onderzoekscentra' (SOC) in Dutch), sometimes referred to as public research organisations (PRO). Each of the centres is active in a specific technological area and they have co-founded several spin-off or start-up companies, often based on breakthrough research:

- ▶ the Interuniversity MicroElectronics Centre (Imec): nanoelectronics and nanotechnology (merged with the former iMinds (digital technologies));
- ▶ the Flanders Institute for Biotechnology (VIB): life sciences and biotechnology;
- ▶ the Flemish Institute for Technical Research (VITO): energy, materials, remote sensing and environment;
- ▶ Flanders Make: advanced manufacturing technologies for products and processes.

With each of these SRCs, the Flemish Government concludes a multi-annual management agreement including key performance indicators, in return for an annual grant. In addition, some SRCs receive a grant for the execution of 'reference tasks' on behalf of the Flemish Government (see 3.3.2.3). At the end of each multi-annual management period, the SRCs undergo an in-depth evaluation and peer review, followed up by the EWI Department (see 3.2.2.1) and assisted by independent international experts. As a result, the achievement of the performance indicator targets of their strategic plan is assessed with a focus on their activities in research and scientific output (publications), technology transfer (patents, licensing agreements, start-up companies, etc.) and communication. Moreover, the impact on the Flemish research landscape is analysed and the economic added value is quantified. In 2019, the total Flemish Government budget for the four SRCs was €250.6 million. The amount of public support for Imec alone was

88. Source: <https://www.vlaamsindicatorenboek.be/2.3.3/internationale-vergelijking>

€111.23 million in 2019, which makes it the biggest funding amount from the Flemish Government awarded to any knowledge institute.

3.3.2.1 *The Interuniversity Microelectronics Centre, Imec*

Imec is a world-leading research and innovation hub in nanoelectronics and digital technologies. Leveraging its unique combination of leadership in microchip technology with profound software and ICT expertise, Imec creates disruptive innovation in application domains such as healthcare, smart cities and mobility, logistics and manufacturing, energy and education.

Imec employs around 4,000 researchers from almost 100 nationalities. It is headquartered in Leuven and has distributed R&D groups at several Flemish universities, in the Netherlands, Taiwan and the USA. Moreover, Imec has offices in China, India and Japan. Imec was founded in 1984, as a non-profit organisation as a part of the Third Industrial Revolution Flanders initiative (DIRV) of the Flemish Government. Imec's research covers various aspects of nanoelectronics such as advanced semiconductor scaling, low power sensing and actuating, radar and radio technology, and digital technologies including data science, security expertise and AI. Its research horizon is ahead of industrial needs by three to ten years, bridging the gap between basic research at universities and R&D in industry. The Imec campus in Leuven consists of 24,400 m² of office space, laboratories, training facilities, technical support rooms, and two cleanrooms that run a semi-industrial operation (24/7). There is a 300 mm cleanroom that focuses on advanced R&D related to (sub-)3 nm process technology and a 200 mm cleanroom for R&D, development-on-demand, prototyping and low-volume manufacturing of innovative technology solutions for smart applications including sensors, actuators, and micro- and nanoelectromechanical systems (MEMS/NEMS), photovoltaic technologies, wireless technologies, life sciences technologies, and wearables, etc. Imec has, among others, a pilot line for silicon and organic solar cells, unique laboratories for bioelectronics research, life sciences labs, state-of-the-art tools for materials characterisation and reliability testing as well as dedicated labs for sensor-, imaging and wireless connectivity technologies. In 2019, Imec's total revenue (P&L) amounted to €640 million, of which over €100 million support was from the Flemish Government.

Imec has teamed up with industry, universities, polytechnic schools, associated labs, and research institutes from all over the world since its establishment, cooperating with more than 1,000 partners worldwide. Through innovative partnerships and agreements, Imec's partners share in the results, expertise, and technological innovations. Furthermore, Imec partners with other research leaders in the region to combine and leverage expertise:

- ▶ *Holst Centre*, set up in 2005 by Imec and TNO (the Netherlands), is an independent research and innovation centre, developing wireless technologies and flexible electronics, aimed at responding to the global societal challenges. Supported by local, regional and national governments, Holst Centre is located on High Tech Campus Eindhoven, and benefits from and contributes to the state-of-the-art on-site facilities. Holst Centre has over 180 employees from 28 nations.
- ▶ *EnergyVille* was set up by Imec, KU Leuven, VITO, and UHasselt to perform research in sustainable energy and intelligent energy systems. EnergyVille employs 400 researchers, whose work centres around six interdisciplinary domains: photovoltaics, electrical and thermal storage, power control and conversion, electrical and thermal networks, buildings and districts, strategies and markets.

- ▶ *Solliance Solar Research* was founded in 2010 as a joint venture between the Dutch TNO, the Belgian Imec and ECN (the Energy research Centre of the Netherlands, which became a part of TNO in 2018). Together with industrial and academic partners, Solliance Solar Research plays a leading role in the worldwide research and development of thin-film solar technology.
- ▶ *The OnePlanet research centre* is a Dutch innovation centre for Food, Health and Agricultural Technology. It was launched in 2019 as a collaboration between Imec, Radboud University, Wageningen University & Research (WUR) and the academic hospital Radboudumc, focusing on the development of sustainable technologies for food, health and agriculture.

Imec offers a variety of tailored venturing support mechanisms to give new start-ups and entrepreneurs a head-start on their go-to-market. Imec has a long tradition of creating start-ups, with 118 spin-offs since its foundation in 1984. Its business accelerator programme, Imec.istart, offers selected start-ups an initial financial injection (€50,000 pre-seed funding), professional coaching and mentoring, access to technology and working facilities, plus access to its network of partners and investors. Since its launch in 2011, Imec.istart has helped more than 198 tech start-ups in diverse fields, ranging from multimedia and logistics to the healthcare sector, to develop into sustainable ventures. In 2019, Imec.istart was ranked first in the European ‘Top University Business Accelerators’ ranking by UBI Global and was ranked fourth best in the world. Imec.xpand is a venture capital fund investing in innovative semiconductor and hardware research spin-outs and start-ups.

3.3.2.2 *The Flanders Institute for Biotechnology, VIB*

VIB is an independent research institute where some 1,700 top scientists from Belgium and abroad conduct pioneering basic research. Based on a virtually integrated partnership with five Flemish universities – Ghent University, KU Leuven, University of Antwerp, Vrije Universiteit Brussel and Hasselt University – and supported by a solid model-based funding programme, VIB unites the expertise of all its research collaborators and research groups in a single institute. VIB is geographically decentralised: it consists of nine thematic research centres located at the campuses of the partner universities. For example, the *Centre for Inflammation Research* is physically located at three campuses (Ghent University, Vrije Universiteit Brussel and Hasselt University) while the *VIB-KU Leuven Centre for Cancer Biology* is located, as the name indicates, at the KU Leuven. The headquarters of VIB, which is legally a non-profit organisation, is based in Ghent and accommodates the institute’s general management. Its primary role is to create a stimulating environment for the research centres, which includes a range of activities such as providing state-of-the art infrastructure for the research teams as well as for the two bio-incubators in Ghent and Leuven, identifying and tapping into new funding channels, developing and implementing the HR strategy to attract and support scientific talent, setting up standards for monitoring and benchmarking VIB’s research, and providing expertise for the translation of basic scientific discoveries (VIB Innovation & Business, see also infra), etc. VIB’s 2020 revenue was €120 million, of which €34.5 million came from contract research and about €84 million from grants and subsidies.

The **scientific research** at VIB pushes the boundaries of what we know about molecular mechanisms and how they rule living organisms such as human beings, animals, plants and

microorganisms. The institute has already achieved major breakthroughs in the fields of cancer research, immunology and inflammation, neurobiology and neurogenetics, angiogenesis and cardiovascular disease, plant biology and plant systems biology. VIB also engages actively in the public debate on biotechnology by developing and disseminating a wide range of science-based information.

While research forms the basis of VIB model, **transferring research results to the market** is of equal importance to VIB. The *Innovation & Business team* ensures that research results are translated into tangible products and services that find their way to patients and consumers. Financial return from tech transfer activities is reinvested in VIB's basic research programmes. Translation is a long and costly process, requiring skills, expertise and financial means that exceed VIB's resources. To bridge this gap, VIB has established partnerships with several companies. Additionally, VIB's *Discovery Sciences team* specifically bridges the gap between promising targets to the commercial development of products, de-risking the initial investments of interested industry partners. A final component of VIB's strategy to fuel economic growth and accelerate the translation of its research into novel products, is investing in *start-up companies*. For this purpose, VIB manages two bio-incubators and one bio-accelerator in Ghent and Leuven. So far, VIB has been involved in creating 22 new companies in the field of therapeutics, diagnostics, ag-bio and bioethanol, employing around 850 people.

VIB believes in an integrated approach to the various 'omics' domains. This approach opens perspectives to gain more focused insights into the molecular blueprint of many development and disease processes. Staying at the forefront in research therefore also means staying on top of developments on the technology front. Besides the combined expertise of its world-leading scientists, one of the institute's strengths is its **core facilities** that allow the use of the latest technologies on a scale that cannot be achieved by a single research group. VIB has made substantial investments in embedding high-tech platforms in the institutional core and service facilities. Its *Technology Watch programme* ensures that its scientists have early access to a wide range of state-of-the-art technologies through continuous scouting for novel technologies of potential interest to VIB and, when appropriate, mediating early access through partnerships with cutting-edge technology providers. A recent evaluation by an international expert panel has confirmed the status of VIB's core facilities, which are not only provided to researchers within the institute but also to scientists from academia and industry, as a 'gold standard' in Europe. To solidify VIB's position at the leading edge of technological development, VIB has recently launched the *Technology Innovation Lab*. This Technology Watch division focuses on providing VIB researchers priority access to the very latest research technologies, often still in the prototype or pre-commercial stage. Finally, in order to consolidate VIB's expertise in single cell studies – a research field of increasing importance – the *Single Cell Accelerator programme* was initiated. Through this initiative, VIB scientists will have access to funding to evaluate, develop and integrate emerging breakthrough single-cell technologies.

3.3.2.3 The Flemish Institute for Technical Research, VITO

VITO is an independent research centre in the area of cleantech and sustainable development in Flanders. As an innovative customer-oriented research organisation, it accelerates the transition to a sustainable world, providing knowledge and technological innovations that facilitate this transition to a more sustainable society. VITO de-risks innovation for businesses and

strengthens the economic and societal fabric of Flanders, with interdisciplinary research and large-scale pilot installations.

VITO does this in the field of energy, chemistry, materials, health technology and land use. VITO unites research centres, commercial parties and the authorities in sustainable value chains to make smarter use of existing sustainable solutions and develop new technologies. VITO is the driving force in these partnerships (e.g. EnergyVille) by providing practical knowledge, innovative processes and business models.

From 2019 on, VITO focuses more than ever on circularity, such as in the domain of energy and energy management. VITO puts a lot of effort into everything to do with land use. More efficient use of agricultural land will lead to better harvests, less spraying and more profitable cultivation. In view of the challenges posed by climate change, better monitoring and management of water usage helps to anticipate the negative consequences of a changing climate. Relatedly, VITO also develops solutions for capturing and reusing CO₂, reducing the energy demand for chemical processes and processing plastic waste and residual flows. Through large-scale biomonitoring, VITO helps governments to draw conclusions and take measures for environmental factors that determine our health.

VITO is also charged with executing tasks on behalf of the Flemish Government, including testing the quality of environmental and energy-related measurements and analysis that must be conducted according to environmental regulations, known as 'reference tasks'.

In 2019, VITO employed 959 employees and 103 PhDs and post-docs of 45 nationalities. VITO had a revenue of €203 million, of which €63 million was public funding. Apart from Flanders, it has offices in China, India and the Middle East.

3.3.2.4 Flanders Make

Flanders Make is the Flemish strategic research centre that aims at stimulating product and production process innovation in the Flemish manufacturing industry, thus supporting the digital transition towards Industry 4.0 to further strengthen the international competitiveness of Flemish manufacturing industry. Flanders Make's research focuses on the development of personalised, smart and connected products (vehicles and machines) and production systems (flexible assembly). Flanders Make combines its expertise in four key competences, all related to modelling and virtualisation:

- ▶ 'Decision & Control' focuses on innovations in localization, adaptive control and decision support for operators. Flanders Make helps industry to measure data, interpret data and apply it in robust, self-learning measuring and knowledge instruments to improve mechatronic systems. Artificial Intelligence plays a major role in these areas.
- ▶ 'Design & Optimization' helps developers to improve the increasingly complex design process, by aligning it with the production process from the outset. Specific tools give designers near-instant insight into the different possible concepts and optimal design choices. Flanders Make also offers support for production environments, in which it takes into account the impact of production on the design.
- ▶ 'Motion Products' emphasises products with a mobility component such as vehicles and machines, helping enterprises to develop new 'future-proof' products that are smart, auto-

matically adapt to the environment to provide optimal performance, and use Industry 4.0 technology. The focus is on the architecture and the validation of systems, as well as the combination of autonomy and automation ('autonomation') for professional applications.

- ▶ 'Flexible Assembly' is about supporting businesses in their digital transformation to become 'factories of the future', getting smart machines and people to work together. Research is done into flexible assembly units that can cope with multiple product variations.

For each key competence, a 10-year research roadmap has been developed and competence clusters have been set up in which Flanders Make works together with universities and other research institutes as well as companies on (pre-competitive) research, tailor-made innovation (for individual companies) and testing and validation.

Flanders Make provides high-tech infrastructure where companies can test and validate their products, e.g. (components of) vehicles or machines, and optimize their production processes. All these activities take place in three physical 'co-creation sites' that combine office space and research labs, in Kortrijk (customised production), Lommel (vehicle development) and Leuven (machine development). Furthermore, Flanders Make is involved in the Flemish drone federation EUKA (Sint-Truiden) and in the labs and test facilities of the universities (including the 12 Core Labs dedicated to the clusters) and other associated research institutes. In 2020, Flanders Make had more than 700 affiliated researchers and over 160 company members (of which 50% are SMEs). Its 2019 revenue was €65 million, of which €24.9 million was from the Flemish Government.

3.3.3 Flemish scientific institutes, research infrastructure and knowledge centres

Flanders funds a number of scientific and knowledge institutes as well as policy research centres. The Collective Research Centres, discussed in section 1.3, benefit from financial support from VLAIO through the Innovative Business Networks (in which they can participate) and/or via the COOCK-projects for collective research (see 3.2.4.1). For example, the 'Innovative Coatings'⁸⁹-IBN cluster has Centexbel and Sirris as members. Recent COOCK projects include Centexbel, Sirris and WTCB as participants.

3.3.3.1 Scientific Institutes

Within the Flemish Community, there are five Scientific Institutes, all managed by a department of the Flemish Government. These perform scientific research in a specific policy field. Apart from building up and disseminating the knowledge gained from scientific research, the institutes also provide advice and assistance to policymakers, as well as services to society as whole. Furthermore, they strive to develop and exchange their knowledge through international contacts or programmes and via cooperation with other (foreign) institutes, e.g. through membership of EU research networks.

- ▶ Botanic Garden Meise (Plantentuin Meise) is a scientific research institute, operating as a centre of excellence for research into tropical and European botany, with a collection of over 18,000 species of plants and one of the largest herbaria in the world. As part of the Flemish Community, it became an agency of the EWI domain in 2014, following its de-federalisation. On site, 150 employees of the Flemish Government work together with 30 employees of the FWB.
- ▶ The Institute for Agricultural and Fisheries Research (Instituut voor Landbouw en Visserijonderzoek, ILVO) conducts research in four main areas: plant sciences (applied genetics, breeding, crop protection), animal sciences (functional nutrition), technology and food science (food safety), and social sciences. In 2020, ILVO received a subsidy of €24.7 million, which is complemented by revenue from project research with various (international) partners.
- ▶ The Research Institute for Nature and Forest (Instituut voor Natuur- en Bosonderzoek, INBO) conducts research on themes such as fauna, flora, biotopes, areas and regions, sustainable land and water use, with a focus on factors such as ecohydrology, acidification, pollution and climate change. In 2020, INBO received a subsidy of €15.4 million, which is complemented by revenue from project research.⁹⁰
- ▶ The Royal Museum of Fine Arts Antwerp (Koninklijk Museum voor Schone Kunsten Antwerpen, KMSKA) is charged with the care of a unique art collection, composed of mainly Flemish works, complemented with several pieces from other schools. KMSKA is the only Flemish museum with a scientific status and it received a subsidy of €4.8 million in 2020.
- ▶ The Flanders Heritage Agency (Agentschap voor Onroerend Erfgoed, AOE)⁹¹ conducts research into the immovable heritage of Flanders (archaeology, monuments, landscapes), focusing on themes such as the restoration of historic gardens, sea wrecks, historic musical organs, parks, industrial and maritime heritage, etc. In 2020, AOE received a subsidy of €17.1 million.
- ▶ Flanders Hydraulics Research (Waterbouwkundig Laboratorium,⁹² FHR) investigates the impact of human activity and nature on water systems and its consequences for shipping and water-related infrastructure. With about 100 staff, it develops and disseminates knowledge about shipping safety, coastal and port management, flood resilience, etc.

3.3.3.2 Other institutes: ITM, VLIZ, CRC, Alamire Foundation

Apart from the above-mentioned organisations, there is a variety of other institutions and organisations in the public domain with activities that primarily focus on (scientific) data collection, research and/or knowledge generation. Usually, they are mainly, or to some extent, supported by the Flemish Government. Some of these organisations play a prominent worldwide role in their field of activity. The knowledge institutes include:

- ▶ *The Institute for Tropical Medicine* (Instituut voor Tropische Geneeskunde, ITG/ITM) is one of the world's leading institutes in the domain of tropical medicine and health care in developing countries. It is active in training (400+ students in 2020 at Master, PhD and post-doc level), research (387 scientific publications and lead partner in nine international research

90. See: <https://www.vlaanderen.be/inbo/over-ons/het-eigen-vermogen/>

91. See: <https://onroerenderfgoed.github.io/about/>

92. <https://www.waterbouwkundiglaboratorium.be/nl/over-wl/wl-jaarverslag>

consortia in 2020) and support (40,000+ patient contacts in 2020). ITM hosts many international reference laboratories, including high-security biosafety level 3+ labs for research on dangerous pathogens, and is an expert centre on HIV. It has also been very active in the response to the COVID-19 pandemic, working on diagnostic tools to map the epidemic, trying to find treatments through biomedical research and clinical trials, and studying the impact of COVID-19 on people and society. The Institute, with more than 160 academic, scientific and medical staff, focuses particularly on pandemics in low- and middle-income countries and on vulnerable populations.

- ▶ *The Flanders Marine Institute* (Vlaams Instituut voor de Zee, VLIZ) is renowned for supporting coastal and marine scientific research. It does so by offering an array of services for which scientists do not have the time or resources, but that are nevertheless essential for the success of scientific research. It operates the Simon Stevin vessel (the Flemish multidisciplinary coast research ship), manages the InnovOcean campus site and the Flanders Marine Data and Information Centre, which is active in international networks such as the IOC of UNESCO. It also houses the European Marine Board and supports the European-level initiatives EMODnet and JPI Oceans. VLIZ has been instrumental in supporting knowledge brokerage for the benefit of the Blue Economy in Flanders, where the new spearhead cluster 'Blue Cluster' (see 3.2.5.3) is catalysing innovation projects among its industrial membership.
- ▶ *The Centre for Research and Conservation* (CRC) is the research department of the Royal Zoological Society of Antwerp (RZSA/KMDA), conducting applied and fundamental hypothesis-driven conservation research in various zoological disciplines (e.g. veterinary sciences). Research takes place in Flanders, in zoos and associated institutions, as well as in Brazil, Cameroon and Congo (bonobo research).
- ▶ *The Alamire Foundation* is a cooperative association between the KU Leuven's Musicology Research Unit and the non-profit organisation Musica (Impulse Centre for Music). Its mission is to undertake, stimulate, and coordinate innovative research on music and musical life in the Low Countries from the early Middle Ages until 1800.

3.3.3.3 Policy Research Centres

In 2001, the Flemish Government launched a centralised 'Steunpunten' programme to provide a scientific basis for policy relevant research. From 2016 on, a decentralised approach towards policy research centres has been developed, whereby every policy area was made responsible for setting up, funding and following up its own centres. The policy research centres that are active today with the EWI policy area are:

- ▶ *Expertisecentrum Onderzoek en Ontwikkelingsmonitoring* (Expert Centre Research and Development monitoring, ECOOM):⁹³ an interuniversity consortium in which all Flemish universities participate;
- ▶ *Steunpunt Circulaire Economie* (Policy Research Centre Circular Economy, CE): a consortium of the KU Leuven, Ghent University, the University of Antwerp, and VITO.

93. ECOOM integrates the former *Steunpunt Economie en Ondernemen* (Policy Research Centre Economy and Entrepreneurship), which includes activities like analysing the spearhead clusters and mapping entrepreneurship in Flanders.

ECOOM is, among others, responsible for the calculation of the official R&D-intensity indicator of Flanders, whilst the CE Policy Research Centre translates research on the circular economy into policy measures for Flanders.

3.3.4 Enterprises

Enterprises are of major importance within the R&I system in Flanders: 75% of R&D in Flanders was funded by the business enterprise sector in 2017. While 70% of businesses were innovative in the period 2016-2018 (CIS 2019), they are a very heterogeneous group: large firms – those with more than 500 employees – accounted for about half (41.7%) of all intramural R&D in Flanders in 2017, which is also reflected in their share of R&D subsidies, with 43% of all VLAIO R&D project support (in 2019). Given the industrial structure in Flanders, most of these large enterprises belong to multinational groups, so that their research strategy is not exclusively determined in Flanders. Nevertheless, several multinationals operate key R&D labs in Flanders, such as *Danone's* global plant-based innovation centre *Alpro* or *Daikin's* R&D headquarters for heating technology. Besides the manufacturing sector, the chemical & pharmaceutical industry accounts for significant R&D activity in Flanders with 41.1% of all intramural R&D in the business sector in 2017.

Biopharmaceutical firms in particular have a large footprint in terms of employment and research, with more than 5,000 active industry scientists and €3.9 billion in R&D investments in 2019. Alongside the large, innovation-intensive companies, a group of high-technology SMEs has arisen in recent years and continues to grow steadily. International comparisons demonstrate that the share of people employed in (medium) high-tech industry and high-tech services in Flanders is almost comparable to the EU average (8.8% versus 8.9% for the EU-28 in 2018). The R&D expenditures within companies in Flanders are mainly focused on the following high-tech sectors (2017): chemicals and pharmaceuticals (NACE 20-21) account for more than 41% of total BERD (based on a sample); motion picture, video and TV production, computer programs, engineering, and technical testing and analysis activities (NACE 59-63, 71-72) account for 14.1%. Information technology, electronic products, optical products and electrical equipment (NACE 26-27) account for about 11.4%, and machinery & transport (NACE 28-30) for more than 10.5%.

The Flemish Government has developed several initiatives to increase the valorisation of research results, in order to better disseminate technology, and to strengthen the direct links between companies seeking to innovate and researchers from higher education institutions. Support is available to companies, institutions, networks and private individuals (researchers). In addition, promotional campaigns, such as “Ik innoveer!” (“I innovate!”) with a focus on low innovation-intensive companies and SMEs, have been set up to better disseminate innovation among smaller and less-technological firms. Another example of a measure aimed at business is the support for the university colleges to professionalise knowledge dissemination towards SMEs through the ‘Blikopener’ initiative (‘Mind opener’).

Other measures geared towards knowledge institutes, but many of which involve cooperation with the business sector, were discussed in the preceding sections (see 3.2.4.1). Examples include the spearhead clusters and innovative business networks, the Baekeland mandates and innovation mandates, the TETRA fund for applied research, the COOCK instrument for valorising research and the Living Labs. In addition, many intermediaries facilitate innovation in the business sector (see 3.2.5), such as the business centres and incubators, public and private risk capital providers, and the thematic or sector-oriented organisations (including the collective research centres, see 3.3.3.3). Finally, private enterprises are often involved in international research collaborations and support schemes, such as EUREKA and Eurostars (see 3.3.6).

3.3.5 Researchers & Students

Policy increasingly acknowledges, and supports, the myriad of ways in which individuals take up the role of researchers and students. In particular, research not only happens within but also outside the confines of the institutional R&I actors while learning increasingly occurs not only during but also beyond the usual educational trajectory.

3.3.5.1 Citizen Science

In line with the quadruple helix model of innovation, citizens and civil society are increasingly involved in the development and deployment of innovations. The Science Communication Policy Plan 2015-2020 engages various science information and media channels to reach out to the broader public (see 3.2.3). Besides their regular activities, these entities ensure the general public can meet with scientists, science educators and science communicators and interact with them in other ways, including science festivals such as the Flemish Science Day, Day of Biotechnology, Sound of Science festival, and festival and Supernova, as well as in Science shops, Science bars, etc.

Citizens are also increasingly invited to take up an active co-creation role in knowledge development: since 2018 a yearly call for Citizen Science project proposals has been launched in Flanders. These scientific projects rely on the active participation of citizens for data gathering and data processing. Researchers from universities, university colleges and research centres initiate the projects. They collaborate with trained science communicators to reach and to engage with the general public. In 2018, the FWO and the Royal Academy of Sciences launched a comprehensive project 'Science Agenda: people's questions to scientists.' They collected 10,559 questions, which were categorised in five clusters: society, science and technology, biology, health and medicine and culture. In 2019, these themes were further developed in science policy (artificial intelligence, cybersecurity, personalised medicine) and in new science communication initiatives. During the current government period 2019-2024, regular calls for citizen science projects were launched in cooperation with *Scivil*, the knowledge centre for citizen science.

3.3.5.2 Education and Lifelong Learning

Attracting more people to take up STEM-careers remains a challenge for Flanders. Between 2015 and 2017, the number of people obtaining a STEM-degree remained stable at around 20% of all the people obtaining a higher education degree. In 2019, the fifth edition of the STEM Monitor (an annual report the Flemish Government uses to monitor the popularity of STEM courses of study) for school year 2017-2018 was published, reporting an increase in the number of pupils in STEM courses of study in the second and third grades of secondary education. During school year 2010-2011, 53,806 young people entered courses of study centred around STEM, compared to 55,153 in school year 2018-2019, an increase of 1,300 pupils. More than 55% of all Flemish pupils leaving general secondary education (ISCED 3) have a STEM diploma. To stimulate youngsters to choose STEM-careers, a STEM Action Plan 2012-2020 was developed. Under the current government, an Action Plan 2020-2030 will be developed. One initiative to increase youngsters' interest is the *STEM-academies*. These academies bring together a variety of extra-curricular initiatives. For example, *CodeFever* is an initiative where kids are taught to 'think computational'. It aims for kids to not only be end-users of digital technologies, but also to be creators. Another initiative, *CoderDojo*, organises free workshops where kids between the ages of 7 and 18 can learn to code. The current Flemish government has the ambition to install a *STEM-academy* in every municipality and to offer a comprehensive set of activities for kids between the ages of 8 and 14.

3.3.5.3 Research Careers

Flanders' ambition to be a successful knowledge society can only be realised if it continues to invest in high-level research and good researchers. Important levers are the development of transparent career paths, as well as specific programmes to attract foreign talents or externally active Flemish researchers. Therefore, apart from the regular funding channels – such as the Special Research Fund (BOF) or the grants, fellowships and research projects from the Research Foundation Flanders (FWO), several specific initiatives have been developed to encourage excellent researchers and support them in a long-term career path. These include budgets for the 'tenure track mandates' that lead to a position within the ZAP (Senior Academic Staff) and Methusalem (long-term support for excellent researchers), worth a total of about €28.5 million in 2019, as well as the Odysseus programme, a multi-annual brain gain initiative (see 3.3.1). Moreover, the Flemish Government supports the training on career development and transferable skills of PhD students and other young researchers through funding of the Doctoral Schools at the Flemish universities under the OJO-support (support of young researchers), worth €5 million in 2019.

3.3.6 Internationalisation of Flemish research and innovation

The internationalisation of R&I policy is shaped by the preparation and follow-up of policy initiatives either at bilateral (region or national), inter-regional, inter-governmental, EU and/or international (OECD, UN) policy levels. The international aspects of R&I cover a wide range of activities and institutions, embedded at the public, semi-public and private levels. No single administrative entity or agency is exclusively managing international aspects. This means that all the different public and private actors that are interested or eligible can participate in policy initiatives and programmes operating at the international level. The involvement of EWI in European R&I policymaking was discussed in section 3.2.2.1. In addition, the Department of Foreign Affairs monitors its policy coherence with the international activities of other departments of the Flemish Government. This department is also responsible for the coordination between the various policy areas, one of which is scientific research and innovation, and is the administration responsible for bilateral and multilateral treaties, MoU agreements and declarations of intent. Besides their participation in Belgian economic missions abroad, Flemish R&I actors (universities, university colleges, research organisations, other knowledge institutes, etc.) are offered the possibility by the minister-president of Flanders to join the region's official missions abroad, based on the 'academic diplomacy' principle. During such visits, opportunities may arise to conclude cooperation agreements with actors from the region or country being visited.

Another important actor in the International Flanders policy area is the *Flanders Investment and Trade* (FIT) agency. FIT supports the promotional international trade activities of Flemish companies and attracts foreign investors to Flanders. Companies can call upon its networks of contacts both at home and abroad, and it provides firms with financial support and information on a wide range of financial incentives. Together with VLAIO, it forms the *Enterprise Europe Network Flanders* in the EU network EEN. FIT has a worldwide network of over 90 offices. It includes a few technological attachés that focus on future-oriented, innovative and technological fields of development, specifically in growth markets outside Europe. In the field of international innovation, VLAIO provides co-funding for participants from Flanders to take part in projects in EUREKA or the Eurostars programme (see 3.2.4.1 and 3.3.6.3). EUREKA is an inter-governmental initiative to promote international cooperation for applied and market-oriented industrial R&D, while Eurostars is aimed at innovative cross-border SMEs. The VLAIO agency is involved in the daily management of the EUREKA-network and the representation in the management entities of EUREKA, Eurostars and the EUREKA clusters. VLAIO is also the National Contact Point (NCP) for Flanders for supporting applications relating to thematic programmes within the Framework Programme for Research & Innovation, the ERA-nets, EUREKA and some Joint Technology Initiatives (JTIs) and its successors in Horizon EU, the co-funded partnerships.

The main focus and opportunities of international R&I policy of Flanders, as a region with a small open economy, are embedded in the EU level: Flanders needs to align its R&I priorities with EU policy for a new European Research Area, the European Semester and EU strategies (e.g. Green Deal, industrial strategy, smart specialisation, etc.) that are implemented in Framework Programmes (Horizon EU, COSME, Digital EU, ERDF, etc.). The Flemish-European Liaison Agency (VLEVA), a not-for-profit association which is subsidised on a structural basis by the Flemish Government, provides a link between the EU (particularly the EU Parliament), Flanders stakeholders, intermediaries and local authorities and stimulates Flanders' involvement in the field of R&I. VLEVA influences various EU policy initiatives, provides – in cooperation with NCPs and as a member of EU networks – information on opportunities for EU programme participation for actors from Flanders. Together with EWI, VLEVA is a paying member of the European Regions Research and Innovation Network (ERRIN).

Data from March 2019 show that actors in Flanders participated strongly in the **Horizon 2020** programme. With a financial return there of 2.64%, Flanders is scoring above the expected level. The percentages for earlier EU Framework Programmes – FP7, FP6 and FP5 – were 2.50%, 2.12% and 2.19% respectively. So far, 553 Flemish participants have taken part +/- 2,500 times in 1,876 Horizon 2020 projects, which generates approximately €1,146 million (from January 2014 until March 2019) or about €190 million yearly. Marie Curie (MSCA), ICT and FOOD are at present the three thematic priorities with the highest number of participations from knowledge actors in Flanders. In terms of financial return from the EU Framework Programme to Flanders, Flemish participation was most successful in the thematic priorities information and communication technologies, advanced materials, biotechnology, and food security, sustainable agriculture and forestry, maritime and inland water research. KU Leuven is the strongest Flemish (and Belgian) participant, and the only Belgian university in the top-10 of all academic participants in the FP. Behind KU Leuven, Imec and UGent complete the top-three of Belgian participants and together they represent €506 million, which is about a quarter of the total Horizon 2020 contribution to Belgium. In total, seven Flemish knowledge institutes (see 3.3) rank in the Belgian top-10: KU Leuven, UGent, Imec, VITO, UA, VUB and VIB, in descending order. The top-five of countries that Flemish actors cooperated with in Horizon 2020 consists of Belgium, Germany, France, Spain and Italy (the UK and the Netherlands rank sixth and seventh), whereas the top-five regions are Ile-de-France, Comunidad de Madrid, Bavaria, the Brussels-Capital Region and North-Rhine Westphalia.

In January 2020, evidence of the allocated budget for Flanders' participation in **COSME**, the EU's programme for small and medium-sized enterprises for 2014-2020, shows that close to €40 million went towards various actors from Flanders, including *Enterprise Europe Network (EEN) Vlaanderen*. This represents a little over 1.5% of the total budget for the period 2014-2020.

Figure 33: Flanders' involvement in the Vanguard Initiative

An important initiative in the development of a more focused demand-driven approach for the S3 (smart specialisation) methodology is the Vanguard Initiative, an inter-regional network of currently 32 regions from 13 EU Member States, including Flanders, Baden-Württemberg, the Basque Country, Lombardy, North-Rhine Westphalia, Saxony, Rhône-Alpes, Wallonia, Catalonia, and Scotland. The Vanguard Initiative's main ambition is to contribute to the European S3 agenda and boost industrial transformation by innovation in the EU regions, as well as to set up partnership networks among regions of different countries in several domains. The regions' cooperation also aims at generating an evidence base to support the EU Commission in the development of Thematic Smart Specialisation Platforms (TSSP) in key growth areas (industrial modernisation, agri-food, energy). As such, the Vanguard Initiative supports the development of innovative industrial value chains in Europe by building on S3 strategies. More specifically, it aims to provide industrial stakeholders with easier access to (connected) pilot and demonstration facilities instead of duplicating existing facilities. These activities are based on a four-step methodology (learn, connect, demonstrate, commercialise), which is applied in five industry-led pilot actions, each based on one priority area (KET) in Europe. Flanders takes the lead in the pilot action 'High Performance Production through 3D Printing', which focuses on creating a (virtual) platform for 3D printing infrastructure, capacities and competences aimed at developing a European demonstration and piloting network. Flanders is also involved in all the other existing pilot actions:

- ▶ Bio-Economy pilot – Interregional cooperation on innovative use of non-food biomass;
- ▶ ADMA Energy – Advanced Manufacturing for Energy-Related Applications;
- ▶ NANO – New nano-enabled Products;
- ▶ ESM – Efficient and Sustainable Manufacturing.

Following the Vanguard methodology for scale-up, EWI and Flanders' R&I actors (VITO, Sirris, ILVO, etc.) are active in the DG Regio pilot action preparing the new 'interregional innovation investments initiative (3I)' under the ERDF 2021-2027, through participation in the interregional innovation partnerships (3D Printing, Bioeconomy, Agrofood, etc.).

3.4 Future R&I policy perspectives

In the context of the COVID-19 pandemic recovery, **vertical and horizontal policy coordination** has become more than ever very important through the bundling of efforts at various levels, such as the local, regional and national level for the EU Semester country reporting (for 2021: the Recovery and Resilience Plan). In the September declaration of 2020, the Flanders Government announced a budget of €4.3 billion for the Flanders recovery plan '*Flanders Resilience*' ('*Vlaamse Veerkracht*'). Of this budget, €2.2 billion will come from the EU Recovery and Resilience Facility (€312.5 million in subsidies and €360 million in loans), of which a significant budget of €446 million is earmarked for EWI to contribute to sustainable and digital transition and for projects in the Health area. The Belgian Recovery and Resilience Plan submitted to the European Commission in order to benefit from this EU facility includes six stra-

tegic axes, each with a number of thematic components: (1) climate, sustainable and innovation, (2) digital transition, (3) mobility, (4) social inclusion, (5) economy of the future and productivity, and (6) public finance control. A governance structure for the recovery plan has been established to bring different entities (taskforces, SERV, expert panels, finance department) together for the future coordination and monitoring of the actions across the different policy domains in Flanders.

As part of the broader COVID-19 'Flanders Resilience'-plan, steps have recently been taken to increase **vertical and horizontal budgetary monitoring**. For example, the screening of the Flemish public budget ('*Vlaamse Brede Heroverweging*', VBH) in 2021, which includes budget flexibility with the aim to increase the efficiency and effectiveness of public expenditures. Based on evidence and input from the involved policy domains, this screening allows the identification of 'authority gaps' in realising policy objectives as well as in intervening at the most appropriate level (regional vs local) and involving the most suitable actors (public, private, social profit) to implement actions of the policy plan. The exercise also envisages the embedding of policy evaluations in the budgeting process to establish a more structural approach to evidence-based policymaking. Important steps have been made towards making more systemic evaluations of R&I policy (VARIO, 2019), with such exercises completed in 2016-2018 for the strategic research centres, the financing of basic research and science communication.

Stepping up policy coordination at the supra-national or EU level too is essential to achieve increased **resilience of the R&I and industrial ecosystems**, as the recent pandemic has illustrated. It is very notable that international cooperation of the academic and private research and innovation community is more important than ever (see also 3.3.6), given the importance of putting in place a response system for future pandemics. One example is the development of a platform technology that can deal with a range of viruses at the *Rega Institute* in Flanders. In terms of policy coordination, the exchange of information and best practices with other governments requires the further development of organisational structures that can deal with such global challenges. An example emanating from the COVID-19 pandemic is the *Biomedical Advanced Research and Development Authority* (BARDA) in the US, which to an extent has assumed such a governance role, including the construction of a balanced portfolio of projects for vaccine development or the coordination and integration of clinical trial data. The efforts of the EWI Department in its role of organising public innovative procurement (*Programma Innovatieve Overheidsopdrachten*, PIO), a rather novel policy instrument involving other policy departments to procure innovation, can become an integral part of designing a more resilient R&I ecosystem: through such advanced market commitments (AMC) the government can encourage both R&D and investments in manufacturing capacity (Veugelers, 2021). As a case in point, PIO is involved in the MOW-EWI partnership for the Mobilidata programme, coordinated by Imec, for the roll-out of smart traffic infrastructure in Flanders.

For **strategic innovation policy**, addressing the major societal challenges as reflected in the *sustainable development goals* (SDG) has recently received major attention in Flanders through the societal transitions policy. In the past decades, Flemish R&I policy strongly emphasised a bottom-up approach using open calls, which then select the best project ideas originating from scientists (via channels like FWO, BOF and IOF, see section 3.2.4) or firms (such as the VLAIO R&D projects, see section 3.2.4.1). This bottom-up environment is combined with the Flemish smart specialisation strategy, which hinges on priorities as defined by the government via a ‘top-down approach’. The mix of both approaches reflects a long tradition in which the top-down perspective focuses government support to acquire critical mass and the bottom-up angle ensures that excellence can maximally manifest itself. This approach resulted in the strategic research centres (section 3.3.2) and in the spearhead clusters (section 3.2.5.3) that build on capacity for excellence, but where also more directed and thematic approaches are followed. In addition, the ‘transversal strategic objectives’ (section 3.1) reflect Flemish R&I policy’s increased intention to achieve societal impact, noting that it has long been a key element of policy, as it is used as a selection criterion in, for example, VLAIO-projects and in strategic basic research projects of the FWO. Finally, in 2019, the annual budget for R&D&I was increased by €280 million. While two-thirds of this investments went to reinforcing existing funding channels such as FWO, BOF and IOF, one third went to new policy initiatives. A large share (€70 million) is earmarked for three ‘grand policy initiatives’:

- ▶ The *Policy Plan Artificial Intelligence* is aimed at strengthening Flemish competitiveness by boosting the uptake of AI-technologies by enterprises. It also reinforces Flanders’ strong research base in this area. Lastly, it aims to improve the framework conditions for taking up AI by focusing on ethical and legal aspects, as well as competences and skill development. Therefore, a new knowledge centre ‘Data and society’ has been set up to act as facilitator. The policy plan foresees an annual investment of €32 million.
- ▶ The *Policy Plan Cybersecurity* is set up in a similar way as the Policy Plan Artificial Intelligence, focusing on research, implementation and competence development. It foresees an annual investment of €20 million.
- ▶ The *Moonshot CO2* will invest €20 million every year in innovation and research that contributes to the Flemish climate targets. Given the importance of chemical compounds, the spearhead cluster for the chemistry and plastics sector *Catalisti* (see 3.2.5.3) has been assigned a coordinating role here.

In addition, in 2021 the Flemish Government launched the programme ‘Flemish Space Economy’, funded with €11 million in 2021-2024 and embedded in cluster policy through the Innovative Business Network *Space 4.0* (see 3.2.5.3). There are many other examples of policy initiatives reflecting long-term directionality, such as the region’s coordinated efforts on the bio-economy among the *Policy Research Centre Circular Economy* (see 3.3.3.3), the spearhead clusters *Catalisti*, *Flanders’ Food* and the *Blue Cluster* (see 3.2.5.3).

In future years, impact objectives may be expected to gain importance in the evaluation criteria for proposals, as also shown by the involvement of VLAIO's involvement in ongoing work to integrate SDGs in R&I policy in the international network of innovation agencies (TAFTIE). Nevertheless, the Flemish tradition is to refrain from strong steering in terms of thematic priorities, and in the future such an approach will need to be balanced with the bottom-up channels in the policy mix.



**OVERALL POLICY FRAMEWORK
AND PRIORITIES**

**ACTORS AND INSTRUMENTS
OF R&I POLICY**

**MAIN RESEARCH AND
INNOVATION ORGANISATIONS**

**FUTURE R&I POLICY
PERSPECTIVES**

4 THE WALLONIA-BRUSSELS FEDERATION

The Wallonia-Brussels Federation (*Fédération Wallonie-Bruxelles*, FWB)⁹⁴ is responsible for policies that concern individual rights for the French-speaking population of the Walloon and the Brussels-Capital Regions.⁹⁵ Hence, the FWB is responsible for funding research in French-speaking higher education institutions (HEIs): universities, university colleges and art colleges. In the current FWB Government, the Minister of Higher Education⁹⁶ oversees scientific research and the Directorate for Higher Education, Life-Long Learning and Scientific Research (DGESVR) is the administration in charge of applying the research policy. The FWB Government funds research notably via the National Scientific Research Fund (F.R.S.-FNRS) funding agency, but it also supports research through several other schemes and organisations. Another key priority is to ensure quality training of researchers, from the perspective of a future career within or outside of academia.

4.1 OVERALL POLICY FRAMEWORK AND PRIORITIES

Since the last BRISTI report in 2010, the **FWB Government** priorities have been set out in the Research Strategy 2011-2015,⁹⁷ by the adoption, jointly with the Walloon government, in 2011 of a Wallonia-Brussels Partnership for researchers, in the Community Policy Declaration (CPD) 2014-2019⁹⁸ and most recently the CPD for the 2019-2024 period.⁹⁹ Moreover, an important reorganisation of the Higher Education landscape took place with the adoption of the ‘*Paysage*’ (landscape) decree in November 2013. The HEIs are now federated under the umbrella of the Academy of Research and Higher Education (*Académie de Recherche et d’Enseignement Supérieur*, ARES), with the aim of enhancing the coherence of the higher education system.

The CPD for the period 2019-2024 aims to :

- ▶ Develop and promote effective coordination with other federated entities for the benefit of research and higher education institutions,
- ▶ Continue efforts to refinance research, including research subsidies granted directly to universities (in particular special research funds) in order to contribute to the European objective of 3% of GDP, of which 1% is financed by public authorities,
- ▶ Support the inter-university investment plan set up by universities for research infrastructures,
- ▶ Support and stimulate the international opening of our research and European projects in the Wallonia-Brussels Federation.”

94. See: <http://www.federation-wallonie-bruxelles.be>

95. The FWB Parliament is composed of the elected members of the Walloon Parliament (except those of the German-speaking community) and 19 of the French-speaking members of the Brussels-Capital Parliament.

96. The Minister’s full portfolio is Higher Education, Social Welfare Education, University Hospitals, Youth Welfare, Houses of Justice (paralegal support), Youth, Sports and promotion of Brussels.

97. See: <http://www.enseignement.be/index.php?page=26069&navi=2937>

98. See: <https://bit.ly/3obgvtV>

99. See: <https://gouvernement.cfwb.be/home/publications/declaration-de-politique-communautaire.html>

Despite a difficult long-term budgetary trend, the 2015-2019 Government priorities reconfirmed the objective to increase research funding (in line with the EU's 3% GERD/GDP target) and pursued seven priorities including an updated research strategy; ensuring sufficient funding for basic research; deepening the contribution of basic research programmes to new knowledge and innovation; strengthening research evaluation mechanisms for excellent and innovative research; improving research equipment and infrastructures; promoting research careers and scientific education; and the participation of researchers in international projects and networks of excellence.

Figure 34: Open Access Decree and policies

Adopted by the FWB Parliament in 2018, the Open Access Decree¹⁰⁰ establishes a policy of open access to scientific publications. The decree obliges researchers to deposit, in extenso, in an institutional digital archive, the articles resulting from research carried out in whole or in part with public funds that come totally or partially from the FWB and published in periodicals appearing at least once per year.¹⁰¹

The decree also entrusts the Commission of Libraries and Collective Academic Services (CBS) of the ARES, in collaboration with the Interuniversity Library of the French-speaking Community of Belgium (BiCfB),¹⁰² with monitoring and evaluating the effects, particularly concerning the publication costs required by publishers. In this context, the CBS and the BiCfB developed a questionnaire to collect data allowing, in the long term, to track the evolution of publication costs charged to institutions and open access practices, and thereby the effectiveness of the decree.

The ARES published the report for 2020¹⁰³ on the implementation of the decree in June 2021. The report found clear evidence that the implementation of the Open Access Decree has enabled considerable progress to be made in terms of open access to scientific production in FWB. However, there is still room for improvement, particularly in the monitoring of publication costs (estimated at close to €600,000, but only based on data from four universities and four university colleges), in the use of the institutional archive LUCK by all university colleges, in the obligation to submit open access or embargoed journal articles published since the decree came into force, and in the evaluation of scientific production.

In total, €80 million will be injected into higher education during the lifetime of the current government, of which €20 million will be into research. Mid 2021 €8 million has been invested in research, with €3 million going to special research funds and €5 million to the European engagement units of universities and university colleges. A set of priority actions (see section 4.4 for details) are listed including academic freedom, gender equality, open science, improved

100. See: <https://www.pfwb.be/le-travail-du-parlement/doc-et-pub/documents-parlementaires-et-decrets/documents/001597235>

101. Source: Rapport d'activité 2018-19: <https://www.ares-ac.be/images/publications/rapports-d-activites/ARES-RA-2018-2019-Site-web.pdf>

102. See: <https://www.bicfb.be>

103. See: <https://www.ares-ac.be/en/actualites/770-decret-open-access-un-vrai-plus-pour-les-etablissements-d-enseignement-superieur>

104. See: <https://gouvernement.cfwb.be/home/publications/declaration-de-politique-communautaire.html>

evaluation processes and harmonisation of the researchers' status, joint research projects between HEIs and businesses and intensification of the links between basic and applied research, as well the links between research activities, economic development, the ecological transition and social trends. A commitment was made to implement an investment plan for research infrastructures and technological platforms. Finally, the FWB Government intends to implement measures to encourage researchers to participate in European and international research projects.

In August 2020, the FWB Government adopted an International Policy Note¹⁰⁵ for the 2019-2024 period structured around seven priority themes, including one on 'fostering scientific and academic diplomacy'. The ambition of the FWB is to develop scientific and academic diplomacy (revolving around three dimensions: 1) diplomacy for science to foster scientific cooperation; 2) science for diplomacy, making use of scientific cooperation to improve international relations; and 3) the use of science to support diplomatic action. The policy note proposes actions focused on ensuring a coordinated internationalisation of French-speaking HEIs, notably via the ARES, the WBI and the F.R.S.-FNRS. The note also foresees actions to develop targeted partnerships with selected countries and for reinforcing of the positions of FWB researchers and academics in international networks.

Figure 35: Research and innovation to tackle COVID-19

From the outset of the health crisis in early 2020, a series of research projects and initiatives were rapidly launched in Wallonia and Brussels to combat the COVID-19 virus and its impact on health, society and the economy. Numerous skills and expertise in all fields of science have been associated with them.

The FWB Government approved funding of almost €2.7 million for higher education institutions involved in research against COVID-19 and the management of the health crisis. During 2020, the F.R.S.-FNRS awarded research funds of just over €1 million to 21 scientific projects to tackle the coronavirus as urgent research credits, supplemented by €2 million funding as exceptional research projects. At the initiative of the Royal Academy of Medicine and the Royal Academy of Sciences, Letters and Fine Arts, supported by the Universities of the FWB, the F.R.S.-FNRS drew up an online inventory¹⁰⁶ which is enriched on an on-going basis. Additionally, in 2021, support of just over €3.8 million was provided to doctoral students employed by universities and the F.R.S.-FNRS who currently benefit from a scholarship or work with a fellowship contract and have been impacted by the health crisis (international missions cancelled, laboratory work delayed, etc.). As the crisis also jeopardised the careers of post-doctoral researchers in the 10 years following their doctorate, the FWB Government also released €4.2 million to support post-doctoral researchers whose research has been slowed down due to the health crisis.

105. See: <https://gouvernement.cfwb.be/home/publications/declaration-de-politique-internationale/maincontentright/declaration-de-politique-internationale-2019-2024.publicationfull.html>

106. <https://www.covid19-wb.be>

In 2020, the FWB Government submitted projects to the EU's **Recovery and Resilience Facility** (RRF), notably to support the twin digitalisation and green transitions.¹⁰⁷ These include a project (with a budget of €21,25 million) to develop an inter-university technological platform for research in environmental and energy transition. The platform will host complex research projects in a variety of research domains related to the energy transition such as energy storage, smart grids, energy efficiency in buildings, biomass recovery, decarbonised mobility biomass, decarbonised mobility, etc. The research facilities in the field of energy transition will be integrated into a common platform, bringing together five universities (ULB, UCLouvain, ULiège, UMONS and UNAMUR), which have research activities in this field. This equipment, although not gathered on a single site, will be grouped in technological sub-platforms under the joint responsibility of the FWB and the universities.

4.2 ACTORS AND INSTRUMENTS OF R&I POLICY

4.2.1 Government departments and other relevant public bodies

The Directorate for Higher Education, Life-Long Learning and Scientific Research (DGESVR)¹⁰⁸ is responsible for the application of laws, decrees and orders relating to the organisation of higher education and scientific research. It is responsible for:

- ▶ Funding of higher education institutions (HEIs) including research funding (see section 4.2.2).
- ▶ Ensuring the application of the laws and regulations, directives and international conventions relating to higher education and scientific research.
- ▶ Representing the FWB within intergovernmental cooperation structures and funding programmes in the field of higher education and research at Belgian, European and international level.

Within the DGESVR, the Scientific Research Department is responsible for:

- ▶ Managing the international dimensions of research: monitoring European research programmes and promoting the participation of research stakeholders, and developing the position of FWB in consultation processes.
- ▶ Managing research funding: participating in the elaboration and implementation of the FWB research budget, liaising with the federal research programmes, informing researchers and the Cabinet of the Minister of Research about Belgian and European initiatives.
- ▶ Managing the FRHE (Financement de la Recherche en Haute École) fund for research in university colleges.

107. See: https://ec.europa.eu/info/business-economy-euro/recovery-coronavirus/recovery-and-resilience-facility/recovery-and-resilience-plan-belgium_en

108. See: <https://www.mesetudes.be/enseignement-superieur/institutions/dgesvr/>

The DGESVR staff represent the FWB in committees related to Horizon Europe (Cluster II, Excellent Science pillar, Widening participation and strengthening the ERA) and the ERA governance (Gender in Research and Innovation, Human Resources and Mobility, Open Science and innovation). The DGESVR also represents the FWB within the 'Grande Région', a territorial co-operation area covering German (Saarland, Rhineland-Palatinate), Belgian (FWB) and French (Lorraine, within the Grand Est region) partner regions, as well as the Grand Duchy of Luxembourg, in matters that relate to higher education and research (including two research-related awards).

The **Academy of Research and Higher Education (ARES)**¹⁰⁹ is the federation of higher education institutions (HEIs) of the Wallonia-Brussels Federation. It is a public body funded by the Wallonia-Brussels Federation and created by the 'Landscape' (*Paysage*) decree of November 2013. ARES brings together 127 HEIs in Wallonia and Brussels: six universities, 19 university colleges (*Haute Écoles* in French), 16 arts colleges, and 86 adult higher education colleges (lifelong learning). The HEIs host approximately 220,000 students and have some 22,000 staff members. The ARES missions include:

- ▶ Guarantee the public service mission of higher education.
- ▶ Support institutions and ensure the overall coordination of teaching, research and community service missions.
- ▶ Encourage collaboration between them, while respecting their autonomy.

These missions are in particular delivered in the research areas:¹¹⁰

- ▶ Promotion of joint research; organisation of thematic doctoral schools with the F.R.S.-FNRS; collection and processing of statistical and scientific data on the sector; collect good practices; publication of analysis and recommendations for authorities and other institutions.
- ▶ International promotion and coordination of international missions: however this mission does not include the representation of the FWB in EU committees that concern the ERA and the Horizon Europe programme, which is the responsibility of the Scientific Research Department of the DGESVR.

The activities of the ARES in the field of R&D mostly relate to the COVRI (Commission for research valorisation) and CBS (Commission for libraries and academic services) commissions. As part of the implementation of the open access policy for scientific publications, the CBS is mandated to evaluate the costs incurred by institutions in this respect. ARES also hosts the 'Femmes et Sciences' committee, established by decree on 10 March 2016 as an advisory body, to make recommendations to the Government on the issue of gender in scientific and academic careers.

109. See: <https://www.ares-ac.be>

110. From Rapport d'activité 2018-19 – published March 2020: <https://www.ares-ac.be/images/publications/rapports-d-activites/ARES-RA-2018-2019-Site-web.pdf>

Created in 2009, **Wallonia-Brussels International (WBI)**¹¹¹ is the body responsible for Wallonia, FWB and Brussels international relations. It acts as an international policy instrument for Wallonia, the FWB and the French Community Commission of the Brussels-Capital Region (COCOF). WBI's mission is to increase the impact, influence, and reputation of the Wallonia-Brussels area and of its representatives (creators, artists, entrepreneurs, students, higher education institutions, researchers, etc.). WBI's mission covers five activities: diplomatic representation; support for project development; promotion; networking; advice and strategic monitoring. WBI is also the management authority for the European territorial cooperation programmes (Interreg) for Wallonia.

In the R&I field, WBI promotes Wallonia-Brussels mobility grants in academic and cultural fields. The internationalisation, visibility and attractiveness of education, research, and training are of strategic importance for both higher education institutions and the Wallonia-Brussels Federation and Wallonia. The WBI also manages the network of Scientific Liaison Officers. The latter are, in their areas of expertise, the relay of the operators of Wallonia-Brussels research and innovation for their collaborative and partnership projects. The Scientific Liaison Officers mission concerns both basic and applied R&D matters, in particular:

- ▶ The organisation of seminars on key scientific themes;
- ▶ The organisation of networking events and visits of research infrastructure;
- ▶ Support for setting up projects and search for partners;
- ▶ The promotion of collaborative research and mobility researchers;
- ▶ Promotion of excellence science in Wallonia-Brussels and university collaborations;
- ▶ The search for funding for the development of research projects and innovation;
- ▶ The dissemination of a scientific watch and technological enhancement of existing opportunities.

The WBI Research and Innovation Department runs the Research and Innovation Platform, which brings together the main players in research and innovation in Wallonia-Brussels (universities, competitiveness clusters, clusters, science parks and incubators, research centres, agencies and ministries in charge of funding and the promotion of research, ministerial offices, etc.). This platform is also conceived as a place of exchange, where major common geographic and sectoral priorities are defined.

The **NCP (National Contact Point)** is the interface for businesses, universities, university colleges, research centres, associations and other organisations located in Wallonia and in Brussels seeking to participate in a European funded research and innovation project. For French-speaking stakeholders, three NCP structures exist: one for the Brussels Region (see section 5.2.3), one for the Walloon Region (see section 6.3.7) and a third hosted by the F.R.S.-FNRS. The thematic coverage of Horizon 2020 and now Horizon Europe is in line with the institutional distribution of competences. NCPs provide advice, guidance, and personalised assistance to set up projects and maximise the funding opportunities available from the European Commission for R&I actors from Wallonia and the FWB. The NCP-FNRS¹¹² focuses on supporting researchers from universities and other HEIs of the French Community to participate in the excellent science pillar (European Research Council, Marie Skłodowska-Curie Actions, research infrastructures).

4.2.2 Research funding in the FWB

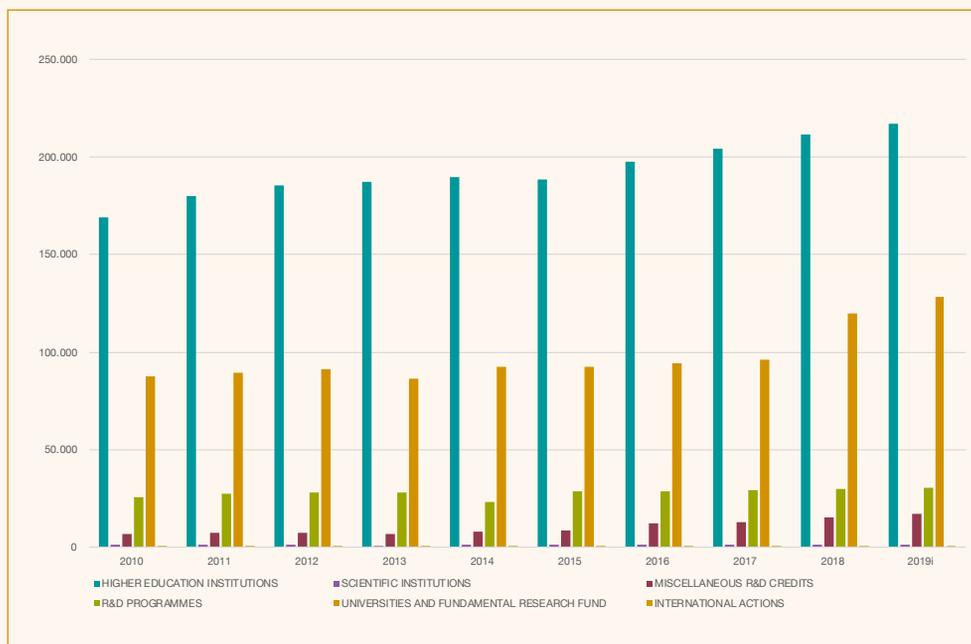
The FWB's support for scientific research operates via three main subsidy programmes:

- ▶ STEM attractiveness, including, in particular, the organisation of the Printemps des Sciences and support to SparkOH! (formerly PASS), as well as subsidies for STEM consciousness-raising actions;
- ▶ Direct support to FWB research actors, including support to research in universities, support to researchers' participation in European initiatives, knowledge sharing, travel grants, support to research infrastructures, collaborative research actions within universities and special research funds;
- ▶ Grants to the F.R.S.-FNRS to support research in higher education institutions, including the statutory grant for inter-community basic research programmes (EOS Fund) - ex PAI, the Observatory for Research and Scientific Careers and artistic research.

In the FWB, government budgetary appropriations for R&D (GBARD) have increased from €290 million in 2010 to €395 million in 2019 (3.49% AAGR), an annual average of €330 million (with a high of €395 million in 2019). As can be seen from Figure 36, the majority of GBARD is allocated via the universities' operating budget followed by the funding via the F.R.S.-FNRS for fundamental research.

112. See: <https://www.ncp.frs-fnrs.be/>

Figure 36: Trend in Government budgetary appropriations for R&D in the FWB (,000 euro)



Source: CSF/STAT

In addition to the research funding that is provided from the FWB budget to the universities via the block grant (of which a quarter is considered to be allocated for research), the FWB scientific research budget for 2020¹¹³ was €181.5 million, which is an increase of over 36% compared to the same budget for 2014. Of this total, funding for basic research was €180 million, of which the F.R.S.-FNRS budget was €143 million (78.8% of the budget), notably to fund salaries of doctoral and post-doctoral researchers, inter-university research projects, etc. (more details below).

The DGESVR directly manages the remainder of the budget. In particular, the Special Research Funds (*Fonds spécial pour la recherche*, FSR) and the Concerted Research Actions (*Actions de recherche concertées*, ARC) accounted for an additional 18% in total (9.2% each) of the research budget in 2020. These instruments aim at stimulating coordinated and interdisciplinary research between the six universities of the FWB. The FSR subsidies are distributed among the universities according to a distribution key that is based on the number of their graduates. Each university is required to make available a co-financing from their own resources. The ARC is also divided between the universities according to a distribution key, which includes criteria such as the number of European projects, the number of publications and citations, etc. The universities

113. See: <https://statistiques.cfwb.be/recherche-scientifique/budget-et-financement-de-la-recherche-scientifique/budget-de-la-recherche-scientifique/>

can propose research programmes for major, multi-year funding, ideally involving several teams with complementary multidisciplinary skills. The ARCs, which in principle last for five years and can be renewed, are aimed at developing university or inter-university centres of excellence in basic research in areas considered a priority by the universities concerned. They may also be centres of excellence that carry out both basic and applied research and aim to make economic and social use of research results.

In addition to the research activities of universities, the university colleges pursue an applied research mission (related to their vocational teaching), carried out in close collaboration with businesses. Since 2019, the university colleges can submit funding requests to the Department for Scientific Research for research projects through the Financing Research in University Colleges instrument (FRHE, *Financement de la Recherche en Hautes Ecoles*).¹¹⁴ FRHE had in 2021 an annual budget of €1 million to fund, on a competitive basis, applied and strategic research conducted in university colleges. The aim is to foster a new dynamic in the research ecosystem of the FWB, beyond the conduct of research in universities, in a diversity of disciplines, and considering the societal impact of the research.

Under the scientific research budget of the FWB, funds are also made available for studies and actions to disseminate scientific knowledge which, like the 'Printemps des Sciences', aim to raise awareness and interest among young people in studying scientific disciplines. The Printemps des Sciences is an annual scientific awareness event of FWB, which in 2021 celebrated its 20th anniversary. Activities are offered free of charge in Wallonia and Brussels by higher education institutions (colleges and universities) and partners (museums, associations, etc.). This annual event is aimed at pupils from the third year of kindergarten to the final (sixth) year of secondary school over a full week.

Since 2017, the FWB has also provided co-funding to the Scientific Discovery Centre (*Parc d'aventures scientifiques*, recently renamed SPARKOH!¹¹⁵). The centre, which originally opened in May 2000, receives financial support, via a management contract, from the Walloon Region and the FWB, as well as from institutional and private partners. Based near Mons, in Wallonia, the SPARKOH! is built on a stunning industrial site, the former Crachet-Picquery coal mine.

Created in 1928, the **National Scientific Research Fund (F.R.S.-FNRS)** is a foundation of public interest, independent from the FWB Government. In 2019 it had a budget of €207 million, of which more than 90% was financed by public funds, 75% of which was provided by the FWB. In 2019, the F.R.S.-FNRS administration was composed of 77 equivalent full-time staff, overseen by a board of directors (each of the specialised funds has a separate board of directors). The F.R.S.-FNRS mission is to develop scientific research by funding research on the initiative of researchers. It promotes the production and development of knowledge by funding directly individual researchers, as well as by funding research equipment and programmes carried out in laboratories in the FWB universities.

114. See: <http://www.recherchescientifique.be/index.php?id=1607>

115. See: <https://sparkoh.be>

Based on the criterion of scientific excellence, the financial support of the F.R.S.-FNRS is provided in several ways:

- ▶ The temporary or permanent remuneration of individual researchers;
- ▶ Funding of research teams;
- ▶ Funding of equipment;
- ▶ Participation in international networks and programmes;
- ▶ The allocation of scholarships and credits to promote scientific exchanges;
- ▶ The awarding of scientific prizes.

The F.R.S.-FNRS is also responsible for promoting to FWB researchers the European research and innovation programmes, and for supporting researchers for participation in these programmes (notably as a National Contact Point for Horizon 2020 and Horizon Europe).

The F.R.S.-FNRS funding instruments are divided into four types:

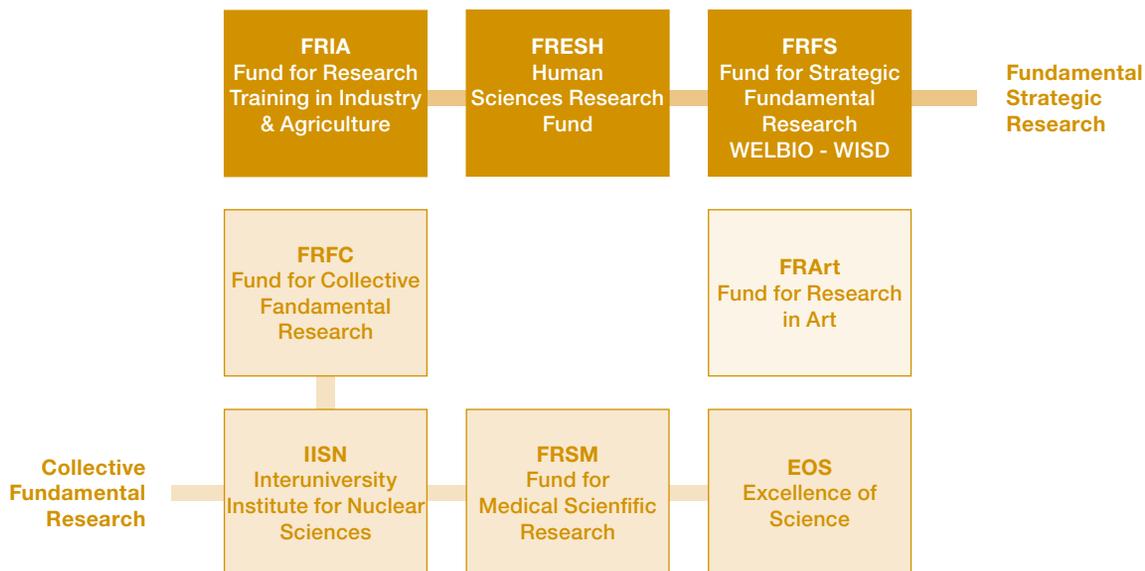
- ▶ Researcher instruments: doctoral, post-doctoral, permanent researchers and mobility of researchers (Mandat d'impulsion scientifique);
- ▶ Project instruments, funding individual or collaborative research at the initiative of researchers;
- ▶ Capacity instruments, particularly targeting research infrastructures;
- ▶ Research Life instruments, for scientific dissemination and specific needs of researchers such as mobility, congresses, etc.

These instruments are implemented within a 'bottom-up' approach: the researchers are free to propose the research theme they wish to develop, in the research institution which agrees to host them. The F.R.S.-FNRS organises three main calls for proposals:

- ▶ The 'Grants and Mandates' call: instruments funding researchers at four different skill levels;
- ▶ The 'Credits and Projects' call: instruments funding individual or collaborative research at the initiative of researchers;
- ▶ The 'Large Equipment' call: instruments targeting research infrastructures and equipment.

In some cases, however, funding addresses a major theme considered important for society, for which the F.R.S.-FNRS receives a dedicated budget: 'strategic research'. Over time, eight specialised funds (see the figure below) have been created to fund basic research done in pre-defined scientific sectors, which have been identified as strategic due either to societal needs or their potential application in the specific sectors.

Figure 37: F.R.S.-FNRS specialised funds



- ▶ The Interuniversity Institute for Nuclear Sciences (IISN) funds peaceful nuclear research, and now mostly funds Belgian projects at CERN.
- ▶ The Fund for Medical Scientific Research (FRSM) meets the specific needs of collective scientific research in the human health field.
- ▶ The Fund for Collective Fundamental Research (FRFC) encourages team-based research in all the scientific disciplines not already covered by the IISN and FRSM.
- ▶ The Fund for Research Training in Industry and Agriculture (FRIA) provides FRIA scholarship to complete a PhD in fields of research related to industry or agriculture. It is in the form of two successive grants: the 1st scholarship for a maximum duration of 27 months and the 2nd scholarship for a maximum duration of 21 months.
- ▶ In 2012, the FWB Government created the Human Sciences Research Fund (FRESH) to address the diverse and complementary needs for basic research in Humanities and Social Sciences. The FRESH Fund supports basic research projects whose conclusions are likely to improve, in the short to medium term, the understanding or operation of a sector of society at the local, regional, national or international levels, especially through cultural, economic, political, social or socio-psychological aspects. The FRESH fund provides grants for doctoral studies for four years.
- ▶ The Fund for Strategic Fundamental Research (FRFS) created in 2013 in order to ensure greater policy synergies with the Walloon Region, finances high-quality basic research in key areas for the Walloon Region, currently biomedical (Welbio) and sustainable development research.
- ▶ The Art Research Fund (FRArt), created in 2018, funds non-doctoral art research projects led by artist-researchers, individually or in groups, approved by one or more Schools of Art.

- As explained in Figure 2, the F.R.S.-FNRS has also co-managed the Excellence of Science (EOS)¹¹⁶ programme with the FWO since 2017.

In 2019, the F.R.S.-FNRS handled close to 3,800 requests for funding and awarded 2,239 grants. For expenditure, in 2019, out of a total expenditure of €189 million, 57% was awarded to individual researchers, 34% to research teams at universities and 4% to international research activities. Via the funding of researchers' salaries, the F.R.S.-FNRS employs more than 2,200 researchers (regarding gender balance, 45% were female and 55% male in 2019) at different stages of their career (1,373 doctoral researchers, 423 post-doctoral researchers and 407 permanent researchers in 2019) who carry out their research in the laboratories of the FWB's HEIs.¹¹⁷

Figure 38: F.R.S.-FNRS – amounts spent in 2019 by type of funding instrument

Funding instrument	Amount
Support to Researchers	108,933,655 €
Doctorate	38,673,789 €
Post-doctorate	17,402,857 €
Permanent Researcher	49,256,912 €
Functioning Credits	3,597,220 €
Other Support	2,877 €
Support to Research	65,260,993 €
Research Projects	22,039,186 €
Research Projects Télévie	6,318,368 €
Incentive Grant for Scientific Research	3,490,134 €
Research Credits	4,762,156 €
Equipment	2,097,047 €
Fund for Strategic Fundamental Research (FRFS/WELBIO)	7,205,875 €
Fund for Strategic Fundamental Research (FRFS/WISD)	1,033,450 €
Programme Excellence of Science	14,250,902 €
Interuniversity Institute for Nuclear Sciences (IISN)	3,061,923 €
Fund for Art Research(FRArt)	474,369 €
Other Support	527,673 €
Support to International Research	7,958,887 €
Collaborative Research	3,086,516 €
Instrument of Mobility and Diffusion	2,604,827 €
Ulysse Incentive Grant for Mobility in Scientific Research	397,800 €
Partnerships and Other Support	1,869,746 €

Source: F.R.S.-FNRS, Annual Report 2019

116. See: <http://www.eosprogramme.be>

117. See: https://www.frs-fnrs.be/docs/RapportAnnuel_2019.pdf

During 2015-2019, the implementation of the F.R.S.-FNRS' Strategic Plan (PHARE II) included additional budgetary allocations for research credits (CDR) and ERA-Nets. The Strategic Plan PHARE 2020-2025¹¹⁸ is based on two key assumptions about the research system: academic freedom and adequate financing of strategic research oriented to address societal needs. The budgetary allocation from the FWB is defined in a decree that provides a degree of stability.

An additional tool to support policy making is the Observatory of Research and Scientific Careers (ORCS) created in 2018 and hosted by the F.R.S.-FNRS. The ORCS monitors and analyses the careers of FWB researchers, developing knowledge about the doctoral and postdoctoral pathway as well as formulating recommendations to facilitate the professional integration of PhD graduates and optimise the doctoral process by making it consistent with the expectations of researchers and society. The ORCS has produced a series of reports on parliamentary discussions on research and scientific careers.

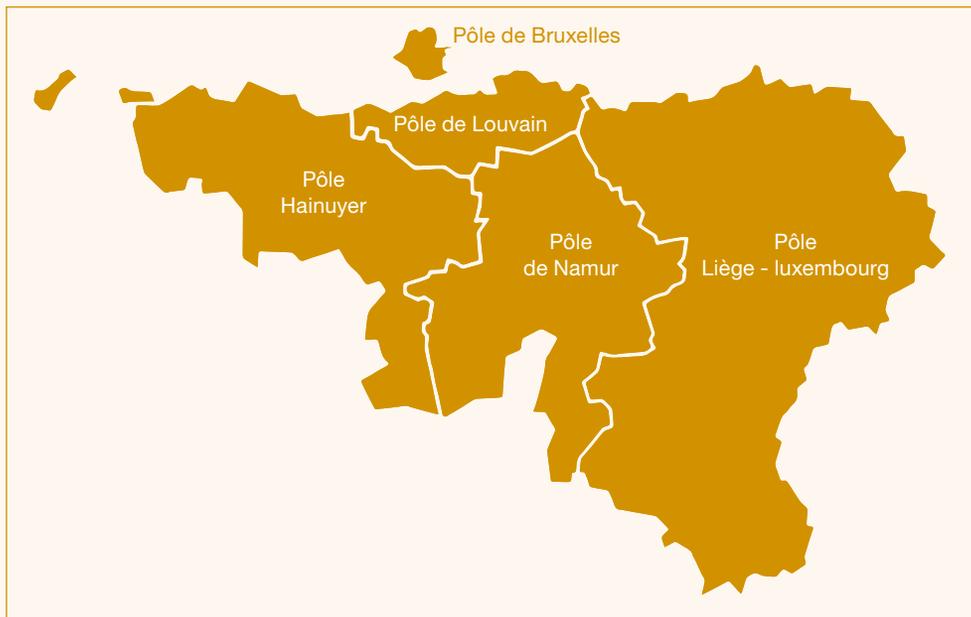
4.3 MAIN RESEARCH AND INNOVATION ORGANISATIONS

4.3.1 Universities and University College research

Since the 2013 'Paysage decree', the FWB higher education institutions are now federated in a single Academy (ARES). In addition, they are grouped in five 'academic hubs (*rôles académiques*) based on the location of each HEI and its specific institutes (e.g. the ULB has institutes in the Hainaut province and the UCLouvain medical school is in Brussels). The hubs' mission is to promote and support collaboration between the HEIs in order to offer quality services to students.

118. See: https://www.frs-fnrs.be/docs/FRS-FNRS_PHARE_2025.pdf

Figure 39: Five academic hubs in the Wallonia-Brussels Federation



Source: map <https://www.mesetudes.be>

Figure 40: Key figures on university and university college research activities

HEI	Key facts & figures
Université catholique de Louvain (UCLouvain)	3,054 researchers. R&D spending of €242 million. 22 research institutes and 25 technology platforms in health, technological and social sciences. ¹¹⁹
Université de Liège (ULiège)	3,079 researchers. 60% of annual budget of €281 million allocated to research spending. Research is structured in three research sectors and 42 research units. ¹²⁰
Université de Mons (UMONS)	1,000 researchers and 500 PhD students grouped in 10 research institutes in fields such as biosciences and complex systems. ¹²¹ The UMONS Innovation Network federates university research, spin-offs and associated accredited research centres and a living/fab lab. ¹²²

119. <https://uclouvain.be/en/research>

120. https://www.recherche.uliege.be/cms/c_9006501/en/recherche-innovation

121. See: <https://web.umons.ac.be/en/missions/research/>

122. See: <https://web.umons.ac.be/en/recherche/umons-innovation-network/>

HEI	Key facts & figures
Université de Namur (UNamur)	More than 900 researchers, 400 PhD students, R&D spending of €44.5 million, 11 transdisciplinary research institutes and 9 technology platforms. ¹²³
Université libre de Bruxelles (ULB)	3,400 researchers, 2,000 PhD students and annual research budget of €185 million. The ULB has 10 interdisciplinary research institutes in fields such as bioinformatics, cancer, neurosciences, etc. and 11 technological platforms. ¹²⁴
Université Saint-Louis - Bruxelles (USL-B)	229 researchers and 74 PhD students, 17 centres and 3 interdisciplinary institutes in social sciences and humanities. ¹²⁵
University Colleges	19 French-speaking university colleges exist in Brussels and Wallonia, with over 1,000 researchers at the associated research centres organised in seven departments: agronomy, applied arts, economics, paramedical studies, social and technical fields.

Source: information from university websites.

In addition to each university's own research activities, for example, two inter-university initiatives exist in Wallonia, one in the life science field (WELBIO) that has been operating for over a decade, and one launched in 2020 on artificial intelligence (TRAIL) (for more details see section 6.3.2).

Figure 41: The Council of Rectors

The **Council of Rectors (CRef)**,¹²⁶ created in 1990, is a consultative body created by the six FWB Universities. It is overseen by a management committee made up of the six rectors and a General Assembly composed of the rectors, the Secretary General of F.R.S.-FNRS and the Secretary of the CRef. The main activities of CRef are to:

- ▶ Develop exchange of know-how and cooperation between the universities;
- ▶ Collect and manage useful information and data concerning the universities;
- ▶ Carry out studies of relevance for all the universities;
- ▶ Communication and publication of data, information and results of studies.

The CRef has three sub-councils for teaching, research (made up of the vice-rectors for research) and international relations, which examine topics of interest to all universities. It also manages three statistical databases on: students, personnel (academic, scientific and administrative staff) and research (data on R&D expenditure).¹²⁷

123. See: <https://www.unamur.be/recherche>

124. See: <https://www.ulb.be/en/research>

125. See: <https://www.usaintlouis.be/sl/733.html>

126. See: <http://www.cref.be/>

127. See: <http://www.cref.be/annuaires/>

Prior to the 2018 elections, the CRef issued a memorandum¹²⁸ on required reforms and investments calling for measures to attract and retain the best and brightest researchers in a field of strategic interest; and to promote the training of young researchers by refinancing the FRIA and to promote and maintain efficient infrastructures research infrastructures, in coordination with initiatives of the federal authorities, and strengthening efforts to valorise research results.

The FWB Government is also responsible for funding four **academic hospitals** (out of seven in Belgium):¹²⁹ the Erasmus Hospital (ULB), the Saint-Luc and Mont-Godinne clinics (both UCLouvain) and the University Hospital Centre of Liège (ULiège). The FWB finances construction and renovation work and investment in important medical (Nuclear magnetic resonance (NMR), radiotherapy and positron emission tomography (PET) scan) equipment. An annual subsidy is paid to cover the cost of equipment for significant medico-technical services. An accommodation charge is also allocated, based on a fixed daily amount for admitted patients. Furthermore, new construction projects or major renovation works are approved by the FWB Government, according to defined priorities, and included in a quinquennial construction plan. For the period 2019-2023, a budget of €150 million was agreed for the construction plan for the four hospitals.

4.3.2 Royal Academies and other research centres and facilities

Royal Academies are publicly funded learned societies, divided by academic discipline or linguistic group. Besides holding meetings, many publish academic monographs, peer-reviewed journals and hold conferences. Three main scientific academies fall under the aegis of the FWB and notably the:

- ▶ **Royal Academy of Sciences, Literature and Fine Arts of Belgium** (*Académie Royale des Sciences, des Lettres et des Beaux-arts de Belgique*);¹³⁰
- ▶ **Royal Academy of Medicine of Belgium** (*Académie Royale de Médecine de Belgique, ARMB*)¹³¹
- ▶ **Royal Academy of French Language and Literature** (*under the responsibility of the Minister of Culture of the FWB*);¹³²

In addition, the FWB science budget provides a grant to the **Academia Belgica**¹³³ in Rome, a Centre for History, Arts and Sciences that welcomes Belgian researchers and artists in residence in Rome to pursue their work in Italy and organises scientific and cultural activities of international scope.

128. See: http://www.cref.be/communication/20181204_Memorandum_CREF_2018.pdf

129. A Council of Academic Hospitals was created in 1998 regrouping all seven academic hospitals (three in Flanders) to promote and defend the financing of their research, tertiary care and training of medical specialists. <https://www.univ-hospitals.be>

130. <https://www.academieroyale.be/>

131. <https://www.amb.be/>

132. <https://www.arlfb.be>

133. <http://www.academiabelgica.it>

In line with the recommendation of the EU Council of Ministers of December 2015, that Member States create structures to promote scientific integrity and deal with individual cases of scientific integrity violations, the two scientific Royal Academies worked together with the Vice-Rectors for Research of the six FWB universities, lawyers and representatives of the F.R.S.-FNRS to develop a **Higher Committee for Scientific Integrity**. The committee can issue recommendations and opinions on issues related to scientific integrity, either on its own initiative or at the request of the F.R.S.-FNRS, universities, etc. It is also responsible for:

- ▶ promoting the rules and good practices of scientific integrity;
- ▶ participating in European and international networks of bodies dedicated to scientific integrity;
- ▶ giving advice in the field of scientific integrity.

The committee is established within the three Royal Academies of Belgium in charge of the Minister for Research and it comprises an advisory body and a supervisory committee made up of members proposed by the universities and academies.

Co-financed by the FWB, the **Centre for Socio-Political Research and Information (CRISP)**¹³⁴ is an independent organisation that studies political decision-making in Belgium and in the European context. CRISP's work aims to show what is at stake in the political decision, to explain the mechanisms by which it is made, and to analyse the role of the actors who take part in it, whether these actors are political, economic, social or associative.

The **Meise Botanic Garden**¹³⁵ is an internationally renowned centre of excellence for plant diversity research, conservation, and documentation. Since January 2014, the Meise Botanic Garden is managed by the Flemish Government, however the scientific heritage (library, herbarium, collections) is largely federal and is given on loan to the Botanic Garden. On the site, 150 employees of the Flemish Government work together with 30 employees, the majority of which are researchers, of the FWB. The FWB is also represented on the board of directors.

The **Royal Museum of Mariemont**¹³⁶ is a scientific establishment of the FWB that manages and promotes an important collection of artworks. In addition, the museum is set in a 45 ha parkland and hosts a Regional Centre for Environmental Initiation (CRIE) funded by the Walloon Region, that carries out environmental information, awareness, education and training activities, with a view to sustainable development. In recent years, the Museum has worked with the Walloon Agency for Heritage in carrying out archaeological research.

134. See: <https://www.crisp.be/>

135. See: <http://www.jardinbotanique.be/>

136. See: <http://www.musee-mariemont.be/index.php?id=6804>

4.3.3 Technology and knowledge transfer services of the HEIs

The **LIEU (Liaison Entreprises-Universités) Network**¹³⁷ combines the expertise of the knowledge transfer offices of the six FWB universities. It fosters innovation and facilitates the access to university research competences as well as providing professional and personalised support for collaboration and knowledge transfer, right up to the completion of projects. LIEU's missions are: (1) raise awareness and inform about competences of research and opportunities of innovation; (2) detect and understand research results and innovation needs of non-academic sector; (3) facilitate the networking of researchers and socio-economic stakeholders; and (4) support knowledge transfer and collaborations between researchers and non-academic sector.

The LIEU Network's 80 specialist advisers facilitate access to the skills of more than 10,000 researchers, in all scientific fields. LIEU is organised in six working groups: agro-food; materials; health and life sciences; energy and environment; digital technologies; social sciences and humanities. In 2019,¹³⁸ 3,434 researchers were involved in awareness-raising campaigns, 965 contracts for applied research projects were signed, 195 new inventions were announced and 99 patents filed, 1,214 enterprises were matched with researchers, 171 technology transfers completed and 10 spins-off created.

SynHERA¹³⁹ is a non-profit organisation supporting and promoting the research of the university colleges and their 10 associated research centres in Wallonia and Brussels. It supports applied research and the research valorisation efforts of over 1,000 researchers working in seven main fields: agronomy, applied arts, economics, paramedical studies, pedagogy, social and technical research. More specifically, SynHERA activities include:

- ▶ Promoting applied research to meet specific needs;
- ▶ Maximising synergies between the university colleges and companies to boost innovation and develop new technologies;
- ▶ Enabling companies to access the skills and expertise of the university colleges;
- ▶ Supporting researchers in the development of their activities;
- ▶ Highlighting and disseminating the work of researchers;
- ▶ Training teaching and research staff to conduct research activities;
- ▶ Representing the university colleges to public and political authorities.

In 2019,¹⁴⁰ SynHERA published 61 calls for Proof of Concept (POC) projects in the final stage before exploitation and launch on the market with a budget of €117,000, and 22 calls for international mobility projects (budget of €36,000).

137. See: <https://www.reseaulieu.be>

138. See 2019 Annual Report: <https://www.youtube.com/watch?v=eTfsb90G2Eo>

139. See: <https://www.synhera.be/>

140. See 2019 Annual Report: <https://fr.calameo.com/read/006337097766c14a4bce4>

The institutional archive LUCK,¹⁴¹ whose acronym stands for Library of University College Knowledge, is a digital archiving platform that contains all the scientific output of the 19 university colleges and their associated research centres. This project is a concrete output of the Open Access Decree of 2018 and aims to collect and keep the scientific publications of researchers and teachers, make (as far as possible) these documents freely accessible and searchable via the Internet, and encourage research and disseminate the scientific production.

a/r asbl – art-recherche (art and research) is a non-profit organisation for the support, exchange, circulation and promotion of arts research in the Higher Schools of Arts (*Ecoles Supérieures des Arts*) of the FWB. The organisation has developed over the last decade, based on a decision that artistic creation is fundamentally unpredictable, unexpected, and even unverifiable, so that it is essential to establish evaluation and identification strategies that are tailored to these particular objects. In 2016 and 2017, a/r asbl, thanks to a public grant, organised international calls for artistic research projects and financially supported 10 selected research projects. In 2018, at the initiative of the FWB Government, the FRArt was created and provides an annual grant of €250,000. The a/r ASBL pursues this objective in close collaboration with the FRArt (Fonds de la recherche artistique of the FRSS-FNRS). From 2019 onwards, the FRArt organises the calls for proposals, while a/r asbl organises the dissemination, archiving and dissemination of research.

4.4 FUTURE R&I POLICY PERSPECTIVES

The Government of the FWB has set out a series of priorities for the coming years to further strengthen the means available to researchers and is committed to maintaining efforts to refinance research (notably, the special research funds) to contribute to the objective of investing 3% of GDP, of which 1% is financed by the public authorities. In this context, the Government also aims to ensure a fair balance in research funding between the humanities, health and science and technology fields.

At the same time, the Government is facing medium-term financial factors that may make it difficult to maintain public investment in higher education and R&D.¹⁴² The mobilisation of additional EU funding through the EU's Recovery and Resilience Plan will enable upgrading of university and university hospital infrastructure and investment in new technology platforms. Hence, while the long-run perspectives for public funding of research and research infrastructures remain challenging, the Government is committed to a structural refinancing of higher education and research to the tune of €20 million per year, with the aim to reach 80 millions in 2024.

141. See: <https://luck.synhera.be/>

142. As it does not collect taxes directly, the FWB's main sources of funding are from the tax revenues collected and transferred (based on certain criteria such as the number of students) to the FWB by the Federal Government. Due to trends in tax revenues and a structural gap in funding, by the end of the legislature in 2024, the FWB's debt is expected to reach €15 billion.

Part of the solution may come from enhanced cooperation with other Belgian authorities. The exemption of payment of withholding tax on earnings by the federal authority for researchers is a key instrument in ensuring competitive salaries at a lower budgetary cost for research institutes and the EES. The example of the Walloon Region's funding of special research funds (WELBIO) linked to regional priorities provides a model that could be expanded in the future to mobilise funding for dedicated research activities. Indeed, the Walloon Government decided in October 2021 to double the funding available to €15 million annually. An additional source of finance for the research system comes from the increasing participation of FWB researchers in European projects. The CPD foresees support for projects that have passed the threshold of excellence necessary for pre-selection but are not financed by Horizon Europe, or by granting funding to enable the initiation and resubmission of the European project.

The French-speaking higher education research system includes a varied set of institutions (universities, university colleges, art schools, etc.) and the Government is committed to supporting the development of research activities in all HEIs and to encouraging cooperation through more joint research projects amongst researchers from different types of institutions. Similarly, there is an intention to further intensify links between the actors involved in basic and applied research and to reinforce the impact of strategic research activities on economic development, the ecological transition and social conditions.

The promotion of research careers has been and remains a key priority of the FWB. The creation of the ORCS provides the Government and the research community with data to design policies and actions. Actions are also taken to promote science from the youngest age and to encourage young people of school age to pursue science, technology, engineering and mathematics (STEM) studies and ultimately careers. The underlying gender issue of research careers is visible in terms of female participation rates in STEM studies. According to data from the ARES, over the period 2004-2005 to 2017-2018, the proportion of higher education students enrolled in a STEM field of study has fluctuated around 15.5% with a maximum of 16.4% in 2004-2005 and a minimum of 15% in 2014-2015. In 2017-2018, while women represented a little more than six out of 10 students in non-STEM fields, conversely, in STEM fields, they are in the minority, their share varying from 8.5% (Information and Communication Technologies) to 40.8% (Natural Sciences Mathematics and Statistics). More positively, the number of women studying STEM has had the fastest growth rate over the period 2004-2005 to 2017-2018¹⁴³ and the gap has closed with men studying STEM to some extent. The CPD 2019-2024 foresees that the ARES will coordinate measures to improve the attractiveness of STEM fields in higher education, such as better information for students, improved collaboration between the various stakeholders and a reflection on financial incentives to enhance the attractiveness of these courses, following the example of the Netherlands.

Building on the implementation of the 2018 Open Access decree, designed to ensure free access to publicly funded research results, a working group dedicated to open science has been established which brings together representatives of the ARES, the CRef, F.R.S-FNRS, the BICfB, the DGESVR, art schools and the HEIs. This one has jointly drafted a roadmap for open science in the Wallonia-Brussels Federation that will set medium-term objectives not only in terms of open access, but also for opening up the data underlying research and promoting citizen science.

This roadmap for Open Science (2021-2022), approved by the Government, builds on the initiatives already carried out in the field of Open Science in the Walloon Federation and Wallonia, in particular the Open Access decree of May 2018, the ERA roadmap in French-speaking Belgium (2016) and the Brussels Declaration on Open Access (2012). The aim here is to extend the effort initially focused on Open Access to publications to other dimensions of Open Science - in particular Open Research Data and Data Management Plans. In addition to universities, non-university higher education (universities and colleges of art) should also be fully integrated into the reflection and implementation of Open Science. On the basis of this roadmap, several open science projects are now funded by the government each year.



**OVERALL POLICY FRAMEWORK
AND PRIORITIES**

**ACTORS AND INSTRUMENTS
OF R&I POLICY**

**MAIN RESEARCH AND
INNOVATION ORGANISATIONS**

**FUTURE R&I POLICY
PERSPECTIVES**

5 THE BRUSSELS-CAPITAL REGION

5.1 OVERALL POLICY FRAMEWORK AND PRIORITIES

Established in 1989, Brussels-Capital is a relatively young region and during the first decade it outsourced most of the research policy to the federal authorities. However, over the past two decades, it has put in place a comprehensive system to encourage, support, and monitor R&I in Brussels. Indeed, since 2004, the Brussels authorities have increased their support for R&I, recognising the potential contribution to the economic development of the city region. Moreover, with 13,000 employees, of which nearly 9,700 researchers, the research sector has a direct impact on the economy.

To understand the objectives of the regional R&I policy, it is necessary to consider certain characteristics specific to the 'capital of Europe'. Brussels is home to many higher education institutions (HEIs) in a relatively small area, as well as several leading university hospitals. The Brussels-Capital multilingual Region hosts important international, national, and regional bodies, think tanks, and, of course, EU institutions. Moreover, given the institutional landscape of the Brussels-Capital Region, its government is not the only institution developing research policies in the region. The Federal Government, which is headquartered in Brussels, retains important powers in R&I policy; similarly the Flemish Government exercises its powers in the Flemish provinces and Brussels and the FWB serves French-speakers in Brussels and Wallonia.

Since 2010, the Brussels-Capital R&I policy landscape has evolved significantly. Overall, gross expenditure on R&D (GERD) in the region has increased significantly over the last decade, rising from 12.6% of the national total to 14.2% with a notable increase in business sector R&D expenditure (112% growth rate from 2010-17). Moreover, Government budget appropriations for research and development (GBARD) increased from roughly €34 million in 2010 to €52 million in 2019.

Figure 42: Public budgets for R&D in Brussels-Capital, 2004-2009 in millions of €

2010	2011	2012	2013	2014	2015	2016	2017	2018	2019p
33896	31404	36947	29812	34441	34248	43713	45051	52975	52182

Source: BELSPO; note: i: based on initial budget data; p = provisional

Besides this public R&D budget in the strict sense, one should add the other budgets used to support R&I, such as the budget for incubators, for which more than €30 million has been invested between 2010 and 2018 in the development and operation of infrastructures offering young innovative companies an environment facilitating their growth.

Other public budgets are helping to improve the overall R&I environment. This is especially the case for business investment support (RDI and export incentives), which benefits a large number of Brussels companies. The regional public aid is added to by private investment, as well as by the programmes and investments of the FWB, the Flemish Government, plus the federal measures, in particular the R&D tax credits.

Along with the increase in financial resources, the Brussels-Capital Region has made an effort to create a clearer and more up-to-date legal framework for the various forms of aid to R&I actors, including a thorough review of the ordinance on the financing and encouragement of scientific research.¹⁴⁴ The measures to implement this ordinance are in line with those put in place a few years ago for other business support mechanisms (economic development, export support, etc.) with a view to rationalisation, consistency, and administrative simplification.

The regional R&I policy was updated in July 2016 by the adoption of the Regional Plan for Innovation (RPI) 2016-2020¹⁴⁵ which included a 45 actions strategic plan structured in four cross-cutting areas:

- ▶ Improve the innovation chain;
- ▶ Support new forms of innovation and new players in RDI;
- ▶ Improve communication and awareness around RDI;
- ▶ Ensure broad, participatory, and effective governance of the regional innovation plan.

In line with the smart specialisation concept, there is a focus on three strategic areas of activity, reflecting the core strengths of the region:

- ▶ Health – personalised medicine;
- ▶ Environment – green economy, energy efficiency, green chemistry, circular economy, mobility;
- ▶ ICT – digital economy.

The RPI 2016-2020 and the revision of the Ordinances to Promote RDI in 2017 have significantly expanded the range of tools to support innovation. These changes have opened up R&I to a wider range of actors. For example, it is now possible for non-market sector companies to participate in research and innovation projects. It is now also possible to support organisational or social innovation, and new possibilities have been created to support stages of business development that were previously ineligible for subsidy (pre-seed funding). Finally, this new framework has also led to the implementation of support for research infrastructures and innovation poles and has perpetuated the encouragement of knowledge transfer between sectors through co-creation programmes, living labs, support for KTOs, help with setting up projects, etc.

During the second half of 2018, the 2016-2020 RPI was the subject of an in-depth interim assessment by the Council for Science Policy of the Brussels-Capital Region (CPSRBC). The assessment was generally positive, particularly concerning the scope and scale of the results al-

144. Ordinance of July 27, 2017, aiming to promote research, development, and innovation by granting non-economic aid in favour of non-market organisations, research bodies, and businesses.

Ordinance of July 27, 2017, aiming to promote research, development, and innovation by granting aid earmarked for economic purposes in favour of companies and research organisations similar to companies.

Ordinance of the Government of the Brussels-Capital Region of February 21, 2019, implementing the order of 27 July 2017, aiming to promote research, development, and innovation by granting non-economic aid in favour of non-profit organisations, research organisations, and companies.

Ordinance of the Government of the Brussels-Capital Region of February 21, 2019, implementing the order of 27 July 2017 aimed at promoting research, development and innovation by granting aid earmarked for economic purposes in favour of companies and research organisations similar to companies.

145. <https://innoviris.brussels/regional-innovation-plan>

ready achieved: some 80% of the 45 actions were already operational at that time. The majority of the remaining actions could not be operationalised before the entry into force of the implementing orders of the new Ordinances (21 February 2019). Overall, the outcome of the 2016-2020 RPI is positive, with 42 actions completed (93%).

In its memorandum of June 2019¹⁴⁶ to the new regional government, the CPSRBC identified new directions and opportunities for research in Brussels, on which the future R&I strategy should be built:

- ▶ Strengthen the supply of human capital by stimulating scientific and technological careers and entrepreneurship;
- ▶ Strengthen support for innovative companies throughout their development;
- ▶ Strengthen support for potential niches of specialisation (personalised medicine and personal care, green economy, digital economy);
- ▶ Stimulate the approach to urban challenges through initiatives such as 'living labs' (e.g. Brussels Smart Mobility Challenge, 2018);
- ▶ Substantial reduction in animal experiments.

Several cross-cutting issues were also identified:

- ▶ Knowledge transfer from academia to private and public sectors;
- ▶ Taking advantage of the international image of Brussels;
- ▶ Cooperation with other regions.

A new Regional Plan for Innovation (RPI) 2021-2027 was adopted in June 2021 by the Brussels-Capital Region. More details are provided in section 5.4.

5.2 ACTORS AND INSTRUMENTS OF R&I POLICY

The two main authorities in the Brussels-Capital Region are the Parliament and the Government, which are jointly responsible for defining policies to be implemented in the context of the region's areas of competence. Since July 2019, the R&I policy has been under the responsibility of the following members of the regional government:

- ▶ The Secretary of State for the Brussels-Capital Region, in charge of Economic Transition and Scientific Research;
- ▶ The Minister of the Brussels-Capital Region Government, in charge of Climate Transition, Environment, Energy and Participatory Democracy;
- ▶ The Minister of the Government of the Brussels-Capital Region, in charge of Digital Transition.

5.2.1 Advisory body on R&I policy

The CPSRBC¹⁴⁷ was established by the Ordinance of 10 February 2000. The 20 members are drawn from the academic community (10 members) plus five representatives from the social

146. https://innoviris.brussels/sites/default/files/documents/cps_avis_51.pdf

147. <https://innoviris.brussels/cps/council-science-policy>

partners (employer associations and trade unions) represented on the Economic and Social Council of the Brussels-Capital Region (CESRBC).¹⁴⁸ The composition for the fifth term (2017-2021) of the CPSRBC was approved by the Brussels-Capital Region's Government on 26 October 2017. Council meetings are attended by observers representing regional ministers and secretaries of state, and by two experts from the collective research centres. The activities of the CPSRBC are structured along three main lines:

- ▶ Advising the Government and Parliament on strategic decision-making;
- ▶ Helping the Government define measures to address the concerns of local stakeholders;
- ▶ Assessing the effectiveness of the regional policy.

The CPSRBC has no operational role; it is politically independent and is therefore a representative forum for strategic thinking on R&I related topics in Brussels. Its views are expressed via own initiative opinions or in response to a government request. In addition, it contributes to inter-regional cooperation through regular contacts with the counterpart councils of the other two regions, and with the Federal Science Policy Council (to which two members of the CPSRBC are appointed by the Government).

5.2.2 Government departments

The Brussels Regional Public Service (BRPS) is a key institution through which the Brussels Government pursues its policy objectives. It is structured in six different administrations: the Regional Coordination administration (policy, control, expertise and support) plus five in specific fields: Economy and Employment, Finance and Budget; Housing; Mobility and Local Authorities.

The Brussels Economy and Employment department provides several services directly to entrepreneurs, the self-employed, and enterprises: grants, financing for calls for projects, financing for certified businesses, training support (paid educational leave, training fund for service voucher companies), food analyses, etc. The administration organises examinations regarding management knowledge and for access to certain professions. Businesses must apply to Brussels Economy and Employment to employ a non-European national, for certifications for temporary employment agencies and service voucher companies, registration of tourist accommodation, etc.

5.2.3 Implementing agencies

Since 2004, the Ministry of the Brussels-Capital Region no longer has a department responsible for R&I. Instead, a public agency, reporting directly to the regional minister responsible for scientific research, was created to manage the implementation of regional R&I policy. Innoviris is the main agency for R&I funding and related support activities. In addition, the Brussels-Capital Region entrusts public utility missions to other para-public bodies and non-profit organisations of regional interest. This is the case for two other main agencies, hub.brussels and finance&invest.brussels and regional non-profit organisations such as the Brussels Regional Informatics Centre.

5.2.3.1 Innoviris

Innoviris¹⁴⁹ is the regional Administration in charge of the R&I funding. Its mission is to connect, encourage and financially support citizens, companies, research institutes, and non-profit organisations in their R&I projects. The agency's tasks¹⁵⁰ are:

- ▶ The encouragement, financial support, and commercialisation of scientific research and technological innovation, within the framework of the regional policy;
- ▶ Consciousness to sciences;
- ▶ The representation of the Brussels-Capital Region in various organisations or committees concerning R&I policy;
- ▶ The provision of statistical indicators and information to Brussels research players; and
- ▶ The management of scientific research projects in an international context.

Innoviris promotes financing tools applicable to scientific research on various relevant forums. It manages databases on regional R&I. Innoviris represents the Brussels-Capital Region in various scientific coordination bodies. It also maintains international relations in this field. Innoviris prepares the indicators needed to develop an effective research policy. It also provides the secretariat of the CPSRBC.

Innoviris funds scientific research and technological innovation. Businesses, universities, and university colleges¹⁵¹ in the region can apply for financial support for research in the following areas:

- ▶ Grants and subsidies for industrial research and precompetitive development at SMEs and large businesses;
- ▶ Universities and university colleges may apply for grants and subsidies for research under the 'Brains (Back) to Brussels' and 'Prospective Research for Brussels' programmes, as well as studies on specific themes.

Innoviris also provides several services:

- ▶ Commercialising academic research results in the Brussels economy;
- ▶ Assisting spin-offs for scientific research.

Innoviris seeks to ensure adequate monitoring of funded projects. Since its creation, various measures have been launched,¹⁵² which can be classified into four categories:

- ▶ Business support;
- ▶ Aid to universities;
- ▶ Support for technology transfer; and
- ▶ Support to non-profit actors such as not-for-profit organisations and public bodies such as administrations and local governments' entities.

149. <https://innoviris.brussels>

150. The Institut d'encouragement de la Recherche Scientifique et de l'Innovation de Bruxelles (IRSIB) was created by the Order of 26 June 2003 (published in *Moniteur belge* on 29 July 2003). The Order of 26 March 2009 amended the legal framework to adapt to European directives. In September 2010, the IRSIB changed its name to Innoviris.

151. Unlike the universities, the teaching employed in the university colleges (Hautes écoles or Hogeschool) is focused on vocational learning and the world of work. Theoretical and conceptual aspects are all part of the programme with a heavy focus on internships, which are mandatory.

152. <https://innoviris.brussels/get-funded>

Most of these measures follow a similar process: annual calls for proposals, evaluation, and selection of proposals by expert juries or Innoviris experts specialised in the themes of the various calls, scientific and financial monitoring of projects selected.

Innoviris also represents the Brussels-Capital Region in various fora (information, steering committees, supervisory committees, intra-authority consultations, etc.) and negotiations in the R&I field at regional, federal (CIS, CFS, CEI), European (COST, Eureka, ERAC, etc.) and international (OECD) levels. Innoviris is also the NCP responsible for disseminating information on calls for the EU's Horizon Europe programme, in collaboration with hub.brussels.

Figure 43: Innoviris – key facts and figures

Key figures	Total subsidies awarded €49.32 million	Number of projects submitted: 709	Number of funded projects: 358
Beneficiaries	Enterprises: 90	Not for profit sector: 86	Research organisations: 16

Source: Innoviris, Activity Report 2020

Figure 44: R&I financial tools managed by Innoviris

Programmes for Academia	
Spin-off	To valorise academic research and to create a spin-off in Brussels
Proof of Concept	Adapted funding for a proof of concept for research results
Prospective Research	Funding to contribute to the future of Brussels
Programmes for Industry	
Feasibility Studies	To carry out a technical feasibility study (50 to 70% of the costs covered)
R&D projects	Financial support to develop an innovative product, process or service
Recovery of urban waste	To set up an innovative activity based on the recovery of urban waste
Corporate spin-off	To create a new entity in the Brussels-Capital Region to valorise research results
R&D projects - Covid-19	R&D projects targeting the Covid virus in several areas
Programmes for Science Promotion	
STEM Projects	Financial support for your science promotion project
Brussels Science Promotion Network	To meet colleagues and get inspired during our events
STEM Project Call-Science for Climate	Financial support for micro-projects that will get Brussels residents enthusiastic about science and technology and exciting careers in these fields; this year's theme is science and climate.

I Love Science Festival	For people active in science promotion
CanSat Belgium	For third-cycle secondary school teachers or students fascinated by science and space exploration
Brussels Science Ambassadors	For young women in Brussels excited about science and technology
Programmes for Collaboration	
Urban Europe	For international partners to find solutions for urban challenges
ERA-MIN 2	For organisations active in the raw materials sector and looking for international partners
Experimental Platforms	Funding to propose, together with other stakeholders, innovative solutions for a sustainable future
Eureka Clusters	The EUREKA clusters finance market-oriented European R&D projects
Research platforms - New Approaches of Testing	Funding to set up a collaborative and multidisciplinary project conducted by research organisations located in the Brussels Region
Eurostars	SMEs working in R&D and looking for a first international collaboration
Co-Creation	Co-creation project to make our city more resilient
Ecsel	Financial support for organisations active in the electronics market and looking for international partners
Active and Assisted Living	To find international partners for SMEs in IT or health care or working with older adults
Joint R&D Project (Towards Carbon Neutral Energy)	Funding from 40% up to 100% to develop a joint R&D project for academics and companies
Applied PhD	100% funding for PhD in collaboration with a company or administrative authority
Interregional cooperation	Financial support to collaborate with Flemish or Walloon companies or research institutions
European Digital Innovation Hubs	Network of European Digital Innovation Hubs (EDIH) in order to support the private and public sectors in their digital transformation
Eureka covid-19 call 2	This call is supported by the EUREKA association
BEL-COO	Innovate together with enterprises from Flanders, Wallonia and/or Brussels and work on a transregional research or development project

Programmes for Start-up	
Proof of Business	Funding (50 to 70% of the budget) to validate an innovative project
Bruseed	Seed capital funding for SMEs in the development or pre-commercialisation phase
Innovative Starters Award	Newly-established Brussels company can participate and win a €500,000 grant to develop its Strategic Innovation Plan
Prove your social innovation	To validate the feasibility and viability of a new socially innovative product, process or service that meets a clearly identified social need
Programmes for R&D Support	
Test your idea	To test if an idea can potentially benefit from financial support from Innoviris
Innovation vouchers	Innovation voucher for SMEs with an innovative project to validate their idea
Patents	Funding for Brussels SMEs looking to submit a patent application for their innovation
International projects set-up	Financial support to set up an R&D project
IPCEI-Hydrogen	Official call for expressions of interest (CEI) from the Belgian authorities
Programmes for Academia, Science Promotion	
Science Vouchers	To stimulate actions to raise awareness about science and new technologies among Brussels schoolchildren

Grants or repayable loans for applied research projects

Under the Community Framework for Public Aid for R&D and Innovation, industrial research (R projects) and pre-competitive development (D projects) are distinguished from each other by the tools of direct regional financial support. The level of aid granted varies according to the size of the companies (large or SMEs), the existence or lack of cooperation with university laboratories, and, where applicable, the transnational nature of the project (Eureka, Eurostars, etc.). Since 2000, 709 projects have been supported.

Innoviris selects the projects to be subsidised, within the limits of the available budgetary allocations and according to the following criteria (regional ordinance of 27 July 2017):

- ▶ The innovative nature of the project;
- ▶ The scientific or technological risks to be overcome;
- ▶ The relevance and realism of the work programme;
- ▶ The competence of the R&D team;
- ▶ The interest of the project in terms of the industrial or commercial strategy of its beneficiary;
- ▶ Prospects for achieving results;
- ▶ The potential impact of the results on the regional economy, employment, and environment;
- ▶ The beneficiary's ability to finance its share of the costs for the execution of the proposed work.

Feasibility studies and assistance to individual inventors

Only SMEs can claim financial support for feasibility studies. A subsidy can be granted by Innoviris to a company for a preliminary technical feasibility study before launching an R&D project. The study should be carried out by a specialised organisation (university, college, collective research centre) and the size of the grant will depend on the type of project (R or D). In addition, Innoviris also finances between 50 and 75% of the cost (with a ceiling of €125,000) of feasibility studies for inventions by individual inventors who officially reside in the region, if such a study is entrusted to a specialised organisation.

Figure 45: Research platforms

Research platforms¹⁵³ have been launched in the past in three regional priority sectors (ICT in 2006, health and life sciences in 2007 and environment in 2008) with the aim to strengthen the region's technological potential and to promote technology transfer between basic research and industrial research. The most recent call was launched in 2021 focused on new testing approaches in accordance with three complementary areas: tests that evaluate the environmental effects on human health; tests applied during the evaluation of new treatments; diagnostic tests and screening strategies.

The programme is open to universities, university colleges and collective research centres located in the Brussels-Capital Region, and they must submit a collaborative project. The project must involve at least two research units of two separate organisations, which have their head office in the Brussels-Capital Region and involve at least one Brussels company ('project mentor') to reflect the socio-economic interest of the proposal. The funding covers a period of a minimum two and maximum three years. Research institutes are funded at 100% and companies wishing to participate in the project may also be eligible for funding.

Filing and maintenance of patents

Aid for patent filing is a long-standing measure by which the Brussels-Capital Region subsidises the costs of filing and maintaining patents. The level of subsidy depends on the type of project (R or D). The filing and maintenance of patents resulting from the results obtained under an R&D project that has received funding from the Region can benefit from financial support covering 50% of the application and procedure cost. The intervention period is limited to four years (three years for an extension), from the date of submission of the grant application. This grant is exclusively reserved for SMEs.

Prospective Research for Brussels / Recherche prospective pour Bruxelles – PRFB

Since 2000, the PRFB programme has funded projects led by researchers in areas deemed essential for the Region. The objective is to encourage the development, within the Brussels Region, of platforms in areas of regional interest such as mobility, multiculturalism, the environment, employment, housing, etc. A researcher from a university or a university college can submit a project proposal. Each year, a control commission examines the selected projects,

153. <https://innoviris.brussels/research-platforms>

grouped by theme. The research themes are selected to cover all areas of expertise in the region, For instance, the 2021 theme was 'Questioning systemic crises and exploring possible futures', focusing on the post-COVID society. Given that Brussels political decision-makers will have to make decisions for the region's recovery and redeployment: the focus is on possible futures, which are desirable, and what can be done to achieve them. Within these themes, researchers have the freedom to develop specific research topics. There are two eligible researcher profiles:

- ▶ Profile A: young researcher (max. 30 years old), holder of a PhD (two years, renewable for two years);
- ▶ Profile B: experienced post-doctoral researcher (two years, renewable for one year).

The grants cover the salary of the researcher, the operating costs of the host laboratory, and the administrative costs of the establishment.

Figure 46: Brussels Studies

Brussels Studies¹⁵⁴ is an interdisciplinary scientific journal on urban issues specific to Brussels. It publishes research on the current realities of Brussels that are significant for the city and its region, from all disciplines. To ensure a wide distribution, each article is published in three languages: French, Dutch and English. All academic disciplines and all themes are accepted. A large amount of the research carried out under the Prospective Research for Brussels is published in Brussels Studies.

5.2.3.2 hub.brussels

hub.brussels¹⁵⁵ is the Brussels Business Support Agency that supports companies, particularly in their innovation activities. It was launched on 1 January 2018 and is the result of a merger between Atrium.Brussels, Brussels Invest & Export and impulse.brussels.¹⁵⁶ hub.brussels aims to turn Brussels into the most attractive European place to start and grow a business and it seeks to contribute to the sustainable development of the Brussels economy by fulfilling a triple task:

- ▶ Providing advice, tools, and support for economic projects and the project leaders, to make sure they are successful both in Brussels and abroad;
- ▶ Detecting, generating, initiating, and attracting new economic, technological, and commercial opportunities in Brussels and abroad;
- ▶ Helping the regional authorities to formulate and implement a proactive economic policy and to ensure a stimulating entrepreneurial ecosystem.

hub.brussels provides businesses with a single point of contact¹⁵⁷ for all the information necessary for setting up or operating a business in the Brussels-Capital Region, including innovation

154. <http://www.brusselsstudies.be>

155. <https://hub.brussels/en/>

156. Created in 2003 by the Brussels-Capital Region's government, the Brussels Business Support Agency – renamed impulse.brussels in 2013 – rapidly became one of the privileged contacts for all beginner or experienced entrepreneurs in the Brussels-Capital Region.

157. 1819 is a service offered by hub.brussels, the Brussels agency for business support. 1819 is a platform and a single information point for anyone who wants to start, grow or develop a business in Brussels.

activities. Its mission is “to be the first public entity intended for businessmen (entrepreneurs, company founders, SMEs, independents, and foreign investors) of the Brussels-Capital Region”. hub.brussels has four departments: economy and start-ups, technology and innovative projects, international relations, and urban planning and the environment.

In terms of innovation support, hub.brussels offers two types of actions:

- ▶ Collective actions underpinned by a cluster strategy: networking, internationalisation, visibility, joint projects, technology watch, thematic seminars, technological or commercial missions, and so on in six sectors: food; environment, eco-construction, health, ICT, fashion and design.
- ▶ To facilitate the start-up and growth of innovative projects: verifying the technological and competitive position, optimising the business model, seeking strategic partners, financing, mobilising public aid, notably for R&D and innovation.

hub.brussels is also part of the Brussels NCP network responsible for helping companies and research centres to access EU grants for R&D under the Horizon Europe Framework Programme. In partnership with the BECI (Chambre de Commerce et Union des entreprises de Bruxelles), hub.brussels is also the contact point in Brussels for the EEN network, the aim of which is to help companies develop internationally and make efforts to collaborate with foreign partners.

Figure 47: Other business support services and organisations in the Brussels-Capital Region

Starting a business: counselling & advice

- ▶ 1819 – Running a business in Brussels
- ▶ Accredited business one-stop shops
- ▶ Brussels Enterprises Commerce and Industry (BECI)

Localisation

- ▶ Citydev.brussels (Brussels Regional Development Agency)
- ▶ Brucentre.brussels (Network of Brussels business Centres)

5.2.3.3 finance&invest.brussels

finance&invest.brussels¹⁵⁸ provides financial support to help private businesses set up, restructure and expand in the Brussels-Capital Region. It works to attract investments in the mixed economy in the Brussels-Capital Region, providing three types of assistance to businesses:

- ▶ Facilitating and completing the financial chain for value-creating companies in the region. Depending on the project, this may take the form of capital investment (minority stake) or loans;
- ▶ Providing technical support and financial advice (financial engineering) to businesses that benefit from its investments.

The investment approach of finance&invest.brussels is based on a lasting and constructive partnership with the company, accompanying it in all phases of its development. Nevertheless,

158. <https://www.finance.brussels>

it pursues a return objective by ensuring the profitability of its investments. finance&invest.brussels provides concrete solutions to the financial needs of entrepreneurs, in the form of loans or equity investments, at key moments of their existence: creation, development, innovation, internationalisation, environmental transition, takeover-transmission.

finance&invest.brussels targets two specific audiences: start-ups, scale-ups and SMEs (investment from €100,000 to €5 million), and very small enterprises (VSEs), social enterprises and cooperatives (investment from €5,000 to €150,000).

For start-ups, scale-ups and SMEs, as a first step, the viability and potential of a project are analysed in order to propose the appropriate financing solution. Based on the market's needs, the product offering will comprise five financial instruments that can be combined as needed:

- ▶ Equity investments;
- ▶ Mezzanine debt;
- ▶ Convertible loans;
- ▶ Loans and co-financing;
- ▶ Warranties;
- ▶ ProxiNew loan, which mobilises the savings of private individuals ('Family, Friends and Fools') to finance a Brussels-based self-employed activity or SME.

The financial products also target individuals, micro-enterprises, social enterprises, cooperatives and certain non-profit organisations. The financial intervention varies from €2,500 to €100,000 in the form of a loan, while capital interventions are up to €150,000.

finance&invest.brussels also handles, since 2016, the operational management of the Brussels Guarantee Fund.¹⁵⁹ This facilitates the granting of business credits in the Brussels-Capital Region by providing credit institutions, in return for the payment of a single flat-rate contribution, with a substantial part of the guarantees they require from SMEs and the self-employed.

5.2.3.4 Brussels Regional Informatics Centre (BRIC)

The BRIC¹⁶⁰ is a public administration that aims to become the technologically neutral, competitive, reliable, and high-quality partner of all public institutions in the Brussels-Capital Region that wish to take an informed and proactive approach to introducing innovative and coherent ICT – so as to maximise their efficiency as well as to provide the people and businesses of Brussels and visitors to the city with user-friendly services.

The Brussels-Capital Region Government aims to make Brussels a full-fledged Smart City,¹⁶¹ an attractive and inclusive region where new technologies underpin sustainable economic growth with sensible resource management and contribute towards improving the quality of life of every individual. The Government views the Smart City as a platform for innovation and local participation where the public sector, academia, private interests and citizens can meet and exchange to generate new value, cooperate and create together. The BRIC participates in this model

159. <http://www.fondsbruxelloisdegarantie.be>

160. <https://cirb.brussels>

161. <https://smartcity.brussels>

through its platforms for sharing ICT for public services and is hence a core element in achieving the Smart City ambition.

5.2.3.5 Perspective.brussels

The main role of Perspective.brussels, the Brussels Planning Agency (BBP-BPB) is as a centre of expertise for the regional development strategy. It is responsible for statistics, socio-economic information, and strategic and regulatory planning in the Brussels-Capital Region. In addition to these roles, the BPB also brings together various strategic services to support regional development: the team of the Brussels chief architect (bMa), the Schools Facilitator and his team, and the new Housing Officer. Perspective.brussels is also consulted for projects related to smart cities. The combination of different forms of expertise at Perspective.brussels helps ensure a coherent process for the development of urban projects. The Knowledge Department plays a crucial role: through diagnosis, observation, and prospecting, it constructs a vision of the Brussels urban landscape with a view to effective regional planning. Among other things, this knowledge is the basis for the strategic and regulatory work on regional development. Within this framework, the Strategy Department defines the programming of the priority areas (definition studies, master plans, etc.) and lays the foundations for their concrete development. The strategic work also involves defining the vision of regional development implemented in tools such as the Regional Sustainable Development Plan or the Regional Land Use Plan. This development is governed by regulatory provisions such as the Brussels Regional Development Code or the Specific Land Use Plans. Finally, the Strategy Department builds networks of urban development actors at the metropolitan or international levels.

5.2.3.6 Digitalcity.brussels

Digitalcity.brussels¹⁶² is a training-employment hub that brings together the key players in the digital professions and training in Brussels. It carries out skills monitoring and it communicates to and links companies and job-seekers through training and raising awareness about digital careers.

Figure 48: Other training support organisations in the Brussels-Capital Region

- ▶ Bruxelles Formation
- ▶ Regionale Dienst voor beroepsopleiding Brussel (VDAB)
- ▶ Syntra Bruxelles (Dutch training centre for entrepreneurs and future entrepreneurs)
- ▶ Ichec Entreprise
- ▶ Solvay Entrepreneurs
- ▶ Espace Formation PME

162. <https://digitalcity.brussels/fr/homepage>

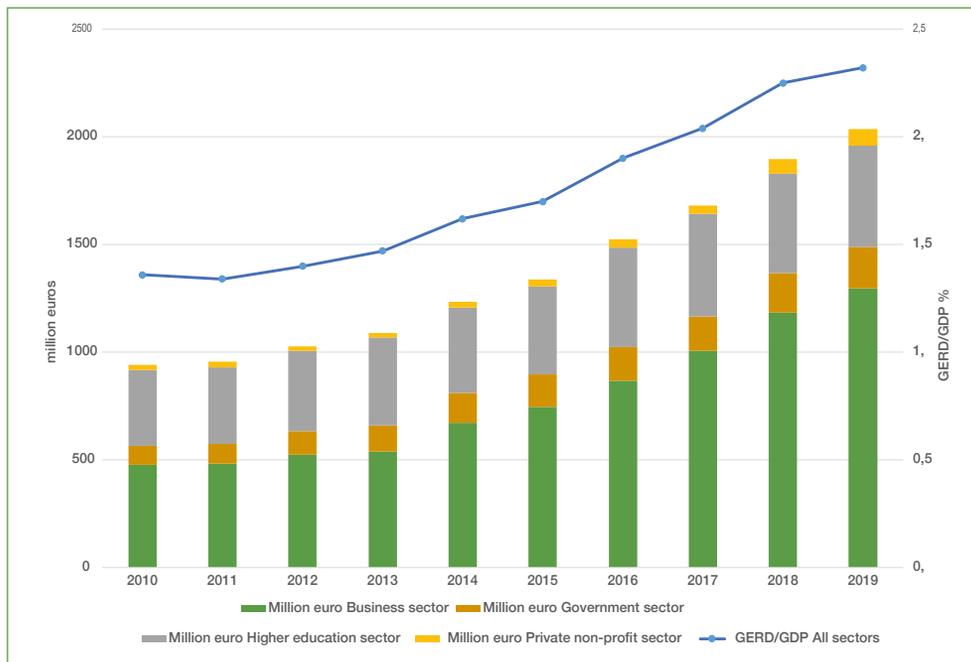
5.3 MAIN RESEARCH AND INNOVATION ACTORS

The Region's R&I performance is good and improving, meaning it is ranked in the 'Innovation leader' category in the European Regional Innovation Scoreboard 2021. It is the best performer in scientific co-publications, sales of innovations on the market and in companies, product and process innovations, innovative SMEs. R&D expenditure also shows a converging trend towards the EU27 average and the share of Brussels employment in R&D represented 16% in 2017, higher than other regions. At the same time, the regional GERD/GDP ratio was 2.35% in 2019, below the Belgian average of 3.17% and most other European capitals perform better on this indicator than Brussels. The main reason for this relatively low level of R&D (particularly in companies) in Brussels is the relative weakness of the high and medium-high technology industrial sectors, where the level of R&D intensity is typically the highest, such as the pharmaceutical industry or electronics. This deficit is understandable given the small and urbanised nature of the Brussels territory and its status as an international city with a focus on administrative functions. Employment is concentrated in public administration, specialised, scientific and technical activities, and human health (40% in total). Moreover, employment in the manufacturing industry is in continuous decline and is expected to fall from around 45,000 to 20,000 jobs between 1995 and 2025.

More positively, the Brussels-Capital Region experienced increasing productivity up to 2019, with a growing emphasis on information-intensive sectors. However, the COVID-19 crisis triggered an estimated productivity decline of 8% for 2020. Moreover, the rate of net business creation is the highest of the three Regions. ICT and digital services represent by far the most important field of start-ups, but there is also a substantial development of new companies in mobility and transport, health and finance.

The Brussels-Capital Region has two major characteristics. Expenditure within the public sector in the broad sense (public authorities, higher education) is particularly high, which is logical given the relatively large number of universities, university colleges and scientific establishments located in the region. Public sector R&D accounts for almost half of total R&D expenditure in the Brussels Region, compared to an average of around 30% in Belgium. On the other hand, the share of R&D expenditure in the private sector is much lower, compared to the national and European averages. Even though this sector is the most important in terms of the performance of R&D in Brussels (approximately 60% of total expenditure), its weight is lower than the Belgian average (70%).

Figure 49: Gross domestic expenditure on R&D (GERD) by performing sector, Brussels-Capital Region, 2010-2017



Sources: BELSPO, EUROSTAT.

Between 2010 and 2019, R&D expenditure increased considerably. Indeed, the regional Government included the 3% of GDP invested in GERD target in its 2019-2024 majority agreement. The business sector has experienced the most significant growth in R&D spending, more than doubling between 2010 and 2019. Higher education spending has also increased steadily since 2010 and is less subject to economic fluctuations. This expenditure corresponds mainly to the investment and funding of the FWO and FNRS in HEIs. Figure 49 shows the evolution of GERD by sector of performance since 2010.

5.3.1 Higher education institutions

Due to the federal structure of Belgium, HEIs are the responsibility of the communities and those located in Brussels are presented in section 3.3.1 for Dutch-speaking HEIs and in section 4.3.1 for the French-speaking HEIs. Universities and university colleges located in Brussels have created business-research interface structures to commercialise their scientific and technological potential and for the benefit of the region's economic activity. The mission of these interfaces is to promote and facilitate collaboration between universities and external partners (government authorities, companies, the social and cultural sector, etc.) in terms of scientific services, R&D, commercialisation of research results, and participation in the local and regional development. They play a dual role of leader and coordinator of the activities concerned, and they

function as advisers and support for university teams and their external partners. For more information, see 4.3.3 on the French-speaking HEIs' networks of interface structures (LIEU and SynHERA).¹⁶³

5.3.2 Collective research centres

As explained in Figure 2, collective research centres provide contract R&D, technological knowledge and technical support services to help companies from specific sectors. Three of the CCR are co-financed by the Brussels-Capital Region: BRUFOTEC,¹⁶⁴ SIRRIS¹⁶⁵ and the BBRI.¹⁶⁶

5.3.3 Clusters

In a region where the tradition of collective action is weaker than in the industrial basins of the rest of Belgium, the clusters were designed as a form of business club, aiming to promote co-operation and exchanges between members and to subsequently expand to other partners based on identified needs or opportunities. Given the limited size of the industrial sector in Brussels, there are very few sectors where the entire value chain is present in the region. Consequently, hub.brussels adopted, from the outset, a horizontal approach bringing together companies with growth potential and similar activities. The objectives pursued by the clusters are to increase the visibility of their members, thereby strengthening the innovative image of the region, and promoting the international development of the clusters and their members. Activities carried out include the development of websites presenting the directories of cluster members, joint stands at major industry events (Bio USA, Medica, Cebit, MIPIM), interregional partnerships through programmes such as INTEREG; study missions, activities within the framework of the EEN on technology transfer, business development, etc. Currently, there are five clusters in the region:¹⁶⁷

- ▶ Circlemade: circular economy
- ▶ Ecobuild: sustainable construction and renovation
- ▶ Lifetech.brussels cluster for healthy technology professionals (including MedTech accelerator)
- ▶ Hospitality.brussels cluster for tourism, culture, and events industry
- ▶ Screen.brussels for the audio-visual media industry

5.3.4 Incubators

An incubator is a real estate structure linked to a university or a university college that hosts, under advantageous financial conditions, spin-off companies or other start-up companies resulting from scientific research. In this way, small businesses benefit from offices and laboratories with fully integrated services as well as personalised technological and administrative support, and in-depth assistance in all areas relating to the running of a company, technology vali-

163. <https://www.helddb.be/fr/recherche/centre-de-transfert-de-technologie-indutec>

164. <http://www.brufotec.be/>

165. <https://www.sirris.be/>

166. <https://www.cstc.be/homepage/index.cfm>

167. <https://hub.brussels/en/services/clusters-to-grow-in-your-sector/>

ation, access to equity financing, grant funding, etc. Currently, the Brussels-Capital Region hosts four technological incubators:¹⁶⁸

- ▶ Inaugurated in 2012 at the initiative of the Brussels-Capital Region and the UCLouvain, the Brussels Life Science Incubator (BLSI) supports life sciences and health start-ups originating from the research community located on the Brussels campus of the UCLouvain. The campus includes the Cliniques universitaires Saint-Luc, the faculties of medicine and dentistry, pharmacy and public health together with five internationally-renowned research institutes (de Duve Institute, Institute of NeuroScience, Institute of Experimental and Clinical Research, Institute of Health and Society, Louvain Drug Research Institute).
- ▶ EEBIC was created 25 years ago to manage a hosting space for start-ups. EEBIC has widened its spectrum of activities considerably, by establishing a series of channels dedicated to the financing of entrepreneurial projects.
- ▶ GREENBIZ supports projects that focus on sustainability and the circular economy. This incubator offers modular offices and production facilities as well as a fab lab.
- ▶ ICAB supports innovative projects in the information technology and engineering sector.

5.4 FUTURE R&I POLICY PERSPECTIVES

In the three decades since the region's creation, the central concern of R&I policy, as in other areas, has been to develop budgetary means, a legislative framework, and support measures. The system has now reached a level of 'maturity' and it is time to look ahead and reflect on how to further optimise the policy and align it with the evolving needs of the actors in the regional innovation system. A key issue that is constantly present is, of course, the place of research in a region like Brussels-Capital. In a series of recent documents and debates, certain common themes emerge: R&I are essential for the general development of Brussels, and the region has all the essential assets to become a leading knowledge city. The issue is how to foster the development of R&I and how to maximise the benefits for the region's economy and population.

The development and implementation of a general integrated R&I strategy in Brussels is undoubtedly the challenge to be met in the coming years. Considering the urban specificity of Brussels and its structurally difficult budgetary situation, it is essential to use the available means in the best possible way. This requires developing the identified R&I potential to contribute to the regional growth and prosperity objectives for all in Brussels.

5.4.1 Regional Innovation Strategy for Smart Specialisation (RIS3) for the period 2021-2027

The new European framework for innovation policy postulates that research and innovation should contribute to social, climate, and economic progress. This shift in approach is at the heart of the European Green Deal, the framework for the development of all European Commission support and funding programmes, which triggers a range of important initiatives affecting regional, industrial, and innovation policies. This new framework puts climate objectives on the same level as economic and social objectives for the first time and aims to achieve them in a

168. <https://incubators.brussels>

coherent way. This focus on societal challenges and impacts is also operationalised in the ‘mission-oriented’ approach that has been adopted in the new European research and innovation framework programme Horizon Europe 2021-2027, which succeeds Horizon 2020. Important new European initiatives and investments in, for example, the circular economy, the bioeconomy or digitalisation (digital transition) also explicitly link the strengthening of competitiveness with the achievement of climate objectives.

The approach adopted for the development of the new Brussels RIS3 is in line with this trend and is explicitly demand-driven. The development process, therefore, started with the identification of the region’s main challenges and the societal needs of its citizens and it links them to the potential of the Brussels R&I ecosystem. The intersection between these challenges and the research and innovation potential lead to the identification of new strategic innovation areas (SIAs). These form coherent sets of activities around which to mobilise regional R&I investments and knowledge capital to contribute to a number of socio-economic transitions.

In a collaborative and inclusive spirit, the development of the new RIS3 and the RIP 2021-2027 includes a broad consultative component. It mobilises the known players in the Brussels innovation system (triple helix), but also new players who are less visible in this system (quadruple helix). This consultation allows for a detailed understanding of the specificities of the Brussels terrain and ensures the selection of BIDs that are deeply rooted in the wider RDI ecosystem.

This consultation also implies a new way of mobilising and organising RDI strengths and competencies in other types of partnerships and projects. There will be a greater role for social and organisational innovation in new forms of cooperation or organisation, with new types of actors (micro-enterprises, social and democratic economy, civil society, non-profit – quadruple helix).

The European and regional contexts are obviously also strongly impacted by the COVID-19 crisis, which highlights fundamental issues such as ‘resilience’ (of industry, economy, health care, and the whole society) and strategic autonomy (local production), which can be supported or improved through innovative solutions. The Brussels-Capital Region Recovery Plan, like all regions impacted by the health crisis, aims to mitigate the negative economic effects and to redouble efforts to increase the resilience of the regional economy, with direct implications for innovation policy in the short and medium-term.

5.4.2 RIS3: Overall trends and regional priorities

The Brussels-Capital Region R&I policy priorities fall under four main headings linked to the economic, societal, ecological and social transitions that are central to the political strategies. The economic development and innovation priorities are expected to contribute to the achievement of these transitions.

The ecological transition towards a zero-carbon region focuses on strategies and activities to mitigate the impacts of climate change (in particular the reduction of direct and indirect CO₂ emissions – with a target of total decarbonisation by 2050 – and adaptation to the effects of new climatic conditions), as well as better resource and waste management. These orientations focus strongly on the energy transition including renewable energies, smart grids, low-carbon

production, and green mobility, as well as on the circular economy, low tech, and recycling, reuse, and repair technologies.

The social transition guarantees the conditions for a dignified life and aims to fight social exclusion, reduce the poverty rate and wage and sub-regional inequalities, to increase the employment rate and the quality of jobs, accessible and safe housing and public green space for all, minimise the consequences of the digital divide, and ensure better health and well-being for all. Innovation policy will contribute to this transition by a better activation of social innovations and 'responsible research and innovation', by the adequacy of spatial planning that takes into account the mechanisms of diffusion, multiplication, and spatial valorisation of innovations, of new infrastructures and methods of learning and training, of new approaches and technologies of care and biomedicine (prevention, psycho-social health, personalised medicine, e-health, etc.).

Economic and innovation policies and strategies in Brussels Region are being put at the service of social and ecological transitions, aiming at a sustainable, resilient, and inclusive economy. The main levers include:

- ▶ A strengthening of the productive capacity in the region to compensate for permanent de-industrialisation, in particular through the promotion of crafts and short/local chains and of the social and collaborative economy.
- ▶ Accelerating the digital transformation of enterprises (with a particular focus on SMEs) for the transition and development and implementation of urban digital services, such as mobility, energy, health, housing, etc. ('smart city').
- ▶ A 'post-COVID-19' resilience that requires more innovation and new business models in many sectors of the economy.

Finally, there is an explicit acknowledgment of the need for a transition in governance and public services in the Go4Brussels 2030 policy statement and strategy. Firstly, the social and ecological transition requires an adapted and innovative governance involving multiple actors: local, regional, federal and European, political, administrative and non-profit, citizens, companies, and researchers/experts. Services to citizens should become more accessible, and participatory, partly facilitated by the digital transition (e-governance). In addition, administrative and government services (serving the local, regional, federal, and international levels) play an important role in the socio-economic fabric of the region and represent a potentially interesting demand pool.

5.4.3 Strategic Innovation Areas of the Regional Innovation Plan

Six societal challenges were identified by combining global challenges with the political priorities for the Brussels-Capital Region: Climate & Energy, Resource Optimisation, Mobility, Healthy & Sustainable Food, Health & Well-being, and Participatory & Inclusive Society. These challenges were juxtaposed with the regional R&I strengths to define one cross-cutting Strategic Innovation Area (SIA) and five thematic SIAs. The cross-cutting SIA 'Advanced digital technologies & services' is one of the key drivers of the current RPI and is critical to the implementation the thematic SIAs. The five thematic SIAs identified represent innovation opportunities for the economic development of the region and have the potential to effectively tackle societal challenges. They have been defined to stimulate a coherent set of innovative activities, while maximising synergies between sectors, technologies, disciplines, and actors. The thematic SIAs are:

- ▶ Climate: Resilient Buildings & Infrastructure;
- ▶ Resource Optimisation;
- ▶ Efficient & Sustainable Urban Flows for Inclusive Urban Space Management;
- ▶ Health & Personalised and Integrated Care; and
- ▶ Social Innovation, Public Innovation, and Social Inclusion.

5.4.3.1 *One transversal SIA: Advanced digital technologies and services*

In the Brussels-Capital Region, advanced digital technologies and services –considered a success factor for the thematic SIAs – are included as a transversal strategic innovation area. The SIA ‘Advanced Digital Technologies and Services’ includes the following sub-areas:

- ▶ AI and computer vision;
- ▶ Machine learning;
- ▶ Big data;
- ▶ Sensors & Internet of Things;
- ▶ Cloud computing;
- ▶ Cybersecurity;
- ▶ Blockchain;
- ▶ Location technologies;
- ▶ Advanced detection technologies; and
- ▶ Digital twins.

The digital sector is significant in the region. According to the inventory of AI-related initiatives, more than 2,000 companies are active in ICT in the territory or its surroundings. These are mostly (very) SMEs, but there are also some major players. In addition, the universities located in Brussels are home to (at least) 13 laboratories/research centres with about 600 researchers specialised in AI, both in theoretical and applied research.

Collaboration within this ecosystem led to the creation of the AI Institute for the Common Good (FARI)¹⁶⁹. FARI aims to develop a sustainable societal impact and change the digital life of citizens, ensuring that digital solutions are beneficial and available to all, inside and outside Brussels. To reach this goal, the Institute will provide advice and training for the development and deployment of AI products and services for the well-being of society. Furthermore, FARI will create a hub of economic activity in the AI field by supporting existing players and by developing new technology companies in Brussels. FARI will also help to focus investment-related economic policies on sustainable research and innovation, particularly in the field of digitalisation. This initiative is one example of the strategic and transversal aspect of this SIA. In conclusion, through this SIA and its objectives, the Brussels RIS3 will further support this ecosystem and promote the development and application of digital technology in a targeted way.

5.4.3.2 Climate: resilient buildings and infrastructures

The Climate and Energy SIA brings together all the innovation activities that will help limit the effects of climate change. This SIA includes the following sub-domains:

- ▶ Construction 4.0 – sustainable, circular, and automated: this sub-domain includes all innovative activities within the building sector, which is particularly predominant in the Brussels Region.
- ▶ Water and soil management tools/systems: this includes all types of tools or systems that allow the optimisation of water management, with the aim of limiting potential floods.
- ▶ Tools/systems for managing heatwaves and heat islands/pollution peaks; these innovation activities are mainly focused on urban-scale control of temperatures, which can be applied to buildings and infrastructures.
- ▶ Natural solutions / biodiversity / urban agriculture: this sub-domain is integrated into the SIA because of its role on climate resilience. Indeed, urban agriculture activities present a multitude of positive attributes (flood management, improving biodiversity, food production, social support) and should be part of the reflection on a sustainable built environment.
- ▶ Cleantech systems: this sub-domain gathers innovation activities that allow cleaning of the environment, mainly through water and air management. Cleantech also revolves around techniques and services that use natural resources, energy, water, and raw materials, with the aim to significantly improve their efficiency and productivity.

5.4.3.3 Optimal use of resources

This SIA responds primarily to the challenge of optimising resources, as its name indicates, particularly through the Regional Programme for the Circular Economy (PREC). All the innovative activities grouped under this heading aim at using fewer resources in the production of goods and services throughout the life cycle. This SIA brings together the following activities:

- ▶ Waste flow management – circular value chains;
- ▶ Resource/material use management;
- ▶ Sustainable / ecological / biobased design & manufacturing;
- ▶ Predictive & precise maintenance;
- ▶ Circular and resource-efficient agri-food;
- ▶ Innovative systems for renewable/sustainable energy flows, including storage;
- ▶ Technologies and methods for optimising/reducing energy consumption; and
- ▶ The functionality economy, i.e. innovative activities that aim at extending the life of products used by customers as long as possible.

5.4.3.4 Efficient and sustainable urban flows for inclusive management of urban space

This SIA has a broad scope, directly related to the challenges of mobility, inclusive and participatory society, but also climate & energy and resource optimisation, and even access to healthy and sustainable food. The SIA is more generally part of societal transitions (social, ecological, and economic) towards a more resilient, sustainable, and inclusive city.

Central to this SIA is the challenge of ensuring optimal accessibility and/or efficient and sustainable access for all to all urban (public) functions and services, which are currently limited by various physical (mobility, mesh, etc.) and social (limitation of means of transport, etc.) barriers and mechanisms. Therefore, this SIA gathers the innovative activities related to promoting:

- ▶ Accessible and safe public space and collective services (as the main urban function);
- ▶ Efficient, comfortable, and safe ways to move to any destination according to one's own preferences and possibilities (intelligent travel/mobility flows);
- ▶ Optimal access to urban (public) functions and services for all their (potential) users;
- ▶ The reorganisation and adaptation of infrastructure and connectivity at the neighbourhood and metropolitan level to facilitate mobility for all and optimal physical access to urban functions and services for citizens;
- ▶ The development and organisation of accessible and safe public space; and
- ▶ Facilities and applications in the field of logistics and supply optimisation (last mile organisation, urban hubs/micro-logistics, alternative delivery/distribution modes, etc.);

The concept and principles of the '10-minute city (on foot or by bike)' as deployed in many cities (Paris, Melbourne) in recent years can serve as a reference framework. In this respect, the application of digital technology can be important in this SIA. This particularly concerns the development and integration of digital tools and services for mobility and traffic management, both for individual and collective use ('smart mobility'), and for facilitating access to urban (public) functions.

5.4.3.5 Health & Personalized & Integrated Care

The Health & Personalized & Integrated Care SIA aims to contribute directly to develop new innovative solutions in the sub-domains laid out in this section (patient-centred, accessible, and inclusive medical care and treatment with a focus on overall wellness). This SIA focuses on accessible care and healthy behaviour. The SIA is essentially in line with the Regional Health and e-health Plans, and more generally with the social transition for a dignified life in healthy conditions. The sub-areas of this SIA can be divided into two main blocks:

Organization of care

- ▶ Development of holistic care approaches and offers, with an increased focus on prevention, healthy behaviours, and psychosocial aspects; and
- ▶ New forms and models of cooperation and organization for coherent and integrated care chains, patient-centred, near and/or home, ambulatory and residential, etc.

The implementation of these new approaches and models can be facilitated by the development of:

- ▶ Digital/high-tech tools and services for the organization of care and health management by both professionals and users of care, allowing a more active role in its care pathway;
- ▶ E-health applications for the management and sharing of patient medical data (computerised medical records);
- ▶ Personalised medical devices facilitating adapted treatments for the individual patient; and
- ▶ Organizational, process, or social innovations focused on the person and physical accessibility.

Advanced medicine

- ▶ Development of new advanced and/or predictive clinical diagnostic and therapeutic applications and solutions, e.g. specific test methods (biomarkers);

- ▶ Customised bio-/nano-pharmaceutical products or treatments, e.g. cell therapies and regenerative medicine based on blood components, hormones, antibodies, enzymes; and
- ▶ Precision/robotic treatment and surgery, based on medical devices.

5.4.3.6 *Social innovation, public innovation, and social inclusion*

This SIA aims to address the challenge of innovating towards an inclusive and participatory society. It is dedicated to tackling major challenges linked particularly with the fight against inequality and exclusion, the fight against poverty, access to employment and the development of quality jobs, and education and training. All recent studies show that these problems tend to worsen because of the health crisis. As such, it will be an important source of research topics.

It also allows for the mobilisation of new forms of innovation and all the actors of the quadruple helix to accentuate the aspects of user/customer orientation, cross-sectoral, functionality, and uses, etc. These dimensions receive a little less attention within innovation policies, although they contribute to building a more inclusive society and boosting innovation in public services.

The topics include:

- ▶ A response to Brussels' social and societal challenges (e.g. the fight against poverty, the development of quality jobs and new forms of employment, the fight against exclusion and social and gender inequalities, access to social rights, access to housing, etc.).
- ▶ Social innovation as a new and innovative response to emerging or insufficiently satisfying social needs, by integrating into its development the participation and cooperation of local stakeholders, particularly beneficiaries, clients, operators, users, citizens, etc.
- ▶ New forms, approaches, tools of participative & inclusive governance (e.g. co-creatives and cooperatives).
- ▶ Digital tools & services to facilitate optimal virtual access to urban public functions and services, especially 'GovTech', both for citizens and companies as well as for administrations and public authorities.
- ▶ Digital tools and services to facilitate citizen involvement in public governance/consultation, that can be grouped under the name 'CivicTech', i.e. the set of processes, tools, and technologies that enable the improvement of the democratic functioning of societies and communities by reinforcing the role played by citizens in debates and decision-making.
- ▶ Tools and services for the dissemination of knowledge. This sub-field includes scientific mediation for better positioning in society and on the job market. and
- ▶ Innovation in the cultural and creative industries to strengthen social cohesion, (re)energise neighbourhoods, and promote the dissemination of knowledge.



**OVERALL POLICY FRAMEWORK
AND PRIORITIES**

**ACTORS AND INSTRUMENTS
OF R&I POLICY**

**MAIN RESEARCH AND
INNOVATION ORGANISATIONS**

**FUTURE R&I POLICY
PERSPECTIVES**

6 WALLONIA

The Walloon Region had a population just under 3.65 million inhabitants in 2021. As explained in section 1.1, the Walloon Government has competence for R&I, business support, regional socio-economic development, energy, environment, agricultural and life-long learning policies, etc. The GDP per capita in Wallonia in purchasing power standards (PPS) in 2019 was €26,700. At current prices, Wallonia's GDP amounts to €110 billion or 23% of the Belgian total, a share which has remained relatively constant over the decade since 2010. Over the period 2009-2019, the average annual growth of Walloon GDP was +1.5%. This growth is lower than that observed in Flanders (+1.8%), but higher than that measured in Brussels (+0.8%).¹⁷⁰ Per capita, Wallonia's GDP is 85.7% of the EU27 average (2019) and is close to that of Estonia and Slovenia. The Walloon economy was traditionally based on a mix of heavy industry and agriculture but has gradually transformed over the last three to four decades. Compared to the sectoral structure of Belgium as a whole, Wallonia's economic activity has a pronounced specialisation in the pharmaceutical industry and specialisations in the manufacture of chemicals and plastic products, in the production and distribution of water, in public administration, in education and health services and in real estate and housing services.

A key challenge for Wallonia is to close the productivity gap with other Belgian regions, although the situation varies a sub-regional level, as the Walloon Brabant province is amongst the most productive in the EU27. Improve productivity is particularly important in the service sector and will require increased investment in R&I and digitalisation of Walloon businesses and public services.

6.1 OVERALL POLICY FRAMEWORK AND PRIORITIES

6.1.1 Main policy priorities and actions 2010-2020

In Wallonia, R&I policy has significantly evolved over the last decade. From 2006, a series of 'Marshall Plans'¹⁷¹ were launched that sought to drive the redevelopment of Wallonia by mobilising public and private investment and creating or reforming a series of institutions and policy instruments. During the period 2006-2014, these plans were approved by both the Walloon Government and the FWB Government and set a framework for financing interventions by both authorities. The last plan, the Marshall Plan 4.0, had a budget of €2.9 billion for the period 2015-2019 and focused on five priority axes: 1) make human capital an asset, implemented in close collaboration with the FWB, to develop skills in line with socio-economic needs; 2) supporting industrial development via innovation and business growth (notably via the smart specialisation priorities defined by the competitiveness clusters, see below); 3) territorial economic development (economic activity zones, multimodal solutions, etc.); 4) support, energy efficiency and transition and the circular economy; and 5) digital innovation (via the Digital Wallonia Strategy). In the last decade, R&I policy was based on the further development of the six competitiveness

170. Source: <https://www.iweeps.be>

171. These were the Marshall Plan 2006-2009, Marshall Plan 2.0 Vert 2009-2014 and the Marshall Plan 4.0 2014-2019. See <https://economie.wallonie.be/content/plan-marshall-40> for a summary of the process (in French).

clusters ('pôles de compétitivité'), initially launched in 2006, with the aim to boost the involvement of businesses (of all sizes) in conducting R&D and innovation, through collaborative projects (see section 6.3.3). The six 'poles' bring together large companies, SMEs, higher education institutes and research centres to implement applied industrial research, investment and training projects. They also aim to give a stronger international visibility to the key Walloon fields of economic and research and innovation activity. The competitiveness clusters were the priority areas for the 2014-2020 smart specialisation strategy and thus for the use of R&I funds under the ERDF operational programme. Other relevant plans adopted during this period include the first Digital Wallonia strategy (actions to support the development of the digital sector, digitalisation of industrial sectors, intelligent and connected territories, public sector digitalisation and digital skills); and the Walloon investment plan (2019-2024),¹⁷² adopted in January 2018. The latter focused investment on 31 projects with €79 million allocated to R&I and digital technologies, including for the development of research infrastructures in the fields of animal genetics, proton therapy and reverse metallurgy.

The impact of the Walloon R&I policy over the last decade can be measured both by the trends in key R&I indicators and via the results of evaluations and studies carried out on the R&I policy. On an aggregate level, the Regional Innovation Scoreboard 2021 classifies Wallonia as a strong innovator and the regional innovation performance has increased by 20% since 2014, with a particularly strong performance relative to the EU average on collaboration by innovative SMEs and innovation expenditure per person employed. In terms of a more precise estimate of the policy impact, an evaluation of the competitiveness clusters policy was carried out by the IWEPS in 2019. The results confirm that the intervention mobilised initially the 'R&D and innovation (RDI) 'heavyweight' companies of the Walloon economy, those which account for a significant share of RDI carried out by the private sector. Over time the clusters have also begun to mobilise a broader range of smaller innovative firms. Supporting the emergence of a new pool of innovative businesses and promoting their involvement in competitiveness clusters were identified as a challenge for the process of 'entrepreneurial discovery' promoted by the competitiveness clusters. The evaluation found that the clusters had an impact on the economic performance of the companies, with companies financed seeing the volume of employment, value added and exports increasing faster than companies not supported by the clusters. On the other hand, the results were more mixed in terms of the impact on the performance of RDI, with the only observable positive effect being in terms of the percentage of employees involved in R&D. The evaluation underlined the need to reinforce the commercial application of R&D results to increase the impact on the business sector performance.¹⁷³

172. See: https://gouvernement.wallonie.be/files/Documents/PWI/PWI_texte%20du%20plan_V3.pdf

173. See: <https://www.iweps.be/publication/politique-poles-de-competitivite-cadre-de-strategie-de-specialisation-intelligente-analyse-evaluative/>

6.1.2 Policy priorities 2019-2024

Following the 2019 elections, the Walloon Government's regional policy declaration (RPD) set out the main priorities for the period 2019-2024. The priorities are further developed via a series of strategic plans,¹⁷⁴ generally developed via a consultative process with stakeholders. These include the renewed smart specialisation strategy (S3)¹⁷⁵ (adopted March 2021) as well as related digital¹⁷⁶ and circular economy¹⁷⁷ (adopted February 2021) strategies. In addition, in response to the COVID-19 pandemic socio-economic impact, the Walloon authorities developed the Get Up Wallonia! plan¹⁷⁸ and, submitted 29 investment projects for funding via the EU's Recovery and Resilience Fund (RRF)¹⁷⁹ including several with a R&I angle.

The RPD 2019-2024¹⁸⁰ set out a 'triple ambition': social - to reduce poverty and improve quality of life, ecological - to ensure Wallonia has achieved carbon neutrality by 2050 and restored biodiversity, and economic - to make Wallonia one of the best performing traditional industrial regions in Europe. The RPD includes an ambitious plan to invest €4 billion, including R&I funding, to help make the triple transition a reality. The competitiveness clusters remain a core element of the industrial (applied research) policy with an intention to align their operations with the triple transition goal, notably by improving their impact on economic development and the signing of performance contracts that will ensure their interventions contribute in a more integrated fashion to the implementation of the new S3 2021-2027. The RPD reconfirms the commitment to the 3% GERD/GDP target and aims to raise public and private R&D investments to 4% of GDP by 2035. The RDI policy actions foreseen are broad-ranging, and include increasing the use of innovative public procurement, ensuring access to open data, enhancing synergies between the accredited research centres. A key priority is to overhaul and rationalise support structures for innovation and, more broadly, economic promotion (information, awareness, financing, support).

In the RPD, the Government underlined that the new S3 would provide a framework for developing and implementing a new policy mix. The S3 renewal was conducted during 2020 via, despite the pandemic, an inclusive and interactive co-creation approach, with strong involvement of stakeholders from the 'quadruple helix'. By taking the response to societal challenges as a starting point, the approach was demand-oriented: it responded to needs and was open to new perspectives and practices. The process aimed to define where, with whom and how the Walloon innovation ecosystem will be able to provide (at least partial) answers to these challenges in the form of innovative solutions, and how it can accelerate societal transitions necessary for the future development of Wallonia. This process resulted in the identification of five Strategic Innovation Areas (SIA) as summarised in the following diagram.

174. See: <https://www.wallonie.be/fr/plans-wallons>

175. See: <https://economie.wallonie.be/content/smart-specialisation>

176. See: <https://www.digitalwallonia.be/fr/publications/2019-2024>

177. See: https://content.digitalwallonia.be/post/20210310121023/rapport_circular_wallonia_def_v6.pdf

178. See: <https://www.wallonie.be/fr/actualites/get-wallonia-remise-du-rapport-du-conseil-strategique>

179. See: <https://www.wallonie.be/fr/actualites/plan-de-relance-pour-leurope-les-projets-proposes-par-la-wallonie>

180. See: <https://www.wallonie.be/fr/actualites/declaration-de-politique-regionale-du-gouvernement-wallon-2019-2024>

Figure 50: Six societal challenges and five strategic innovation areas – S3 Wallonia 2021-2027

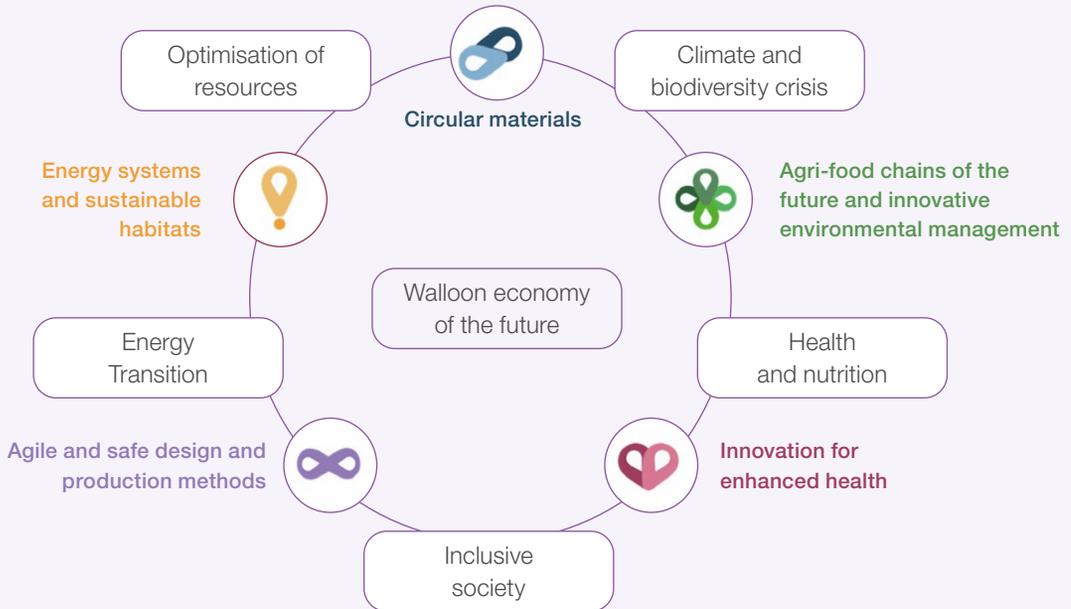


Figure 51: Strategic Innovation Areas 2021-2027

Strategic Innovation Areas	Description and keywords
Circular materials	Innovative activities linked to circularity (ecodesign, industrial symbiosis, reuse, repair and recycling) of materials, with a view to reducing the consumption of resources, increasing regional autonomy and developing new market opportunities. These activities are based on strong regional technological expertise in materials processing, as well as on the presence of valuable natural resources.
Innovations for enhanced health	An ambitious and coherent set of innovative activities of a technological, organisational and social nature to ensure the transformation of the health system in the broad sense, in its preventive, diagnostic and curative missions. These innovations will contribute both to consolidating Wallonia's distinctive strengths as an international leader in bioterapy and medical technologies, and to meeting the challenge of preserving health capital for all citizens, a challenge reinforced by the COVID-19 crisis.

Strategic Innovation Areas	Description and keywords
Innovations for agile and safe design and production methods	Innovative activities related to Industry 4.0 and advanced manufacturing processes, the development of digital technologies for the modernisation of production tools, the development and integration of advanced or composite materials, as well as additive technologies. It concerns the entire manufacturing industry, logistics, market services and agricultural production. It is based on the distinctive skills of Wallonia in areas such as advanced manufacturing (e.g. additive) and advanced materials, the Internet of Things, Artificial Intelligence and digital simulation (including digital twins) as well as in design and simulation tools for the design of new inserts, motors and structural parts.
Sustainable energy systems and housing	New solutions for the green energy transition and the housing of the future. It is based on the distinctive strengths in engineering, design and simulation of more energy-efficient systems and parts, energy storage, flexible integration and management of energy within buildings and smart communities (smart grids, micro-grids, etc.), but also on the opportunities linked to the development of new energies and new insulating materials and/or energy sensors (including energy recovery from biomass), as well as on the application of innovative concepts in civil engineering, architecture and town planning.
Agri-food chains of the future and innovative management of the environment	Innovative activities to support the emergence of products and services with high added value and high market potential within a sustainable agro-food system. To ensure the long-term sustainability of natural ecosystems (soil health and water cycle) on which the production of healthy food products depends, Walloon potential will be strengthened in the field of environmental services for monitoring ecosystems and biodiversity, ecologically intensive agriculture and in terms of sustainable agricultural/forestry innovation.

Each SIA is expected to take account of cross-cutting dimensions, notably digitalisation and a transition to a low-carbon economy. Digital technology is viewed as both a lever for the implementation of the SIA and a growth factor: digital innovations developed in Wallonia can be exported and contribute to developing a high-value added Walloon digital technology sector, notably in Artificial Intelligence, the Internet of Things and cybersecurity. In terms of implementation, the S3 defined nine guiding principles that will serve as a framework for the co-design by the relevant stakeholders of roadmaps and strategic innovation initiatives for each SIA.

Based on roadmaps developed by the key stakeholders for each SIA during the first semester 2021, a first call for strategic innovation initiatives was launched in September 2021 with a closing date in mid-November 2021. The SIIs are defined as coherent and sufficiently critical sets of activities and projects federating the distinctive strengths and relevant actors in response to one or more ambitions of one or more SIA. The call for SII does not lead to direct funding. The ul-

timite objective is to ensure a concentration of efforts and resources for the realisation of strategic initiatives that will enable the ambitions set by the Government to be achieved.

A first key principle is that over the 2021-27 period a minimum of 75% of the total regional RDI funds will be concentrated on the five selected SIAs; a maximum of 25% may relate to financing initiatives not falling under the SIA themes. In the case of the Strategic Objective 1 (A smarter Europe) of the European Structural and Investment Funds (ESIF) Operational Programme (OP) 2021-2027, the alignment of proposed projects with SIA roadmaps will be one of the selection criteria.

In 2021, the Walloon Government submitted 29 projects under the EU's **Recovery and Resilience Facility** (RRF)¹⁸¹ with an emphasis on the green transition, including circular economy, digitalisation, sustainable and multi-modal mobility, quality of life, etc. The relevant R&I projects include:

- ▶ *Circular Economy*: the objective of the project is to accelerate both the development in Wallonia (i) of structures oriented towards the functional economy (ecodesign, repair, rental, loan, pooling, symbiosis, etc.) and (ii) of a platform of industrial, technological, scientific and operational support excellence in the field of innovative selective collection of resource-waste (notably through landfill mining), reuse, upcycling and recycling. It mainly focuses on two of the six priority value chains of the Walloon circular economy strategy, Circular Wallonia, namely that of metallurgy and construction/renovation/demolition.
- ▶ Development of a Walloon hydrogen sector: this project aims at deploying technologies based on hydrogen produced from renewable energy sources in order to address the Belgium and Wallonia objectives to achieve climate neutrality in 2050 and to reduce greenhouse gas emissions by 35% by 2030. The hydrogen project will include a set of coherent sub-projects that cover the entire green hydrogen production sector as well as multiple applications of hydrogen as an energy carrier in the form of e-methane, e-methanol, e-kerosene as well as the adaptation of devices (engines, hydrogen tanks, fuel cells, among others) to allow its use and recovery. They target development of material and specialised production (green e-methane from the CO₂ recovered via CCU, carbon-free e-kerosene), research into the development of the hydrogen combustion in certain applications, and sectoral integrations of hydrogen in transport or industry sectors with an energy chain linking production, transport and targeted use.
- ▶ EU BioTech School & Health Hub: the project aims at creating a European school of biotechnology and health hub. The hub is a new multi-operator and multi-partner vocational training centre on campus. It is an accelerator dedicated to the development of talents, skills and companies in the biotechnology and health sector. This project is complementary to the already existing training initiatives in the field of health and biotech (Cefochim in Wallonia and Vi-Talent in Flanders) and these operators may be partners of the EU Biotech school and Health Hub. The Hub will focus on: STEM education, biofabrication and supply chain management, data and digital, and soft skills.

181. See: <https://borsus.wallonie.be/home/presse--actualites/publications/facilite-pour-la-reprise-et-la-resilience--la-wallonie-adresse-ses-projets-a-la-commission-europeenne.html> and https://ec.europa.eu/commission/presscorner/detail/en/IP_21_3147

As noted above, since 2015, Walloon policy has strongly emphasised supporting the transition to a digital society and economy. An updated Digital Wallonia strategy for 2019-2024¹⁸² was adopted in 2018. The strategy is structured around eight cross-disciplinary challenges that form a framework for all the decisions made and the measures taken within the five core themes:

- ▶ Digital sector: a strong, innovative digital sector to harness the added value of the digital economy, to the benefit of the region and all of areas of activity.
- ▶ Digital economy: support and speed up the digital transformation of its businesses by boosting competitiveness and innovation in Walloon businesses using digital technology.
- ▶ Digital government services: offer a new experience when it comes to government services thanks to online services and the activation of public data.
- ▶ Digital territory: implement a transparent, ambitious policy for the digital development of the Walloon Region thanks to high-quality fixed and mobile infrastructures in order to support the digital transformation of its businesses and its citizens and turn Wallonia into a 'Giga Region'.
- ▶ Digital skills: foster the digital transformation via acquiring technological skills, adopting entrepreneurial habits and the take-up of the tools of digital citizenship.

A growing focus is given in Wallonia to improving the position of Walloon business, HEIs and research organisations in European and international research programmes and initiatives. The 2020 International Policy note¹⁸³ of the Walloon Government outlined strategic actions in the R&I field:

- ▶ Promotion of scientific and technological research excellence by organising foreign missions of delegations of academic and research, business and policy representatives.
- ▶ Develop funding programmes in line with the S3 priorities and promote existing funding sources.
- ▶ Carry out a scientific and technological watch exercise to detect funding and partnership opportunities, expertise and main foreign trends.
- ▶ Promoting and networking research and innovation operators through conferences, participation in fairs and exhibitions or via official Belgian missions.
- ▶ Support young entrepreneurs in their international expansion.

To position Wallonia more strategically in Europe, the note proposes to create a collaborative platform 'Wallonia meets Europe', coordinated by the WBI. The platform is expected to coordinate, rather than duplicate, existing operators and actions to support Wallonia to both ensure Walloon priorities are clearly presented at EU level as well as ensuring Walloon operators have access to information on EU priorities and are supported to seize funding opportunities across a range of programmes (Green Deal, European Innovation Council, etc.). In 2021, a review of past participation by Walloon R&I actors in the EU's R&I Framework Programme (Horizon 2020 period) was being undertaken to identify means to further strengthen the support provided (e.g. via the NCP, see section 6.3.7) and to leverage a greater return from competitive European programmes (Horizon Europe, etc.).

182. See: <https://content.digitalwallonia.be/post/20181206135839/2018-12-06-Digital-Wallonia-2019-2024-GW-Complet.pdf>

183. See: https://dirupo.wallonie.be/files/Diplomatie%20de%20la%20Wallonie_NPI.pdf

Figure 52: Research and innovation measures to tackle COVID-19 in Wallonia

From the outset of the health crisis, a series of research projects and initiatives were rapidly launched in Wallonia and Brussels to combat the COVID-19 virus and its consequences on health, society and the economy. Numerous skills and expertise in all fields of science have been associated with them.

In 2020, the Walloon Government implemented a COVID-19 measure,¹⁸⁴ with a budget of €25 million, to facilitate research projects within Walloon companies in the context of the fight against the COVID-19 pandemic. Other Walloon initiatives in the field of R&I are:

- ▶ Welbio set up a platform (as part of the Walloon Clinical Research Infrastructure Network)¹⁸⁵ that promotes clinical studies to tackle the COVID-19 pandemic and especially vaccine development.
- ▶ BioWin,¹⁸⁶ The Health Cluster of Wallonia, has set up an interactive platform to gather healthcare initiatives around specific and important themes.
- ▶ Need4Health¹⁸⁷ is a platform to identify healthcare professionals and companies, mainly Walloon, active in Medtech, e-health or autonomy, and providing solutions with a positive impact on COVID-19 crisis management
- ▶ The Walloon Creative Hubs, Fab Labs and research centres CRA mobilised rapidly to propose innovative solutions that met the urgent needs of hospitals and health professionals.¹⁸⁸

6.1.3 Trends in regional public funding of R&I

As noted in section 1.3, the government budgetary appropriations for R&D (GBARD) in Wallonia have fluctuated over the last decade in Wallonia from €263 million in 2010 to €284 million in 2019, with an annual average of €302 million and a high of €380 million in 2014. The distribution of GBARD by socio-economic objective (annual average for the period 2010-2019) illustrates the strong emphasis on R&D related to industrial production technologies (84% of GBARD), then the environment (6.6%), political and social systems (4%) and agriculture and energy.

On an operational level, the SPW EER divides funding for R&D into four main expenditure categories:

- ▶ Appropriations to finance regional R&D programmes;
- ▶ Research funding within the framework of regional plans (Marshall Plans, Investment Plans, etc.);
- ▶ Appropriations to co-finance the European Structural Funds programmes;
- ▶ Budgetary funds.

184. See: <https://recherche-technologie.wallonie.be/fr/menu/acteurs-institutionnels/service-public-de-wallonie-services-en-charge-de-la-recherche-et-des-technologies/departement-de-la-recherche-et-du-developpement-technologique/direction-des-projets-de-recherche/mesures-cloturees/covid19.html>

185. See: <https://rechercheclinique.be>

186. See: <https://biowin-cooperation-platform-covid-19.b2match.io/>

187. See: <https://need4health.be/>

188. See: <http://europe.wallonie.be/node/542>

From 2015-2019, most of the expenditure (€152 million out of €249 m in 2019) was provided via general appropriations to the various regional R&D programmes (see section 6.2.4), followed by funding for research allocated via the regional plans (€66 million in 2019). Most of the fund committed was for projects funded via either calls for proposals (€104 million in 2019) and funding requested via on-request R&D and innovation funding (so called '*aides guichet*', €97 million in 2019)

6.2 ACTORS AND INSTRUMENTS OF R&I POLICY

6.2.1 Policy advice

As noted above, the Walloon policy process includes a significant number of plans and strategies, many of which include elements of relevance in the context of a broad-based approach to research and innovation. The policy process in the region tends to be driven by the Government (ministerial) agenda, with the Walloon Parliament scrutinising the policy interventions proposed and debating and voting on related legislation. While there is not a research and innovation policy committee in the Parliament, there are various consultative bodies and mechanisms (e.g. the consultative process applied during the design of the new S3) that provide opinions and advice on policy and legislation.

The RPD 2019-2024 underlined the Government's intention to intensify interactions with civil society, notably via the **Economic, Social and Environmental Council of Wallonia** (*Conseil économique, social et environnemental de Wallonie* – CESE), which is the regional consultative assembly composed of representatives of employers' organisations, trade unions and environmental organisations. The CESE participates in the definition and assessment of the results of the economic and social development policies for Wallonia. The Science Policy Committee (*Pôle Politique Scientifique*, PPS)¹⁸⁹ is composed of 21 members appointed by the Walloon Government: 10 representatives of the social partners, six members from universities operating in the region, two members from non-university higher education institutions; two representatives of research centres; and a representative of environmental associations. The PPS is an advisory body responsible for providing advice on research and innovation policy, including the budget and participation of the Region in national, inter-regional and international R&I activities, at the request of the Walloon Government or on its own initiative. For example, recent opinions of the PPS concern the newly adopted S3 for 2021-2027 and measures to improve the attractiveness of STEM education. In line with its mission, the PPS publishes an evaluation report, every two years, on the Walloon and FWB science and innovation policies. The most recent report covers the period 2018-2019 and was published in December 2020.¹⁹⁰

6.2.2 Government policy departments

In Wallonia, the Minister primarily responsible for research and innovation policy is the Minister of Economy whose portfolio covers a series of related policy areas. The directorate-general of the Public Service of Wallonia (SPW) administers government policy and the SPW Economy, Employment and Research is principally in charge of R&I policy, although other SPW may also provide funding or support initiatives in their field of competence.

189. <https://www.cesewallonie.be/instances/pole-politique-scientifique>

190. See: <https://www.cesewallonie.be/publications>

Over the last decade, the Walloon administration has developed, in the context of the on-going decentralisation of powers (e.g. the 6th Belgian State Reform in 2013) in order to ensure an effective design, delivery and evaluation of government policy. The Walloon Public Service (*Service Public Wallon*, SPW) is composed of eight directorate-generals (DGs), two of which provide cross-cutting management services (the Secretariat General and the SPW Budget, Logistics and ICT) and six which are responsible for specific policy fields. The **SPW Economy, Employment and Research (SPW EER)** is the DG with principal responsibility for matters concerning R&I policy. Other DGs also have financial instruments or activities related to R&I, notably the SPW Agriculture, Natural Resources and Environment (SPW ARNE), the SPW Territory, Housing, Built Heritage and Energy (SPW TLPE) and the SPW Mobility and Infrastructure (SPW MI).

Figure 53: SPW EER organisational chart

Department of weapons and defence-related products export licences		Directorate-General			Operational and Support Management	
Departments						
Employment & Professional Training	Investment	Economic Development	Competitiveness and Innovation	Research and Technological Development	Financial Management	Social and Economic Audit
Units						
Employment and Work Permits	Investment Programmes	Social Economy	Economic Policy	Support and Awareness	Financial Management	Coordination and Support of Social and Economic Audit
Promotion of Employment	SMEs	Thematic Projects	Corporative Networks	Research Projects	Financial Analysis	Social and Economic Audit of Hainaut
Professional Training	Equipment of Activity Parks	Commercial Set-Up	Cooperation and Framing	Research Programmes		Social and Economic Audit of Liège
Transversal Policy Region/ Community		Enterprise Development				Social and Economic Audit of Namur, Walloon Brabant and Luxembourg
Local employment						

Source: adapted from the SPW EER report 2020

The SPW EER is structured in seven main departments (see Figure 53), with the departments of research and technological development and the department of competitiveness and innovation being principally responsible for R&I policy matters. However, the increasingly broad scope of innovation in policy means that other departments also play a role, notably in terms of training and skills and economic development and productive investment. Faced with major changes in the economy – globalisation, digitalisation, climate challenges – the SPW EER seeks to be a driver of business growth, to safeguard and develop quality employment and to support innovation.

In the three areas of competence, the SPW EER's mission is to incentivise economic development through financial support for projects, regulating economic development and ensuring compliance with economic and social legislation. It provides strategic advice on Walloon economic and social policy, as well as providing coordination and operational support for the implementation of Government policies (e.g. competitiveness clusters). In its fields of activity, it ensures the monitoring, management and control of aid co-financed by European funds.

The SPW EER also plays an important role in representing Walloon interests and coordinating Walloon participation in EU programmes. For the period 2021-2027, they are mainly the Research and Innovation Framework Programme (Horizon Europe), the European Innovation Council, European industrial policy initiatives (e.g. clusters, value-chains) and inter-regional investment Instruments.

The SPW EER is also responsible for the management of European Partnerships under Horizon 2020 (Era-nets) and Horizon Europe (Innovative SMEs, Clean Transition, Key Digital Technologies, etc.) and analyses the possibility to integrate the European missions (quadruple helix) on cancer, soil health, smart cities, climate adaptation proposed by the European Commission under Horizon Europe.

In terms of R&I policy, the relevant departments of the SPW EER are responsible for the management, supervision and evaluation of specific programmes, funding schemes for innovation and applied research via on-demand applications or dedicated calls for proposals. Depending on the instrument, the eligible participants can include companies, universities, university colleges and research centres, etc. or a mix of these types of beneficiaries. A number of activities are aimed at the dissemination and awareness-raising on science and technology and innovation for young people and the general public.

From a more holistic innovation perspective, the SPW EER manages and oversees various programmes and initiatives related to entrepreneurship, vocation training, innovation advisory services, creativity (e.g. the creative hubs funded under the ERDF OP during 2014-2020) and digital transition (Industry 4.0, etc.). In addition, a number of policy instruments are managed by the regional agencies: SOWALFIN, the Walloon digital agency (AdN), the Walloon Export Agency (AWEX), Wallonia-Brussels International (WBI), or the regional training agency (FOREM).

In 2020, the funding allocated for R&I-related activities by the two main SPW EER departments was more than €385 million, with a split between R&D funding and innovation funding of roughly 90%/10%.

Figure 54: Main R&I funding streams of the SPW EER in 2020

Department	Funding allocated 2020
Competitiveness & Innovation	€3.1 million in grants to the six competitiveness clusters and seven business clusters
	€6.25 million funding for seven creative hubs, six fab labs and three living labs
	€17.8 million for projects funded under the Digital Wallonia Plan
	€14.8 million funding for creative and cultural industries (audio-visual, gaming, design, etc.)
Research	€344 million for R&D funding: of which €170 million for SMEs, €59 million for university research, €61.3 million for large enterprises and €44.4 million for research centres.
	€1.5 million for innovation vouchers (253 vouchers)

Source: SPW EER Annual Report 2020

Over the last decade, the R&I budget of the SPW EER has varied annually between €275 million and €330 million on average, with the EU Structural Funds contributing a significant share of funding (15% roughly) through the ERDF operational programme. The split in funding allocated between enterprises and research operators (universities and research centres) is roughly 50/50 in terms of expenditure by the SPW EER department of research.

The 2014-2020 ERDF OP priority 2 funded a total of €490 million in projects from 2014-2020, with an ERDF contribution of €166 million and a regional co-financing of €226 million.¹⁹¹

The total funding was divided between three main types of action:

- ▶ Reinforcing R&D capacities of research organisations in fields relevant for SMEs (38%) – investments in cutting-edge equipment and research projects, and the commercialisation of results.
- ▶ Increasing regional innovation through collaboration between public research centres, universities and enterprises (28%) – notably the COOTECH measure for collaborative research and technology vouchers and intellectual property vouchers for SMEs.
- ▶ Increasing the number of product, process and service innovation via increased open innovation and R&D and innovation in firms (35%) – including funding for demonstrators and pilot facilities and the development of a network of ‘creative hubs’.

Other SPW departments – such as agricultural natural resources and environment (SPW ARNE),¹⁹² transport and mobility, energy,¹⁹³ etc. – are also involved in funding R&D, including through EU instruments such as ERA-NETs. For instance, the SPW ARNE draws up a triennial plan for agronomic research with the support of a Consultative committee that proposes priority themes, taking account of the RPD and Wallonia’s commitments (e.g. organic agriculture

191. Source: Evaluation of the ERDF Operational Programme 2014-2020

192. See: <https://www.wallonie.be/fr/acteurs-et-institutions/wallonie/departement-du-developpement-de-la-ruralite-et-des-cours-deau-et-du-bien-etre-animal/direction-de-la-recherche-et-du-developpement>

193. See: <https://energie.wallonie.be/fr/recherche-et-developpement-en-energie.html?IDC=8180>

targets), needs of the Walloon agricultural sector and state of the art and inventory of research carried out previously. However, the available budgets are relatively limited, in the order of €3-4 million per year. SPW ARNE is also participating in several ERA-NETs including Core organic, C-IPM and Susan.

6.2.3 Implementing agencies

SOWALFIN¹⁹⁴ was created in 2002 by the Walloon Government in order to facilitate access to financing for Walloon entrepreneurs, from the self-employed to SMEs, by offering guarantees to cover bank financing and various financing products. In 2018, SOWALFIN absorbed the entrepreneurship promotion and business development missions of the former Agency for Enterprises and Innovation (AEI). SOWALFIN now has the role a role of steering and coordinating all the publicly funded operators that intervene during the business support process: awareness, information, guidance, support and financing. It plays this role at all stages of a company's life cycle: incubation, creation, development, transmission, as well as for cross-cutting aspects such as innovation or environmental resource management. In 2018, the Government mandated SOWALFIN with the task of reforming the business advisory and support landscape to improve the readability of trades and actors; a variable level of professionalism across operators and an absence of evaluation of the results and the quality assessment of services provided. The 2019 RPD confirmed the objective to ensure that the region will reinforce the support for the self-employed, cooperatives, micro-enterprises and SMEs and social entrepreneurs, by strengthening the steering role of SOWALFIN over the landscape of business support structures via an intervention logic of partnership, coherence, evaluation and efficiency. This reform was on-going in 2021 and details are provided in section 6.3.4.

In terms of finance, in collaboration with various partners, SOWALFIN plays a complementary role to the banks. It contributes to business at each stage of the life cycle: from creation to transmission, including growth, internationalisation, the development of new products or eco-transition projects. The funding is provided through and with a network of partners such as the Walloon Investis (investment and financing companies with mixed capital); 12 partner banks; and the European Investment Bank. In 2019, the activities of the SOWALFIN Group¹⁹⁵ grew significantly with an overall financial commitment approaching €500 million. This growth is mainly based on the financing activity of the SOWALFIN / Investis Group (co-financing, loans, equity investments) with a total financing granted of €305 million, supporting 18,000 jobs.

The **Digital Agency**¹⁹⁶ (Agence du Numérique, AdN) is a public limited company responsible for the implementation and development of the Digital Wallonia strategy (2019-2024). It acts as a catalyser for the digital transformation of the region and a centre of digital expertise. Its missions are:

- Governance: advice to the Walloon Government on the definition, coordination and monitoring of the regional digital strategy.

194. See: <https://www.sowalfin.be>

195. See: https://cms.sowalfin.be/wp/wp-content/uploads/2021/03/RAPPORT_AU_GOUVERNEMENT_2019.pdf

196. See: <https://www.adn.be/fr/>

- ▶ Monitoring technological developments and digital applications to strengthen the territorial intelligence of Wallonia.
- ▶ Communication: promotes and enhances Wallonia's digital strategy, its digital ecosystems and its excellence in the use of digital technology.
- ▶ Transformation: contributes to the implementation of Wallonia's digital strategy and coordinates digital transformation programmes and projects.

The AdN manages the Digital Wallonia¹⁹⁷ platform, which showcases Walloon businesses in the digital sector and ecosystem and currently includes more than 4,000 profiles of active digital stakeholders, including 2,000 businesses. Since its creation, about 20 major projects have been launched and nearly 100 initiatives from stakeholders in the territory were assessed and supported to contribute to the objectives of the Digital Wallonia strategy. Some of the topics are: structuring and rationalisation of digital ecosystems; the creation of the Walloon digital fund W.IN.G; support for Industry 4.0 through actions such as Made Different; the promotion of connected agriculture (smart farming); the initiation of an open data platform; the introduction of a cybersecurity label; and the initiation of an e-health platform.

6.2.4 R&I policy instruments

The Walloon R&I policy mix is composed of a series of instruments of both a horizontal (non-thematic, non-sectoral/cluster orientated) or targeted (addressing specific objectives, technologies or clusters of activity) nature. The policy instruments include a mix of direct financial support measures (grants, reimbursable advances, loans and equity) and indirect support via advisory, mentoring and training services. During the period since 2010, the balance between horizontal and targeted instruments can be characterised by the financial split between the R&D and innovation grants and instruments which are allocated on the basis of funding requests from companies (generally of a horizontal nature) and the funding allocated via the competitiveness clusters policy and a few specific funding measures of a more targeted nature. The R&I policy instruments are managed directly by the SPW EER or by one of the regional agencies such as the SOWALFIN, the Digital Agency or the Forem. Access to finance in the form of equity, subordinated loans and guarantees is provided via several publicly owned investment vehicles including the SOWALFIN (and a network of sub-regional Investis), the SRIW, and the SOGEPA. The Government has decided to merge the three investment agencies in 2022.

Figure 55: Management bodies and R&I policy measures in Wallonia

Organisation	Policy measures
SPW EER – R&D	<ul style="list-style-type: none"> ▶ From 2021, seven categories of financial support (including grants, reimbursable loans, etc.) for R&I will be available for businesses, HEIs, research centres and other eligible organisations; ▶ Management of inter-regional (BEL-COO) and European funding instruments (Eureka, Eurostars, BEWARE and new European Partnerships under Horizon Europe such as Innovative SMEs, Clean Energy Transition, etc.); ▶ Funding of R&D projects of the competitiveness clusters; ▶ Innovation vouchers for enterprises; ▶ Funding of the National Contact Point (NCP) for Wallonia.
SPW EER – Economic Development	<ul style="list-style-type: none"> ▶ Management of the enterprise vouchers.
SPW EER – Competitiveness & Innovation	<ul style="list-style-type: none"> ▶ Coordination of competitiveness clusters and business clusters; ▶ Monitoring of the creative Hubs, living labs and Fab Labs (funded under the ERDF OP); ▶ Development of Digital Innovation Hubs; ▶ Subsidies to technology incubators.
Digital Agency (AdN)	<ul style="list-style-type: none"> ▶ Coordination of projects under the Digital Wallonia Plan: including digital audits of companies, DigitalWallonia4.ai, 'Industrie du futur', Smart Farming and calls for proposals (Tremplin IA, etc.); ▶ Coordination of the Walloon co-working network; ▶ Pilot project: UpSkills Wallonia (with Forem).
SPW EER – Employment & Training	<ul style="list-style-type: none"> ▶ Enterprise vouchers (creation, training).
FOREM	<ul style="list-style-type: none"> ▶ Coordination of Competence Centres (professional training centres); ▶ Pilot project: UpSkills Wallonia (with AdN).
SOWALFIN	<ul style="list-style-type: none"> ▶ Management of the one-stop shop service for businesses seeking advice or finance (www.1890.be); ▶ Coordination of the network of business support intermediaries, 'innovation platforms' and Investis; ▶ Guarantees, subordinated loans, equity (via the network of Investis); ▶ NOVALLIA, a subsidiary of the SOWALFIN Group, manages equity and subordinated loan interventions via the Easy Up for innovation and Easy Green for energy/low-carbon transition and eco-innovation instruments, targeted at micro-enterprises and SMEs.

Organisation	Policy measures
SRIW	<ul style="list-style-type: none"> ▶ Equity participation, subordinated loan, convertible loan, equity loan, <i>pari passu</i> loan with a bank, etc.; ▶ W.Alter – equity and loans including subordinated loans for cooperative businesses; ▶ W.IN.G (Wallonia Innovation and Growth) by Digital Wallonia is an investment fund managed by SRIW and specialised in the financing of digital technology start-ups.

The SPW EER Research and Technological Development department (DRDT)¹⁹⁸ is responsible for the management of a range of R&D grants, reimbursable loans and innovation vouchers. Broadly speaking, the ‘on-demand’ (*aides guichets*) grants and reimbursable loans managed by the DRDT accounted for roughly two-thirds of funding to enterprises during the period 2009-2017. These non-targeted R&D projects were open to application from firms from any industrial or knowledge-based service sector. The projects allocated via the competitiveness clusters to firms from specific ‘sectors’ (or multi-sector thematic) accounted for about 17.5% of public R&D funding for enterprises. A series of small grants open to SMEs (such as vouchers for intellectual property, feasibility studies or hiring an innovation manager) accounted for about €6-7.5 million in funding per annum from 2010-2017. In addition to the R&D project funding, several regional programmes were launched and managed by the department. During the period 2010-2017, the programmes accounted for a relatively small share of total funding (10-15%).

In September 2021, a reform of the regional funding instruments was launched under the new name of Win4Research. The aim was to increase the readability of the system for beneficiaries and to facilitate their access to financial support, simplify the aid mechanisms and eliminate duplication, to better accompany beneficiaries towards the appropriate instruments, and to better meet the needs of companies, the academic community and research centres. The funding instruments have been reorganised into seven categories of funding:

- ▶ Win4Company: assistance to companies for a research project which aims either to acquire new knowledge, or to use knowledge for the development of a product, a process or a service. The research project may also foster a strengthening of the scientific and technological potential of the company or the development of a process or organisational innovation.
- ▶ Win4Excellence: helps universities to increase their excellence through the acquisition of new knowledge, to achieve international competitiveness and visibility.
- ▶ Win4Collective: supports accredited research centres to strengthen their expertise and know-how in fields of activity useful to a large range of Walloon SMEs.
- ▶ Win2Wal: finances industrial research carried out by one or more units from universities and/or university colleges in partnership with a company. These projects can also involve an accredited research centre.
- ▶ Win4Expertise: help for companies to access external expertise.
- ▶ Win4Spin-off: supports the creation of innovative companies in universities and university colleges.

- Win4Doc: assistance to companies for industrial research projects that are implemented via a doctoral thesis. The doctoral studies are carried out within a university research unit.

The department is also responsible for the inter-regional programmes (BEL-COO) and international programmes (ERA-Net, Eureka, Eurostars, Ira-SME, Cornet) grouped under the label WIN4Europe.

Figure 56: Win4Research – the new structure of financial support for R&I in Wallonia

	Large firm	Medium sized firm	Small firm	Research centre	HEI
carry out a R&D project alone or with a partner	WIN4Company			Win4Excellence	
				Win2Wal	
				Win4Collective	
	Competitiveness cluster project				
Recruit R&D staff	Win4Doc				
Source external expertise		Win4Expertise			
Create an innovative firm					Win4SO
Participate to an international R&I project	International programmes (Win4Europe)				

This reform, along with the S3 objective that 70% of funding should be granted to projects in the Strategic Innovation Areas (SIA), should help concentrate public R&I funding on the most promising R&I developments for the region.

The SPW EER also oversees the award of ‘vouchers’ to support the creation, transmission and development of Walloon businesses.¹⁹⁹ The vouchers are grouped in eight themes: creation; growth; circular economy; innovation; internationalisation; digital; transmission; energy. There are two types of innovation vouchers: a technological voucher to promote business investment in R&D through developing cooperation with research centres or university colleges; and intellectual property vouchers that can be used to secure advice on IP strategies and prepare for the patenting of a technological development.

6.2.5 SOWALFIN financial instruments

In addition to the SPW EER grant-based funding, the **SOWALFIN** proposes 11 financial engineering solutions, of which three are most relevant for innovation:

- Easy’Up loan: a subordinated loan for a business innovation project aimed at the development or upgrading of a product or service or a production or distribution process. Maximum

199. See: <https://www.cheques-entreprises.be>

of €500,000 per project with a ceiling of 40% of the financing needs (and 75% of the public intervention).

- ▶ Easy'Green Energy Transition: subordinated loan or equity investment to finance a business project, aimed at carbon footprint reduction projects by improving the energy efficiency of buildings or processes, by investing in renewable energy, by adapting equipment to fluorinated gases with regard to relevant legislation.
- ▶ Easy'Green Eco-Innovation: subordinated loans or equity investments for carrying out eco-innovation projects (R&D and close-to-market innovations) that reduce CO₂ emissions or contribute to circular economy goals.

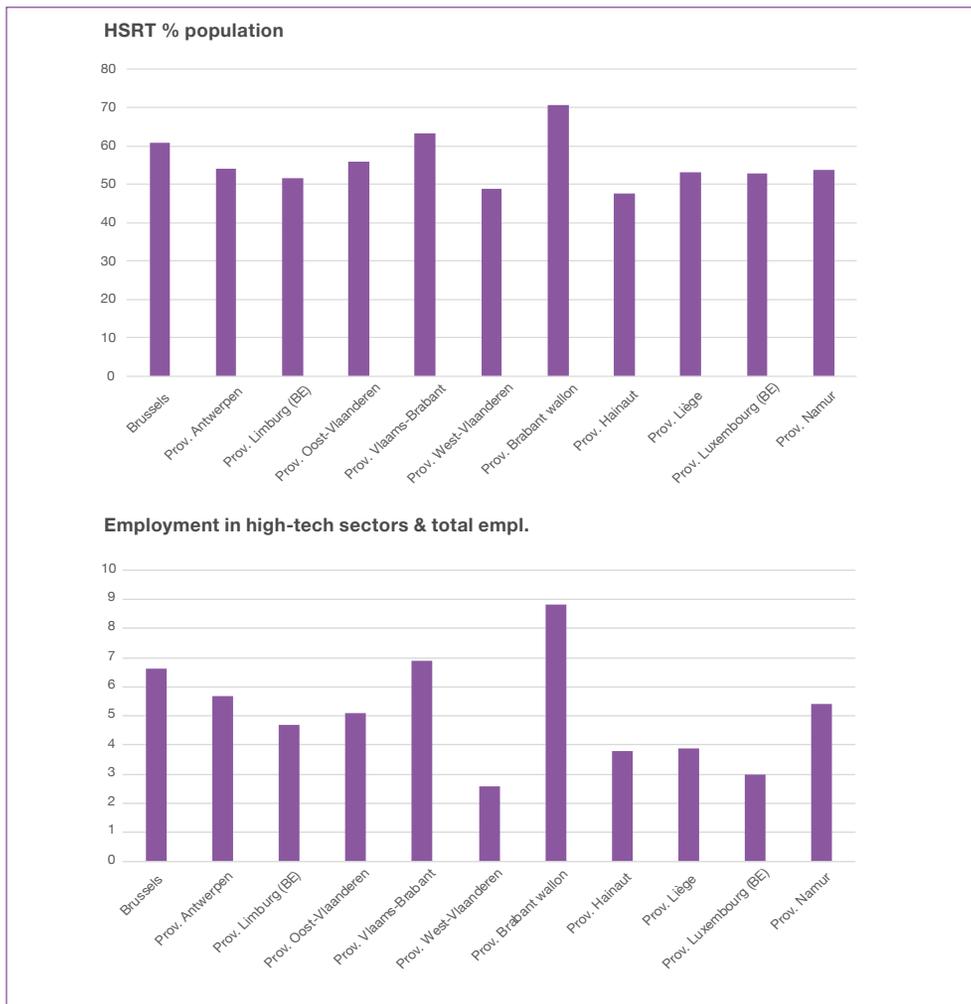
The measures are co-financed by the ERDF programme for 2014-2020 in the case of Easy'Green or based on reimbursed loans from ERDF measures of the 2007-23 period in the case of Easy'Up, plus additional regional funds awarded in 2018 and 2019. In the case of Easy'Green, in 2019, 121 applications were accepted within the framework of the EASY'GREEN measures, for an overall amount of € 21,961,000 (compared to 31 and a budget of €8,470,000 in 2018). Since the launch in 2017, 163 applications were accepted for a total funding of €27,892,000. In the case of Easy'Up, in 2019, 13 applications were accepted for a total amount of €2,037,000 (compared to 15 and €2,152,000 in 2018). In total, since the creation of Easy'Up in 2019, 278 innovation loans for a total amount of €63,024,00 have been awarded, an average loan value of €227,000.

Other financial intermediaries provide equity finance instruments for start-ups and growth orientated innovative firms, as described in section 6.3.6.

6.3 MAIN RESEARCH AND INNOVATION ORGANISATIONS

The Walloon R&I system performs, on average, above the EU27 average. In the Regional Innovation Scoreboard 2021, Wallonia is classified as a Strong Innovator with a score of 105 (EU27=100). However, this hides significant variations at a sub-regional level in potential for conducting R&I and outcomes, as illustrated by the data on human resources for science and technology and employment in high-tech sectors. The Walloon Brabant province is one of the highest performing regions, not only in Belgium but across the EU. However, the performance of Belgium's other provinces is more variable and they typically perform lower on key R&I statistics.

Figure 57: Human resources for science and technology and employment in high-tech sectors (2020)



Source: Eurostat

Aside from R&D carried out within enterprises, higher education institutes and research centres, the Walloon R&I system also includes a significant number of intermediaries providing services to the R&D performers and fostering co-operation. Broadly speaking, the R&I system is composed of the following types of organisations:

- ▶ Business enterprises, ranging from existing SMEs, to high-tech start-ups to innovative larger (multinational) firms.
- ▶ Research teams in the higher education sector (see section 4.3 above for information on the French-speaking universities and university colleges) located in or active in Wallonia;
- ▶ Public and not-for profit research and technology organisations, notably the network of accredited research centres;

- ▶ Business clusters and competitiveness clusters that seek to foster R&D and innovation cooperation amongst companies including with HEI and CRA partners, as well as promotion of Walloon business and applied research expertise and innovations.
- ▶ Innovation platforms: the term is used to cover various organisations such as creative hubs, fab labs, coworking spaces, living labs, incubators and innovation centres – working in partnership with local development agencies or organisation working at a regional level.
- ▶ HEI-business cooperation, including the transfer and commercialisation of research results via university and university colleges technology transfer offices (see section 4.3.3).
- ▶ Internationalisation of R&I, including promotion of participation in EU R&I programmes: NCP Wallonia and the Enterprise Europe Network (EEN).
- ▶ Training and life-long learning: notably the competence centres network but also actions related to digital skills and STEM education.
- ▶ Finance and investment: Walloon Invests, BeAngels (business angels network).

Over the last decade, there has been some consolidation of the intermediaries into platforms or networks, with a view to facilitating access for users and enhancing effectiveness and the impact on R&I performance

6.3.1 Business R&D and innovation performers

The enterprise sector in Wallonia accounts for a significant share of R&I expenditure and activity (2% of GDP in 2018). The share of innovative enterprises is the same as the Belgian average (68%) and considerably higher than the EU average. However, on average expenditure per capita (€577 in 2017, Eurostat) by the business sector is lower than in the rest of Belgium, Germany or the Netherlands, although higher than the EU average.

The key R&I performing sectors are very much in line with the Competitiveness Clusters, with notably a strong presence of life science enterprises (375 registered companies and a higher number of entities per million inhabitants than Germany or France). The pharmaceutical industry contributes 3.24% of regional GDP (twice the level of Belgium as a whole and 10 times the rate in the Netherlands) and pharmaceutical business R&D expenditure was the second highest per capita in Europe in 2017. Bio-manufacturing accounts for 1% of Walloon employment (twice the Belgian average) and Wallonia is recognised globally for vaccine development, immunotherapy and cell therapy. Wallonia has a specialisation index of 1.89 in terms of value added for pharmaceuticals.²⁰⁰ Aside from biopharmacy, Wallonia also has a relative specialisation compared to the EU in a number of other sectors such as aerospace, environmental services, upstream chemical products, agro-food production, metal manufacturing, non-metallic mining, education and knowledge creation.

6.3.2 Research and technology organisations

A number of not-for-profit and public research centres operate in the Walloon Region. **Wal-Tech** is the network of **Accredited Research Centres (CRA)**²⁰¹ in Wallonia, composed of 19 mem-

200. <https://www.iweps.be/indicateur-statistique/tissu-sectoriel-de-leconomie-wallonne/>

201. See: <https://www.wal-tech.be>

bers (including offering technological and scientific services). Some 1,250 researchers and specialist advisers provide independent industrial research services aimed at developing innovative and market-ready technological solutions for groups of companies, for developing their own basic skills, or for single companies on a contractual basis. Some key figures include:

- ▶ Wal-Tech members have 950 employees in Wallonia (out of a total of 1,460), 85% of whom are scientists and technical experts.
- ▶ Wal-Tech members' total budget is €210 million, of which 30% is grant-based funding from public authorities.
- ▶ Wal-Tech provides services to more than 2,500 Walloon companies yearly, out a total of 6,400, of which 75% are SMEs.
- ▶ Research teams are distributed across more than 40 sites, of which 31 are located in Wallonia and the Brussels-Capital regions.

The Wal-Tech networks includes nine of the collective research centres (see Figure 11) including the centres for cement (CRIC), ceramics (CRIBC-BCRC), construction and building research (BBRI-CSTC), metallurgy (CRM), textiles (Centexbel), wood and furniture (Wood.be), technology industries (Sirris), welding (BWI-IBS) and road research (CRR-BRRC). The other 10 centres are presented in Figure 58.

Figure 58: Walloon research and technology centres

Centre	Description	Areas of Specialisation
CEBEDEAU	Centre belge d'Etudes et de Documentation de l'eau, de l'air et de l'Environnement (CEBEDEAU) is an expertise centre for water treatment and management. The centre carries out analyses, sample collection, flow metering, technical assistance, and research.	<ul style="list-style-type: none"> ▶ Research & technology ▶ Water & waste
CELABOR	CELABOR is a research and testing centre with activities in industrial sectors. From its technical departments, CELABOR actively intervenes in the design of purification processes for waste-water and valorisation of solid waste.	<ul style="list-style-type: none"> ▶ Food industry ▶ Industry 4.0 ecosystem ▶ Research & technology
CENAERO	Centre de recherche en aéronautique (CENAERO) is an applied research centre with a focus on the development of multidisciplinary simulation technologies for aeronautics.	<ul style="list-style-type: none"> ▶ Aviation & aerospace ▶ Big & smart data ecosystem ▶ Construction ▶ Energy environment ecosystem ▶ Industry 4.0 ecosystem ▶ Research & technology ▶ Smart building ecosystem ▶ Smart cities ecosystem

Centre	Description	Areas of Specialisation
CER Groupe	CER Groupe is an agro-veterinary research centre with expertise in the field of RES, particularly in the agricultural and agro-food industries.	<ul style="list-style-type: none"> ▶ Agriculture ▶ E-health ecosystem ▶ Health ▶ Research & technology
CERTECH	The Centre de Ressources Technologiques en Chimie (CERTECH) is working for the chemical industry and in other fields where its expertise can be an asset, such as automotive, construction, packaging, food, agriculture, personal care, pharmaceutical, energy, environment, etc.	<ul style="list-style-type: none"> ▶ Chemicals ▶ Circular economy ecosystem ▶ Research & technology
CETIC	Centre d'Excellence en Technologie de l'Information et de la Communication (CETIC) is an applied research centre in the field of ICT, whose mission is to support economic development by transferring the results of the most innovative research in ICT to companies, particularly SMEs. CETIC helps companies integrate these technological breakthroughs into their products and processes.	<ul style="list-style-type: none"> ▶ Big & smart data ecosystem ▶ Cybersecurity ecosystem ▶ E-health ecosystem ▶ Industry 4.0 ecosystem ▶ International & export ▶ Research & technology ▶ Smart cities ecosystem ▶ Support & development
CTP	CTP IS dedicated to the Mineral Processing of materials. It offers a huge range of skills and analyses to companies exploring and developing natural mining deposits, and to companies that transform and recycle industrial and urban post-consumer waste ('Urban Mining').	<ul style="list-style-type: none"> ▶ Research & technology
INISMa	The Institut interuniversitaire des Silicates, Sols et Matériaux is a non-profit organisation performing tests, expertise survey and research, specialised in the field of materials for specific use (ceramic, glass, building and road materials) as well as in soils and environment; it works in close collaboration with CRIBC.	<ul style="list-style-type: none"> ▶ Glass & ceramics & cement ▶ Research & technology

Centre	Description	Areas of Specialisation
Materia Nova	Materia Nova is a multidisciplinary research centre active in the modelling, synthesis, and characterisation of high-technology materials, from the fundamental aspects to their application in devices.	<ul style="list-style-type: none"> ▶ Circular economy ecosystem ▶ Industry 4.0 ecosystem ▶ Research & technology
MULTITEL	MULTITEL is a Belgian technological innovation centre specialised in applied research and development for business. Multitel works in five areas of R&D: Applied photonics, Networks and Telecoms, Signal Processing and Embedded Systems, Machine Vision, and Railway Certification	<ul style="list-style-type: none"> ▶ Cybersecurity ecosystem ▶ Energy environment ecosystem ▶ Industry 4.0 ecosystem ▶ Research & technology ▶ Smart cities ecosystem ▶ Smart grid ecosystem ▶ Smart region ecosystem ▶ Smart waste management ecosystem

In June 2021, the Minister for Economy announced a review of the current decree that provides for the accreditation of the research centres and of the overall research centre landscape. The aim is to optimise the services of the centres and enhance their capacity to provide high-quality R&D and technical services to enterprises and other public services.

In addition to the Wal-Tech network, several public research institutes exist in Wallonia, notably the CRA-W and the ISSeP. The **Walloon Agricultural Research Centre (CRA-W)**²⁰² provides scientific research and on-demand support services: analysis, equipment, advice and expertise. Located on three sites with 23 laboratories, 15 collections and over 300 hectares of land (including 73 for organic agriculture), the CRA-W has 400 employees including 120 scientists. The staff supports Walloon farmers, stockbreeders, horticulturists, forestry producers and operators in the agri-food sector. The CRA-W has three main missions:

- ▶ Applied and basic short- and medium-term scientific research;
- ▶ Scientific research services to beneficiaries in the agricultural and agri-food sector;
- ▶ Perspective view on the development of agriculture and livestock farming.

The organisation of agricultural research in Wallonia is based on the Strategic Plan for Walloon Agricultural Research adopted by the Government in December 2016. The 2017-2019 Agricultural Research Plan (PTR)²⁰³ listed the main research objectives set by the Walloon authorities for this three-year period (future plans are likely to be for four to five years). The Walloon actors in agricultural research are invited to organise and focus their research, in order to contribute to the achievement of the objectives set by the PTR. To help achieve these objectives, the CRA-W has organised its research and other activities into four main categories:

- ▶ Precision agriculture: combining state-of-the-art methods and technologies to make the right choice, at the right time, in the right place, with the right input and at the right dose;

202. See: <https://www.cra.wallonie.be/en/about>

203. See Activity Report 2016-2018: <https://www.cra.wallonie.be/en/content/download/69165>

- ▶ Precision livestock farming: ensuring a balance between profitability and consumer expectations and integrating livestock farming better into ecosystems;
- ▶ Risk management: eliminating, controlling and preventing risks;
- ▶ Understanding products: understanding material, knowing what it contains, and detecting unwanted substances.

Created in 1990, the **Scientific Institute of Public Service (ISSeP)**²⁰⁴ monitors the quality of the environment by collecting, producing and disseminating data on air, water, soil, waste, and sediment conditions. The ISSeP reports to the Walloon Minister of the Environment and has the mission to improve understanding of the environment and related health risks. The Institute provides the regional authorities with tools for environmental protection and management, as well as for assessing the risks of environmental accidents and related health risks. The ISSeP is the Walloon reference laboratory for environment, and it provides advice and supervises other laboratories carrying out analyses. The Institute is organised in three areas of expertise:

- ▶ Environmental metrology: analysis and assessment of the main environmental variables: air, water, soil and subsoil (geological and mining related), waste (landfill), sediment, non-ionising radiation.
- ▶ Assessment of risks and prevention of accidents that can lead to the exposure of humans and the environment to pollution from chemical, physical or biological sources.
- ▶ Conducting research to maintain expertise at the cutting edge of scientific knowledge. The ISSeP's research policy is notably focused on ensuring that its activities contribute to meeting the relevant European Directives and Walloon Decrees on environmental protection and in the validation of new technologies that contribute to this objective. Over the period 2015-2019, the research activities of the ISSeP have expanded, with a tripling of the number of participations in scientific research projects.²⁰⁵

Founded in 2009, **WELBIO**²⁰⁶ **Walloon Excellence in Life Sciences and BIOTEchnology** is an inter-university life sciences research institute. It aims to promote scientific excellence in life sciences research and to translate scientific achievements into medical, pharmaceutical and veterinary biotechnology applications. Since 2009, WELBIO has received funding of €42 million for research activities as well as €22 million for cross-cutting and management activities (a total of €64 million)²⁰⁷. Calls for WELBIO projects are launched every two years and, since 2015, are co-organised by the F.R.S.-FNRS via the FRFS, under the life sciences strategic action line. The projects are funded via three instruments:

- ▶ Advanced Grants for senior researchers;
- ▶ Starting Grants for younger researchers;
- ▶ Continuation Grants for researchers whose WELBIO-funded research leads to a valorisation action.

204. See: <http://www.issep.be>

205. See: <https://www.issep.be/wp-content/uploads/ISSeP-RA2019-screen.pdf>

206. See: <https://welbio.org/>

207. See Annual Activity Report 2019:

https://welbio.org/upload/docs/application/pdf/2020-08/_def_welbio_ra_2019_en_web.pdf

WELBIO is designated as a 'Plateforme d'animation et de valorisation' by the FRFS and industrial valorisation of the research results is a second core element of WELBIO's mission. WELBIO's valorisation goal is implemented through individual support for researchers. A valorisation committee is formed for each project. This committee meets regularly to follow up on any advances in the project, to reflect on any avenues for valorisation that emerge, and to agree on a valorisation strategy for the results, particularly for protecting intellectual property. The development and promotion of inventions are thus supported through close collaboration with members of the business-university interfaces in host universities.

Launched in September 2020, the **TRAIL (Trusted AI Labs) Institute**²⁰⁸ seeks to foster the creation of talent in AI and to carry out cutting-edge research at international level in Wallonia and Brussels. The institute aspires to boost research that allows a wider use of AI on a daily basis, especially for the benefit of businesses. It brings together the researchers working on AI from the FWB universities and the CRA whose research activities are in line with the vision of the TRAIL ecosystem.

The TRAIL Institute will conduct cutting-edge strategic research and aims to have an international influence. It will bring together doctoral students, post-docs and engineers engaged on various funding within research institutions. The research carried out within the institute concerns both purely technological aspects and other questions fundamental to the appropriation of AI by the economy and society ('change management', AI law, data intelligibility, etc.). In addition to research, it aims to develop two services:

- ▶ The 'TRAIL Factory' is a platform allowing an efficient operationalisation of technological bricks and methodologies, for introducing new processes deriving from AI, and it facilitates their dissemination and promotion. To maximise the impact of the TRAIL Factory, TRAIL researchers will deliver successful bricks, documented and distributed under open licences compatible with proprietary use.
- ▶ The TRAIL4Ventures instrument seeks to accelerate the creation of innovative and technological start-ups that can respond to societal challenges around medicine, mobility or the economy of tomorrow using AI. TRAIL4Ventures wants to exert a leverage effect and accelerate the commercialisation of the applied research resulting from the TRAIL Institute and the AI Factory ventures, whose potential is reinforced by the open collaboration of the various stakeholders in the TRAIL consortium (industrial leaders, research centres, public and academic agencies).

6.3.3 Business and Competitiveness Clusters

Support for clusters of enterprises²⁰⁹ has been a feature of Walloon policy since 1999, when a first pilot phase was launched. In 2007, a decree on cluster policy was adopted by the Walloon Government, which foresaw funding of cluster manager and organisations (declining rate of funding beginning with 100% for three years, 80% for the three following years and then 50% thereafter). Walloon funding is conditional on a positive evaluation at the end of each three-year period. This first type of cluster works to develop cooperation between cluster firms in R&D and

208. See: <https://trail.ac/>

209. See: <https://clusters.wallonie.be/federateur-fr/>

innovation, joint business development and exports. A second type of cluster, competitiveness clusters ('pôle de compétitivité'), were launched, in 2006, in the framework of the first 'Marshall plan', these clusters co-manage a major regional investment into collaborative industrial R&D projects (involving large firms and SMEs, universities and research centres) and help to structure and prioritise the business R&D and innovation activity in the six priority fields they cover. Management teams are provided regional funding for organising the calls for projects and support activities to competitiveness cluster members. In financial terms, the competitiveness clusters have represented an important share of the regional R&I funding since 2006.

Walloon Business Clusters are defined by the associative mode of organisation of the productive system. They are established mainly at the initiative of companies that have an activity in the Walloon Region, which can, where needed, appoint the participation of academic institutions, research centres, training centres. These clusters are characterised by:

- ▶ The mobilisation of a representative critical mass covering one or several fields of activity;
- ▶ A cooperation framework encompassing related activities;
- ▶ The voluntary development between the companies of a complementarity relationship, vertical or horizontal, profit or non-profit;
- ▶ The promotion of a common vision of development.

Their objective is to help:

- ▶ Develop a better shared knowledge between the members of the business environment and trends in the field of activity.
- ▶ Strengthen the commercial links between the members or allow to reach an innovative capacity and a higher competitiveness.
- ▶ Develop partnerships involving members in the fields of the production of goods and services, R&D or the creation of new activities.
- ▶ Promote, on a local and international basis, the cluster with a view to strengthening the appeal of the Walloon Region as regards foreign investors and participation in trade fairs.
- ▶ Share knowledge and exchange of good practices between the business clusters, including at the international level.
- ▶ Strengthen the synergy between the activities of the business cluster and those of other forms of enterprises, notably the competitiveness clusters.

Figure 59: Walloon Business Clusters

Cluster	Description	Key figures (2020)
CAP Construction	Walloon network of sustainable construction. It brings together all types of construction actors: architects, design offices, contractors, installers, producers and materials suppliers, real estate developers, research centres and training, associations. Together, members work together to promote sustainable construction, acquire new skills and develop their business.	374 members
Eco-construction	Network of companies that aim at building while taking into consideration today's environment and the one of future generations, while offering a maximum of comfort to the inhabitants. It gathers architects, infrared thermography and electromagnetic pollution specialists, builders, companies active in the green renovation sector, manufacturers, green building materials suppliers and green electricians, companies active in the field of renewable energy, building contractors specialised in water treatment by lagooning, natural pools installation, rainwater treatment and recovery, etc.	250 members
TWEED	Technology of Wallonia Energy, Environment and sustainable Development (TWEED) is the Business Cluster gathering entities active in the 'sustainable energy' sector, which means renewable energy sources, energy efficiency, the implementation of new processes in order to achieve energy savings, energy efficiency or the reduction of greenhouse gas emissions, green products and services.	120
Infopole Cluster TIC	Business Cluster that gathers professionals in Information and Communication Technology in order to promote business and innovation through partnership. The current strategy of the ICT clusters is to focus on the creation of a partnership dynamic structured around priority segments and niches (eHealth, Intelligent Transport Systems, ICT for Green, eGov).	339
Plastiwin	Business Cluster that gathers entities of the plastics industry: the manufacturers of raw materials, masterbatches, dyes and various additives; the mould makers, designers, manufacturers of tools; the plastics processors active in the injection moulding, extrusion, blowing, thermoforming, as well as in machining, cutting, bending, surface treatment and retailers.	124

Cluster	Description	Key figures (2020)
TWIST	Business Cluster that gathers entities working in the field of digital technologies for image, sound and text manipulation. It focuses on both film/animation and broadcasting/multimedia, uniting talents whose know-how is internationally renowned. The cluster is now orienting its development towards the set-up of projects uniting the skills and technologies present at the heart of the cluster, centred on six themes: stereoscopic 3D – Internet/Mobile Content – Digital Archiving – Serious Game – Motion Capture – Digital Signage.	105
EQUISFAIR	Business Cluster for the equestrian sector in Wallonia, all sectors combined. Support for the emergence and development of partnerships is the very nature of the cluster. EquisFair is positioned so as to professionalise and develop existing networks, intensify marketing, potentiate own skills and support the key stages of R&D towards placing on the market.	39

A **Competitiveness Cluster** (*'pôle de compétitivité'*) is a grouping of companies, training centres and public or private research units in a leading sector of the Walloon economy, which are committed to a partnership-based approach in relation to common projects of an innovative nature. The partnership is structured around a market and the related technological and scientific fields and should help develop the critical mass needed for competitiveness and international visibility. Initially five competitiveness clusters were launched in five key sectors, with a sixth focusing on environmental technologies (GreenWin), which was launched in 2011.

Figure 60: Walloon Competitiveness Clusters

Cluster	Description	Key figures (2020)
GreenWin	Competitive Cluster aiming at innovation in green chemistry and sustainable materials (including their applications in zero or near zero energy buildings). Its projects follow three main strategic lines: Design of new products based on renewable (bio-sourced) or recycled raw materials; Design of new products and systems applied to energy management (energy storage, sustainable buildings, etc.); Design of new techniques for re-using/recycling end-of-life products and systems as well as using landfills as a new source for raw materials.	200+ members (150+ enterprises) 85,000 direct jobs

Cluster	Description	Key figures (2020)
BioWin	Health competitive cluster that federates all stakeholders from Wallonia participating in innovation and training in the field of biotechnology and health. The R&D, supported by the cluster, covers all fields related to health. Eight technological themes have been defined: Biomarkers + in vitro & in vivo diagnostic, Innovative tools and instrumentation, Drug delivery systems, Novel therapies, Information technologies applied to human health, Innovative processes and organisational innovations, Medical devices, Drug discovery.	238 members (187 enterprises) €7.7 billion turnover (2019) 16,500+ direct jobs
Wagralim	A competitiveness cluster dedicated to the food industry. Manufacturers in the sector have defined four strategic development areas: 'Health' foods/nutritional quality, industrial efficiency, packaging, development of sustainable agro-industry networks.	220 members €8.3 billion turnover 23,710 direct jobs
MecaTech	Competitiveness Cluster in mechanical engineering. The MecaTech Cluster projects are selected around four strategic lines of development: materials and surfaces of the future, comprehensive forming technologies, microtechnologies and mechatronics, and intelligent maintenance.	340 members (213 enterprises) €871 million turnover 7,494 direct jobs
Logistics in Wallonia	Transport and Logistics Competitive Cluster, created to promote the transport and logistics sector of Wallonia both within the country and abroad, by coordinating activities, by defining a common strategy and by optimising human and technological resources.	364 members €3 billion turnover 29,126 direct jobs
Skywin Wallonie	Aerospace Competitiveness Cluster. Skywin's strategy focuses on three major strands of action: 'More intelligent' – aiming at developing technological niches for the future; 'More applications and services' aiming at diversifying and creating new companies; and 'More composites' which aims at meeting the market demand in terms of even lighter components or increased performance in the structures, as well as reducing the environmental footprint.	148 members (115 enterprises) €1.75 billion turnover 7,500 direct jobs

The Competitiveness Clusters management units (not-for-profit legal entities) are provided with operational funding (in 2019 close to €1.8 million) for their activities (matched by private funding).

The Competitiveness Clusters management teams support the development of collaborative R&D projects, which are selected after calls for proposals by an expert committee (international jury). Since their launch in 2005 to 2019, over 400 projects (covering research, training and investments) have been funded by mobilising public funding of close to €750 million.

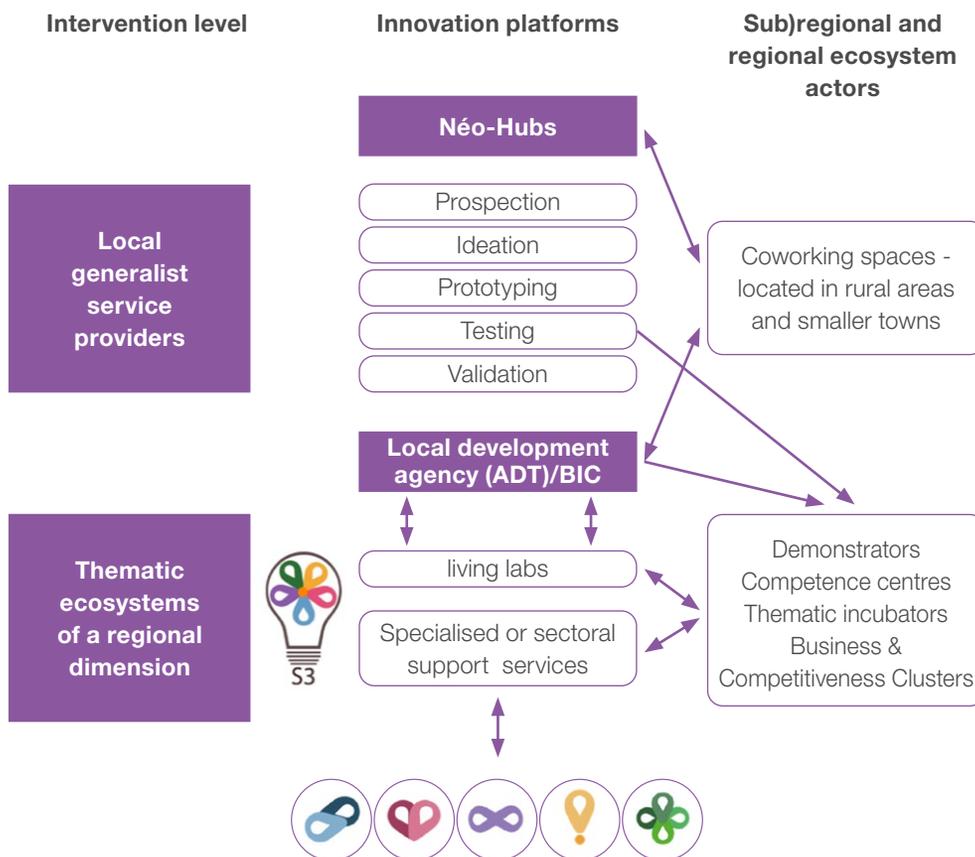
In the RPD 2019-2024, the Government decided to maintain the Competitiveness Clusters but to align them better with the broader triple transition objective and to reinforce the cross-cutting support to enterprises including digitalisation, circular economy, etc. A priority is to be given to increasing the access of SMEs to the Competitiveness Clusters, notably by speeding up the process of awarding support and enhanced support to SMEs from the cluster management teams. Another area for improvement identified is cross-cluster cooperation. This has begun to develop during the last decade but where more opportunities exist to extend this co-operation, notably in the context of the new S3 strategy which has defined SIA starting from broader societal challenges that will require expertise of several clusters. To this end, the Government will draw up new performance contracts for each cluster, with revised key performance indicators for the coming years.

6.3.4 Innovation Platforms

Over the last couple of decades, a large number of organisations providing innovation advisory services, access to equipment and technical services, co-working and incubation space, etc. have been created in Wallonia. In line with the Government's policy objective to optimise the services provided to entrepreneurs (start-up and growth phases) and enterprises with innovation projects, the SPW EER, SOWALFIN and the AdN developed a joint policy concept note in 2020 to structure these initiatives into a more coherent service offering for enterprises. The aim is to ensure a more targeted (less general awareness-raising) approach to identifying novel ideas (ideation and testing) within specific local 'ecosystems' (at a provincial level with 'hubs' located in main cities covering a specific territory) that together provide a package of services to innovators and entrepreneurs to enable them to rapidly prototype, test and validate (with users) their products and services. 'Neo-hubs' will build on the investments made during the 2014-2020 period in a network of creative hubs, fab labs and living labs and provide both physical space for the development of ideas as well as equipment for prototyping in the fab labs and incubation and other services. The hubs will work closely with the local business and innovation centre and territorial development agencies for the area concerned.²¹⁰

The innovation platforms will work at a local level, but will also seek to interact and support the deployment of thematic regional ecosystems, including the thematic living labs, technology incubators, etc. aligned with the SIA of the smart specialisation strategy.

Figure 61: Organisation of innovation platforms as regional innovation ecosystems



Source: S3 Wallonia 2021-2027

Launched in 2014 (under the Creative Wallonia 2010-2014 programme), the Creative Hubs²¹¹ are defined as “platforms of organisations focused on the transformation of the traditional economy into a creative economy, which carry out in a given territory a programme of actions and activities intended to promote open innovation, transdisciplinary hybridization and collaborative intelligence”. The Creative Hubs were funded for the first time under the Creative Wallonia programme in 2014 and 2015. Seven pilot projects were selected in the cities of Namur, Charleroi, Mons, Louvain-la-Neuve, Liège, Tournai as well as one covering the Province of Luxembourg to develop a feasibility study (total subsidy of €1,465,000). Following the pilots, in spring 2014, under the ERDF 2014-2020 operational programme (OP), nine Creative Hubs were funded through 33 projects grouped into a portfolio per hub, which mobilised €53 million of public funds (of which approximately 40% of ERDF co-financing). The nine Creative Hubs invested in infrastructure and equipment (including Fab Labs and building for the hubs with co-working and

211. See: <https://www.1890.be/solution/hubs-creatifs>

incubation spaces) and provide various types of services (creativity awareness activities, idea development, project support and advice, prototyping, testing, etc.) to a range of beneficiaries (enterprises, entrepreneurs, project leaders, non-profit organisations, students-entrepreneurs, etc.). The Creative Hubs (and the 2015-2019 Creative Wallonia programme) were evaluated in 2019-2020.²¹² While the evaluation identified a number of promising results from the activities on certain phases of the innovation processes (ideation, prototyping), the final impact in terms of a verifiable economic impact was not yet verifiable. The evaluation led to a series of recommendations for enhancing the impact and improving the effectiveness of the hubs as a node for the local innovation platforms and ecosystems.

Since 2014, Wallonia has developed a network of 10 **Fab Labs**.²¹³ Short for 'fabrication laboratory', a Fab Lab is a small-scale workshop providing access to digital manufacturing tools and machines (at least a 3D printer; a vinyl cutter; a laser cutter, and a numerically controlled (CNC) milling machine) for innovative entrepreneurs seeking to develop and prototype and test new devices and an open community of 'makers' (students, repair hobbyists, citizen scientists, etc.). The advantage of a Fab Lab is that it allows small series production at a lower cost of devices ranging from simple spare parts to experimental prototypes. The Fab Labs also support the development of skills related to the digital tools by organising training. During the 2014-2020 period, a number of Fab Labs were created or equipped via the ERDF programme (under the Creative Hubs portfolio) as part of the Creative Hubs measure. Based on the evaluation of this measure, the Walloon Fab Labs will be further developed in the coming years by strengthening the regional network through a common pricing and operational framework to enhance access for users. The Fab Labs will continue to provide two main functions: promotion of fabrication methods to a broader public with the aim of strengthening STEM skills and careers; and pre-industrial support for prototyping and testing of innovation ideas.

A Living Lab²¹⁴ is a place of innovation and co-creation involving relevant users. The users can range from citizens (consumers, patients, users of services, etc.), businesses, specialised organisations (hospitals, universities, research centres, sectoral organisations, etc.) and public authorities. During 2014-2020, Wallonia experimented with the development of four **Living Labs** (funded via the Creative Wallonia programme and the ERDF OP 2014-2020 for a total of almost €7 million), specialised in e-health, food tech and gastronomy, cultural and creative industries, and digital manufacturing services. The development of the Living Labs was evaluated as part of the Creative Hubs/Creative Wallonia evaluation. The evaluation concluded that the Living Labs had adopted too broad an approach, with an over-emphasis on awareness-raising rather than focusing the available resources on supporting the development of innovative projects within a specific thematic community of innovators and users. For the future, the Living Labs will be expected to achieve a region-wide reach with their services in support of the SIA priorities of the S3.

212. See: <https://economie.wallonie.be/content/r%C3%A9sultats-de-l%E2%80%99C3%A9valuation-d%E2%80%99actions-du-programme-creative-wallonia-et-des-hubs>

213. See: <https://www.1890.be/solution/donnez-vie-a-vos-idees-grace-aux-outils-de-fabrication-numerique>

214. See: <https://www.1890.be/solution/placez-lusager-au-centre-de-la-conception-de-vos-projets>

Incubators²¹⁵ provide a variety of services to very young companies or those in creation, who specialise in the high technology sector. Incubators' services include carrying out market studies, design of a business plan, technical validation of technology, thematic training, coaching by experts from specific sectors, communication and marketing services, and legal and intellectual property advice. In Wallonia, several incubators are specialised in high technologies in diverse fields such as engineering sciences, life sciences, space applications or autonomous systems and drones. These include WSL (several locations in the region),²¹⁶ I-Tech Incubator (Charleroi), WBC Ventures (Liège), Galaxia Space Innovation (e.g. ESA BIC Belgium) and ID2Move (Nivelles).

The Walloon **CEEIs**²¹⁷ (EC BICs in English) provide support for SMEs and innovative entrepreneurs whose mission is to support the creation of new generations of innovative businesses and help existing businesses to innovate and modernise, by offering different services: coaches in business creation, creation of a business model, market analyses, networking, prototyping workshops, expert support, consultancies in creativity, co-creation, design thinking, etc. Additionally, the Walloon CEEIs also pooled their knowledge and skills to produce an entrepreneurship success kit: the BMC2Grow methodology. This toolbox helps managers ask the right questions at the right time, but also to realise for themselves the points where they must pay full attention. It is based on three pillars: the vision of the leader, the business ecosystem and the implemented Business Model.

6.3.5 Training and life-long learning services

Created in 2000, the **Competence Centres network**²¹⁸ is a cutting-edge initiative in the field of vocational training in Wallonia: they are expertise centres for training the workers of tomorrow, with a focus on quality, creativity, and the development of skills accessible to all. They are based on a public-private partnership, with the participation of the Forem and other sectoral social partners, the IFAPME, HEIs or CRA. There are currently 24 Competence Centres, which are coordinated by the Forem. In 2019, the Competence Centres trained 19,459 job-seekers, 37,141 workers and 42,550 teachers and students in vocational skills.²¹⁹

The ambition is to optimise training resources, as well as to accelerate the deployment of distance training and workplace learning for job-seekers. This is in line with the European objective of 15% of the adult population participating in learning activities (currently 7% in Wallonia) and the challenges of re-skilling/upskilling in the context of digital, technological and environmental transition. The Competence Centres are organised in strategic activity fields, which are complementary to the SIA of the new S3.

215. See: <https://www.1890.be/solution/incubateurs-specialises-high-tech>

216. See: <https://www.wsl.be>

217. See: <https://www.1890.be/solution/accompagnement-ceei>

218. See: <https://www.leforem.be/centres-de-competence.html>

219. See: https://economie.wallonie.be/sites/default/files/Stratégie%20de%20Spécialisation%20Intelligente%20de%20la%20Wallonie%202021-2027%20%28S3%29%20-%20Mars%202021_.pdf

UpSkills Wallonia²²⁰ aims to supplement programmes for the digital transformation of companies with a skills development component to respond to the growing shortage of qualified people on the job market. The main objectives are:

- ▶ Complement organisational transformation strategies based on the Industry 4.0 model with a skills development component (while integrating environmental, energy and ethical issues) and maintain employment by promoting internal mobility to meet the shortage of qualified profiles.
- ▶ Support the deployment of a standardised training offer for ICT professions and digital skills to be developed by training and education operators.
- ▶ Create the basis for the Walloon medium-term digital skills development strategy.

With the digitalisation of the economy and the society, Wallonia and the FWB are in the process of creating science, technology, engineering and mathematics **(STEM) reference centres**,²²¹ which should act both as didactic research centres, as well as providing a unique lifelong learning system, organised around the four Walloon and Brussels 'Cités des Métiers' and Carrefours Emploi Formation Orientation (CEFO). The objective is to propose to both Governments a global strategy over 10 years, which should include a strong gender dimension, including a positive orientation towards STEM training, studies and professions, didactics of the sciences and associated key skills, the training of trainers and teachers, and the deployment of a training and study offer in line with the skills required in the labour market.

6.3.6 Finance and investment support

The nine Walloon Invests²²² were created in the 1980s by the Walloon Region to support local SMEs and the self-employed via equity financing (venture capital). They fund entrepreneurial (start-ups and scale-ups) and investment projects of SMEs that are likely to generate high value-added activities. Invests intervene as shareholders and contribute via board representatives to strategic decisions. At the same time, the finance helps accelerate the growth of the company. Walloon Invests make investments in the financing of the creation (e.g. spin-offs), innovation, growth, transmission or export plans of the companies. Since 2006 to end 2019, they have made 1,255 investments for a total funding of €449 million (of which €42 million came from the ERDF priority 2 during 2014-2020). Roughly 34% of equity financing has been directed at innovative firms in biotech (Biowin), 32% in mechanical engineering (Mecatech), 16% in green chemistry and environmental technologies (Greenwin), and 11% in ICT. The Invests have interested in 632 spin-offs (from universities) and innovative spin-outs from companies since 2006 for a total of €188 million.

In addition to the public measures, the Business Angels Network²²³ (BeAngels) supports and invests in innovative companies. The BeAngels network informs, trains, supports, advises, and guides individuals who want to become Business Angels, as well as those who want to raise funds from the investors. BeAngels has more than 350 members with over €50 million invested.

220. See: <https://www.digitalwallonia.be/fr/publications/upskills-wallonia>

221. See: <https://emploi.wallonie.be/news/un-centre-de-reference-stem-en-wallonie>

222. See: <https://www.1890.be/solution/invests-wallons>

223. See: <https://www.beangels.eu/en>

They propose five investing packages: Independent Business Angel, Business Angels Club, SIBA, Scale Fund and Verve Ventures, with investments ranging from €10,000 to €200,000.

6.3.7 Services for the internationalisation of R&I

The NCP (National Contact Point) is the interface for companies, universities, university colleges, research centres, associations and other organisations located in Wallonia seeking to participate in Horizon Europe. The NCP Wallonia²²⁴ provides advice, guidance, and personalised assistance to set up projects and maximise the funding opportunities available from the European Commission for Walloon R&I actors. The NCP Wallonia staff provide support for the choice of programme, rules of participation, establishment of partnerships, intellectual property, interactions with funding agencies, critical re-reading of the project, and project management. The NCP Wallonia works across all three pillars of Horizon Europe, with a focus on pillars 2 (societal challenges and industrial competitiveness) and 3 (European Innovation Council, EIT, etc.), as well as for actors interested in other programmes such as the Innovation Fund, Digital Europe, or European Defence Fund.

Launched in 2008 and funded by the European Commission, the **Enterprise Europe Network (EEN)**²²⁵ is a network of support structures for SMEs, with 600 member organisations in more than 60 countries, including all EU Member States. Combining local expertise and input from the EEN network, the free information and support services help enterprises to access new markets abroad, innovate, and strengthen enterprise position on the national market or access European funds. Although diverse and varied, the EEN partnerships are all composed of support organisations for SMEs. As part of the network, they offer advisory services focused on integration of SMEs into all relevant European initiatives as well as support services for international partnerships. The services offered, free of charge to European SMEs, must be complementary to the existing national or regional ones. A new Walloon consortium, bringing together organisations working throughout the region, was proposed in summer 2021 to guarantee this complementarity, in order to integrate services into the regional framework and to cover the entire territory. If the European Commission approves this proposal, from 2022, the AWEX, the SOWALFIN and the NCP Wallonia will combine their efforts to offer Walloon SMEs access to all the network's resources and services.

224. See: <https://www.ncpwallonie.be>

225. See: <https://www.wallonieurope.be/>

6.4 FUTURE R&I POLICY PERSPECTIVES

There has been considerable progress in Wallonia over the last decade in reforms to the R&I policy, funding instruments and performance. Yet there are several challenges to be addressed in the coming years to maintain and even increase the rate of progress and to tackle remaining structural issues facing the Walloon Region. The main challenges have been well identified in recent policy documents and studies, and can be summarised as follows:

- ▶ Wallonia has several sectors operating at the cutting edge of advanced technologies (e.g. the biopharmaceutical or aerospace sectors) and a rate of business investment in R&D relative to GDP well above the EU27 average. However, business R&D and innovation activity remains unevenly distributed. This applies to the sectoral distribution, by a dependence on a limited number of large (often foreign-owned) firms, notably in the manufacturing sector (the region lags both the EU and Belgian average for employment in knowledge-intensive services), or to the emphasis on technological innovation rather than non-technological (including business model or system) innovations. The broadening of R&D and innovation activities to a larger number of SMEs and the development of multidisciplinary approaches that mobilise a broader range of actors in the innovation process should strengthen the impact of R&I policies. This should lead to Walloon businesses shifting into higher value-added final products and services that respond to user needs and societal demand, and thus boosting flagging productivity levels.
- ▶ Wallonia has an over-fragmented research and innovation system with a relatively high number of organisations, and they often lack a critical mass of expertise and funding. This situation also creates issues in terms of their coordination and professional delivery of services. Despite policy decision and measures taken since 2010, aimed at enhancing cooperation (clusters policies) and simplifying the landscape, the number of research centres and innovation intermediaries remains significant. A recent mapping of business support and innovation organisations counted upwards of 100 regional structures. The network of sub-regional Investis here contrasts with single region-wide investment companies in other leading regions. Moreover, Wallonia has 19 accredited research centres, in contrast with the Flanders Region, where the policy is to have a limited number of strategic research centres able to compete at European level. This challenge is being addressed by the reform process, which started in 2018, of the business and innovation support ecosystem and by a 2021 review of the accredited research centres. It is expected that a greater emphasis will be placed on performance contracts and by funding the delivery of services by the clusters or other business and innovation support organisations.
- ▶ Wallonia has seen sustained investment in higher education, including in STEM fields, plus initiatives to boost professional training and lifelong learning. However, it is now crucial the region adapts the skills base and qualifications of its population, to increase innovation performance, such as in the availability of technical skills (STEM) necessary for the digital transition, development of cutting-edge activities and R&D, as well as soft skills. There is also a need for greater articulation between education and training and research and innovation policies: this will support the transition towards a digital society and a low-carbon and circular economy, which require skills development linked to the dissemination and uptake of technologies and adaptation to system-wide change (energy, mobility, etc.). Lastly, to support this transition, the scientific research education policies of the FWB and the industrial R&I and training policies of the Walloon Region must be aligned.

- ▶ Compared to the region's strong private sector performance, public R&D funding has barely increased in the last decade. Moreover, R&D expenditure (performance) in both the government and higher education sectors declined from 2017 to 2019 in Wallonia (source CFS/STAT). Walloon budgetary perspectives remain difficult in the short to medium-term and they have been further complicated by the impact of the COVID-19 pandemic and the severe flooding in summer 2021: to address these issues, the region must call on significant public investment. As a result, it seems unlikely there will be any significant increase in regional public investment. However, the mobilisation of additional EU funding through the RRP will provide a boost to R&I and digital infrastructures and projects. Moreover, the new ESIF funding programme will mobilise almost €300 millions of ERDF funding for the same topics (under the first strategic objective). The concentration of public R&I funding on the five S3 priorities should also strengthen the potential impact on regional economic development;
- ▶ The S3 strategy and other recent studies and evaluations have highlighted the need for greater investment in governance and strategic intelligence on R&I performance, anticipation of future societal and technological trends and the impact of policy interventions. The regional administration and agencies have begun work on improving evaluation and monitoring systems (availability of data, use relevant indicators). However, evidence still tends to be collected in discrete evaluations or studies rather than being used to inform and guide policy on a continual basis. Building greater analytical capacity into the regional administration should be a priority.
- ▶ The need to improve the European engagement of Walloon R&I actors (enterprises, research centres, universities, university colleges, etc.) is also high on the region's political agenda. Wallonia's performance under Horizon 2020 has been analysed in a recent study. This highlighted the need for a stronger European dimension for Walloon R&I policy, with clear operational linkages between the S3 strategies' strategic innovation areas as well as initiatives to ensure these priorities are well represented in European R&I partnerships and networks. Several actions have been proposed to increase the European participation of businesses and research centres, as well as to encourage Walloon organisations to play a more leading role in European consortiums under Horizon Europe and other European R&I programmes.



**SUSTAINING BELGIUM'S POSITION
AS AN INNOVATION LEADER**

**OPTIMISING THE RETURN TO ECONOMY
AND SOCIETY OF R&I INVESTMENT**

**ENHANCED STRATEGIC GOVERNANCE
AND MANAGEMENT OF R&I POLICY**

FUTURE-PROOFING R&I POLICIES

7 CHALLENGES AND OPPORTUNITIES: TO 2027 AND BEYOND

This concluding chapter provides a succinct discussion of the cross-cutting challenges for Belgian R&I policy, as identified in consultation with the representatives of the Belgian authorities involved in the editorial committee for this report. The four challenges are:

- ▶ Sustaining the positive trend in research and innovation performance by maintaining a balanced policy mix that creates, retains and grows innovative firms;
- ▶ Ensuring that R&I investment has a beneficial impact on economy and society – translating R&I results into tangible benefits for all in society;
- ▶ Effective management of R&I policy in an increasingly interlinked world: multi-level (within Belgium, Europe, etc.) and cross-sectoral coordination mechanisms for R&I policy;
- ▶ Develop an open and flexible R&I system that is ‘future-proof’ and increases the resilience of the Belgian economy and society.

7.1 SUSTAINING BELGIUM'S POSITION AS AN INNOVATION LEADER

As discussed in section 1.3, Belgium's research and innovation (R&I) performance has globally improved over the last decade. Several indicators show that Belgium is now ranked in the top three to five performers within the EU27. As was highlighted in the first chapter, the policy mix in Belgium has also evolved significantly over the last decade, thanks to the increasing budgetary importance of fiscal measures at federal level. Looking at the trends since 2010, we clearly see the role of fiscal measures (R&D tax incentives) in driving the uptick in business R&D investment. An evaluation of the R&D tax incentives by the Federal Planning Bureau²²⁶ concluded that:

- ▶ All four partial exemption of withholding tax (PWHT) schemes succeed in raising additional R&D. There are robust indications of input additionality for the PWHT on the wages of R&D employees with a master's degree, as well as for R&D employees involved in research co-operation.
- ▶ There are positive results for the Young Innovative Companies scheme as well as for employees with a PhD and civil engineering degree. In addition, for Young Innovative Companies the withholding tax exemption is considered more relevant than a tax credit, as these companies often do not make profits in their early years.
- ▶ However, there is no clear evidence of significant additionality for the R&D tax credit and the tax deduction of patent income. Moreover, additionality decreases if companies combine direct and indirect support schemes.

The increased use of R&D tax incentives has coincided with a growth in R&D expenditures relative to GDP, rising from 2.06% in 2010 to 3.17% in 2019. The increase in business expenditures relative to GDP is even more significant, increasing from 1.38% of GDP in 2010 to 2.34% in 2019. While the study concluded that some of the schemes have increased the R&D expenditures of companies, the direct causality between the two trends is not analysed.

226. See: https://www.plan.be/uploaded/documents/201905070904440.WP_1904_11894.pdf

Nevertheless, evidence from an OECD study (Appelt et al., 2020²²⁷), which covers 20 countries including Belgium, suggests that on average 1 unit of R&D tax support is associated with 1.4 units of R&D investment. The authors estimated the leverage effect in Belgium to be higher, at 2 units of R&D investment per 1 unit of R&D tax support. The effect on experimental development is about twice as large as the effect on basic and applied research. Moreover, the input additionality of R&D tax incentives is larger for small (1.4) and medium-sized (1.0) firms than for large companies (0.4). R&D tax incentives seem to boost R&D more strongly for smaller firms, because these firms perform less R&D on average. In a similar vein, little input additionality (0.3) is found by the OECD for firms in highly R&D-intensive industries (including the pharmaceuticals and scientific R&D sectors). Finally, the OECD study found a similar degree of input additionality for direct R&D government funding measures (1.4) as for tax incentives; it also identified the potential complementarity of direct and indirect support measures. Direct support measures appear more conducive towards promoting research, whereas tax support is principally associated with heightened levels of experimental development.²²⁸

A 2021 study for the Flemish Government, as part of a broad review of policy expenditure, considered the interplay between the Flemish subsidies for R&I and federal tax measures. The majority of Flemish R&D support goes to small companies (<50 employees). The federal tax benefits, on the other hand, mainly go to the large companies, which are often also multinationals. The direct R&D subsidies awarded by the Flemish Government increase the total R&D expenditure of companies (input additionality). This effect remains, even after federal fiscal (indirect) aid is taken into account. This effect is driven by the small enterprises (<50 employees). The impact in medium (50-250 employees) and large companies (>250 employees) is small and statistically not different from zero. The study found a negative complementarity for output additionality: Flemish R&D support is on average less efficient, as companies receive more federal (R&D) tax benefits. Moreover, the study found that the impact on productivity is not immediately identifiable during the period in which companies receive subsidies, but rather seems to pick up later.²²⁹

Furthermore, commenting on the results of the 2019 evaluation, the BNB highlights that in Belgium only a small amount of R&D spending comes from young (innovative) firms, although these are precisely the type of firms that often have the best growth potential. This finding is corroborated by the 2021 OECD study, which finds that R&D performing small firms in Belgium are less likely to be recipients of R&D tax support compared to other countries (France, Norway, and the Netherlands). However, direct support measures (at regional level) tend to benefit SMEs relatively more than larger firms, underlining the potentially complementary nature of federal (indirect) and regional (direct) funding for business R&D.

227. OECD (2020), 'The effects of R&D tax incentives and their role in the innovation policy mix: Findings from the OECD microBeRD project, 2016-19', OECD Science, Technology and Industry Policy Papers, No. 92, OECD Publishing, Paris, <https://doi.org/10.1787/65234003-en>.

228. Direct subsidies mainly have an impact on small and young firms' R&D decisions, while R&D tax incentives are more market oriented, as the decision on which projects to invest in is left to the firms themselves. Larger firms seem to benefit more from the latter.

229. See: https://www.ewi-vlaanderen.be/sites/default/files/bestanden/policymix_additionaliteitvlaio_geintegreerdrapportvbh_10nov2021.pdf

As a result, a rethink of the Belgian R&D tax credit support mechanisms is 'on the table', particularly with a view to raising the additionality of the R&D tax support. In 2021, the Central Council for the Economy (CCE-CRB) also examined the effectiveness of R&D support measures and assessed several factors important for optimising the impact of R&D in terms of economic activity and employment in Belgium.²³⁰ The CCE-CRB repeated the call for a reflection on the effectiveness of the R&D tax credit, as a means for developing a broader base of business R&D and innovation performers as well as for the reduction or elimination of the output support (patent/innovation revenue) for which additionality appears particularly low.

As Appelt et al. (2020) point out, in Belgium business R&D performers receive the same rate of R&D tax subsidy, irrespective of their size or level of R&D spend. This is because no upper ceilings or thresholds apply that would limit the value of R&D tax relief or qualifying R&D expenditure. In other countries, support for R&D is only up to a certain ceiling, be it in-house (e.g. Norway) or outsourced R&D (as in Austria). If this ceiling is sufficiently low, the rate of tax support is effectively higher for firms that perform less R&D, which are on average also of smaller size. The possibility of applying a limit to the total of support a firm receives (from both direct and indirect support), and/or of applying a lower rate of deduction above a certain ceiling, has been recommended by several recent studies (Dumont, 2019; OECD, 2019; CCE-CRB, 2021).

If Belgium is to solve its productivity challenges, it must spread R&D more widely in the business sector, as this is an essential vector of technological dissemination; it must also and particularly increase R&D and innovation activity of SMEs, notably in the service sector. While compound annual productivity growth was 1.1% during 1995-2007 (compared to an EU average of 1.0%), from 2008 to 2018, the productivity growth was only 0.1% per annum (compared to 0.5% for the EU).²³¹ Hence, the increased business investment in R&D during the second period has not yet translated into higher productivity (increased value added) in the Belgian economy. Considering the sectoral contribution of productivity, total factor productivity has increased significantly (20% between 2010 and 2017) in the manufacturing sector in Belgium, but remained stable or declined for market services and non-market services respectively (EC, 2020).

Adapting the federal indirect support measures to be more friendly to younger and smaller innovative firms will reap rewards. But this will depend on the regions also taking complementary action to encourage entrepreneurship, helping firms adopt modern management practices and 'new ways of working', and ensuring that more SMEs have the internal capacities to invest in R&D. Entrepreneurial activity in Belgium is weaker than in many other EU countries. For instance, compared to the three other innovation leaders in EIS 2021 (Denmark, Finland and Sweden), Belgium has a very low rate of opportunity-driven entrepreneurship. Belgium also had the lowest share of start-ups (up to five years old) in total enterprises between 2009 and 2016 in the EU. Moreover, Belgium had one of the lowest rates in the EU of high-growth enterprises in total enterprises in 2017 (9.57% in Belgium compared to 10.57% on average). Furthermore, in 2017, Belgium's performance in terms of the share of high-growth enterprises in high-tech and medium-high tech manufacturing, and high-tech knowledge intensive services in total high-

230. <https://www.ccecrb.fgov.be/p/fr/909/la-r-d-et-sa-valorisation-en-belgique-un-premier-diagnostic>

231. European Commission (2020) Science, Research and Innovation Performance of the EU 2020. A fair, green and digital Europe. Page 106. doi:10.2777/534046

growth enterprises, was close to the EU average (11.8% to 12%) but lower than in other innovation leaders (e.g. Denmark's rate was 14.5%). Such figures point to the existence of an entrepreneurial deficit in Belgium. This deficit is at odds with Belgian's overall positive R&I performance and it may explain the lack of structural change in the economy towards more knowledge-intensive activities, notably high-tech knowledge-intensive services.

As presented in the specific chapters, all three regions have in place a variety of measures to support entrepreneurship and to encourage firms to engage in innovation. However, there is less of an emphasis on scale-up and growth. The European Commission's country report for 2020 noted that, in Belgium, it is difficult to become a high-growth firm, but even more challenging to remain one. The most cited reasons include rigidities in the business environment, a limited appetite for private risk, as well as limitations in the availability of highly-skilled professionals, with the latter affected by a gender gap in STEM education, a lack of businesses started by women and women in senior management positions. In the coming years, further strengthening of the support for dissemination of new technologies will be important, most notably digital and clean energy solutions. This must be among R&D active firms close to the technology frontier, as well as SMEs. Further priorities include the promotion of entrepreneurial activity, new business models and a shifting emphasis from start-ups to scale-ups.

7.2 OPTIMISING THE RETURN TO ECONOMY AND SOCIETY OF R&I INVESTMENT

This report has tracked the changing policy priorities of the Belgian authorities over the last decade. The evidence points to a shift towards a greater focus on the societal impact of R&I investment. All the Belgian authorities have taken steps to refocus and provide more 'directionality' to R&I policies, and there is clearly increased awareness of the potential contribution of R&I policy to sustainable development goals. For instance, while boosting productivity growth is a key expected outcome of R&I policy, as discussed above, this must be done so that it refocuses the use of available resources and investments on more efficient (energy, material) production activities and systems, which must also be environmentally friendly in order to ensure a sustainable growth path.

Figure 62: Selected mission-oriented R&I policies of the Belgian authorities

Federal	<ul style="list-style-type: none"> ▶ Energy transition fund & MYRRHA ▶ Climate centre ▶ Health — 'one world, one health' policy — Sciensano institute
Flanders	<ul style="list-style-type: none"> ▶ Vizier 2030 and work to integrate SDG in R&I policy ▶ Moonschot CO2 ▶ Policy Research Centre circular Economy
FWB	<ul style="list-style-type: none"> ▶ Inter-university technological platform for environment and energy transition ▶ ClimaAX programme
Brussels-Capital	<ul style="list-style-type: none"> ▶ New regional plan for innovation defined six strategic innovation areas addressing societal challenges
Wallonia	<ul style="list-style-type: none"> ▶ New S3 addressing five strategic innovation areas responding to societal challenges: circular materials, innovation for enhanced health, etc...

A shift to 'mission-oriented R&I policies' (MOIP) is a trend that is likely to develop further in the coming decade: it will require new models of governance and implementation to be developed and tested. According to the OECD, a "mission-oriented innovation policy is a co-ordinated package of policy and regulatory measures tailored specifically to mobilise science, technology and innovation in order to address well-defined objectives related to a societal challenge, in a defined timeframe. These measures possibly span different stages of the innovation cycle from research to demonstration and market deployment, mix supply-push and demand-pull instruments, and cut across various policy fields, sectors and disciplines."²³²

232. Larrue, P. (2021), 'The design and implementation of mission-oriented innovation policies: A new systemic policy approach to address societal challenges', OECD Science, Technology and Industry Policy Papers, No. 100, OECD Publishing, Paris, <https://doi.org/10.1787/3f6c76a4-en>

Approaches to MOIP can take different forms, but generally they are about ensuring ‘directionality’ and bringing together existing funding instruments and actors in the R&I system in order to achieve a coordinated and concerted effort to address a specific challenge or achieve a desired outcome. The Moonshot Initiative in Flanders, or the strategic innovation initiatives in Wallonia, are relevant examples in Belgium. MOIP is a very active area of policymaking in Flanders, with the recent introduction of ‘Impulse Programmes’ (e.g. Health & Care, Flanders Space, Bio-Economy) and the development of a framework for mission-driven innovation policy.

Climate research is one example of where Belgian authorities have a broad range of activities underway that would benefit from a MOIP-type approach. This approach would ensure enhanced coordination both horizontally (across government departments and agencies of each authority) and vertically (between the Belgian authorities and with the European and international actors). At federal level, the decision to create the federal ‘Centre of Excellence for Climate Research’ is an example of recent action taken to strengthen and coordinate the input of research for climate policy. At regional and community levels, there is now greater focus on funding for climate research and innovative technological solutions to reduce future CO₂ emissions and to shift to a low-(zero-) carbon economy and society. Flanders Industry Innovation Moonshot²³³ brings together Flemish universities, research institutes and industries to develop breakthrough technologies by 2040, so as to create new climate-friendly processes and products. The Flemish Government will invest €20 million in the Moonshot initiative every year from 2020 to 2040, totalling €400 million. In Wallonia and Brussels, the Governments have also committed to funding for R&I on the circular economy, environmental technologies, sustainable mobility and energy transition: these will help meet the challenges of limiting the impact of carbon emissions. In Wallonia, the objective is to achieve an annual public R&I expenditure of €110 million per year for energy and climate objectives.²³⁴ Beyond the financial contribution, the range of initiatives mobilised across the authorities is broad: from promotion of citizen science initiatives and STEM education on climate science (Innoviris), to the ClimAX initiative of the F.R.S-FNRS, which provided €20 million in funding for climate research (2019-2020) to support for clusters and industrial technologies. The Belgian RRF plan has also been used to support a range of relevant climate, energy and environmental investments.

Within the Belgian institutional context, it will be important to optimise the synergies between the various initiatives, encourage knowledge exchange and pooling of data (open science), ensure alignment of funding and develop a ‘value chain’ perspective (e.g. how do the regions organise to fund development and piloting of research results arising from federal or FWO and F.R.S-FNRS research funding?). In this respect, it would be useful to map the various programmes and initiatives at each level that are funding R&I relevant to various societal challenges (health, climate, energy, circular economy, poverty reduction, etc.) and to identify relevant indicators that could be used to track the contribution of R&I policies to SDG goals and specific targets and international obligations of Belgium in the coming decades.

233. See: <https://moonshotflanders.be>

234. Target set in the Walloon Energy and Climate Plan (Plan wallon Energie Climat) 2030, adopted in December 2019

7.3 ENHANCED STRATEGIC GOVERNANCE AND MANAGEMENT OF R&I POLICY

The Belgian R&I policy system may appear complex to external observers. However, the clear distribution of competences under the nation's constitution means that each authority has a remit for action in their specific fields of power. The BRISTI 2021 report provides an update on the evolution of governance and management of R&I policies for each authority, with some significant changes taking place over the last decade, aimed at enhancing policy design, implementation and evaluation processes.

In all three regions, efforts have been made to enhance policy coordination by developing strategies that adopt a cross-departmental perspective as well as to re-organise (and even rationalise) the agency structures that support R&I. For example, in Flanders, the establishment of VLAIO involved the merger of formerly separate agencies to create a single point of contact for companies for all matters related to innovation and entrepreneurship. In Brussels, Innoviris, responsible for R&I instruments, works closely with hub.brussels, which resulted from the merger of several agencies in 2018. In Wallonia, SOWALFIN absorbed the agency for entrepreneurship and innovation in 2018, to create a one-stop shop for entrepreneurship, innovation and financial support for businesses and it was given a mission to reform the regional business advisory and services landscape.

The European Commission (Country Report 2020) has noted that “the multi-level governance of the Belgian system creates specific challenges, such as the risk of sub-optimal scale of public-private investments that may create disincentives for structural cooperation between the leading research performers and businesses at an interregional level”. However, over the last decade, new forms of cooperation have emerged between Belgian authorities in the field of R&I, notably the EOS and BEL-COO. They provide one potential ‘blueprint’ for enhanced cooperation to optimise public investment in R&I. Given the distribution of competences, joined-up R&I policy is a challenge that the Belgian authorities must address, if public investment in R&I is to be optimised and if Belgium is to make an effective contribution to European R&I priorities and policies. Examples of areas where enhanced cooperation would be welcome include the Horizon Europe missions, defence and security research, cybersecurity and AI. Incidentally, these are areas where all Belgian authorities have plans and initiatives. At Belgian level, the tried and tested coordination structures (CIS/CFS) enable the authorities to speak with one voice at European level and to share the task of representing Belgium in European R&I programme and partnerships. Renewing and extending this coordination structure, by developing thematic working groups on specific R&I topics (e.g. aligning investments in research infrastructures through a coordinated roadmap), could be one action to take in the coming years.

7.4 FUTURE-PROOFING R&I POLICIES

The last decade has been marked by increasing attention paid to the need for our societies to anticipate and adapt to various challenges and trends – from the climate crisis to cyberattacks and ethical issues related to technologies such as artificial intelligence), as well as to prepare for the unexpected ('black swan' events) like the on-going COVID-19 pandemic. This will call for an enhanced and evolving role for R&I as a vector for the necessary 'deep transformative effort' that will ensure the digital and green transition takes place, while fostering well-being across society. As a recent European expert group report²³⁵ underlined, "*this is a question of direction (i.e. R&I should address concrete societal challenges with systemic approaches) and of speed and responsiveness*".

That report calls for a **protect-prepare-transform approach** with investment directed "*towards enhanced protection from the adverse impacts of social, economic and environmental shocks; better preparation to face emerging large-scale risks; and deep transformation to be able to reconcile sustainability with resilience in the future*". Aside from using R&I to adapt to futures challenges, R&I can also help to identify future long-term challenges that are not on the radar yet. Adaptability and responses to already identified challenges are a key aspect, but strategic foresight on long-term challenges is also important.

The COVID-19 crisis has provided an example of how Belgian R&I systems can be mobilised in line with this protect-prepare-transform principle. During the early stages of the crisis, the Belgian authorities mobilised additional funding for both measures in order to monitor public health. They also deployed innovative solutions and coordinated research efforts to prepare for future pandemics and to deploy preventative care measures.

The resilience of Belgium's R&I system will also require sustained investment in science education and in life-long learning. This investment will ensure that Belgium has the skills and know-how in key technologies that are required for the digital and 'green deal' agendas. This includes concerted action to further boost 'STEAM' (adding the A for arts and creative skills into the mix of STEM learning) education, including ensuring an improved gender balance among graduates and researchers.²³⁶ Citizen science has great potential for further expansion in Belgium and this should also move up the policy agenda in the coming years, by building on existing initiatives (e.g. air quality monitoring in cities²³⁷), toolkits (e.g. the BiodivERSA Citizen Science Toolkit²³⁸) and platforms (e.g. Scivil in Flanders)²³⁹.

235. See: <https://op.europa.eu/en/publication-detail/-/publication/9167a698-180e-11eb-b57e-01aa75ed71a1/>

236. See for example <https://www.vub.be/en/events/2021/vub-unveils-plans-for-steam-academy>

237. See: <https://curieuzenair.brussels/en/home/>

238. See: <https://www.biodiversity.be/5546/>

239. See: <https://www.scivil.be/en>

