



**Flanders**  
State of  
the Art

# **STI in Flanders**

Science, Technology & Innovation  
Policy & Key Figures - 2016



# **STI in Flanders**

Science, Technology & Innovation  
Policy & Key Figures – 2016



# Table of contents

Foreword.....	7
Chapter 1 Science, Technology and Innovation system in Flanders.....	9
1 Competencies in the field of science, research and innovation.....	10
1.1 Federalism in Belgium.....	10
1.2 Competencies in the field of science, research and innovation .....	11
1.2.1 Direct support for R&D and innovation in the broad sense.....	12
1.2.2 All research related to the community (= person-related) and the regional (= territorial related) competencies.....	12
1.2.3 Access to finance .....	13
2 General orientations of Flemish STI policy .....	13
2.1 Instruments of policy-making in the field of R&D and innovation.....	13
2.2 Monitoring and reporting of the R&D and innovation policy .....	15
3 Flanders, centre of innovation.....	16
3.1 More resources for R&D.....	20
3.2 Focusing on strengths and “spearhead domains” .....	21
3.2.1 Scientific specialisations.....	21
3.2.2 Technological specialisations.....	22
3.2.3 Economic specialisations.....	23
3.2.4 Combined technological - economical specialisation profiles.....	24
3.3 More opportunities for research talent .....	26
3.3.1 Science popularization .....	26
3.3.2 Science careers.....	27
4 Instruments and actors of Flemish STI policy .....	27
4.1 Government department .....	28
4.2 Policy advice .....	29
4.3 Other bodies of public interest in the field of science and innovation .....	30
4.4 Funding agencies.....	30
4.4.1 Flanders Innovation & Entrepreneurship (AIO) .....	30
4.4.2 Research Foundation Flanders (FWO).....	32
4.4.3 PMV – Flanders Holding Company .....	33
4.4.4 Investment Company LRM .....	34
4.5 Innovation intermediaries.....	34
4.5.1 Infrastructure: science parks and incubators, and support for spin-off companies .....	34
4.5.2 Financial intermediaries .....	35

4.5.3	Innovative networks.....	36
4.5.4	Research – business links.....	37
5	Main research and innovation performers .....	38
5.1	Higher education institutions .....	38
5.2	Business enterprise sector.....	39
5.3	Strategic research centres.....	40
5.3.1	IMEC.....	40
5.3.2	VIB.....	41
5.3.3	VITO.....	41
5.3.4	iMinds.....	41
5.3.5	Flanders Make.....	42
5.4	Collective research and clustering initiatives.....	42
5.4.1	VIS-scheme.....	42
5.4.2	Excellence centres and Innovation Platforms.....	42
5.4.3	Cluster policy.....	43
5.4.4	Support for research performed by collective (research) centres.....	44
5.5	Policy research centres .....	44
5.6	Scientific institutes.....	45
5.7	Other knowledge institutes, and networking platforms for R&D and innovation.....	45
5.8	Institutes governed by other authorities.....	47
5.8.1	Federal authority.....	47
5.8.2	International institutions, organizations or platforms in the STI field.....	47
5.9	Cooperation among different knowledge actors within Flanders .....	48
6	Overview of the various actors in the STI domain in Flanders .....	49
7	Flanders in the international STI field.....	52
7.1	Policy preparation, support and follow-up .....	52
7.2	Bilateral and international co-operation and agreements .....	53
7.2.1	STI actors: universities, university colleges, strategic research centres, scientific institutes and other knowledge organizations.....	53
7.2.2	Public authority level: the EWI policy domain and the International Flanders (IV) policy domain .....	55
7.3	Participation in EU and international programmes, networks and initiatives.....	59
7.3.1	EU Framework Programme for Research and Technological Development (FP for RTD), Horizon 2020, and the EU Competitiveness and Innovation Programme (CIP)	59
7.3.2	EU Regional Policy.....	60
7.3.3	EU initiatives that are inter-governmental and complementary to the topics and initiatives in the EU programmes for R&D and innovation.....	61

8	Smart Specialisation in Flanders .....	64
8.1	More targeted approach in policy design.....	64
8.2	Smart specialisation spearhead domains in the EU context.....	65
<b>Chapter 2 Funding of R&amp;D.....</b>		<b>68</b>
1	Introduction.....	69
2	GERD.....	69
3	BERD.....	71
4	Non-BERD.....	73
5	GBARD .....	75
6	Estimate calculation method for publicly financed R&D intensity (1% objective) .....	78
7	The EU Framework Programme for Research and Innovation - Horizon 2020.....	79
7.1	Introduction .....	79
7.2	Participation by Flanders .....	80
7.3	Benchmark for Flanders.....	82
7.4	Top participating organizations.....	82
8	EU Regional Policy Fund (ESIF) and R&D&I support.....	84
<b>Chapter 3 Human resources in science and technology.....</b>		<b>86</b>
1	Introduction.....	87
2	S&T students.....	87
3	S&T graduates .....	88
4	R&D personnel .....	89
5	Mobility of researchers.....	91
6	PhD.....	93
<b>Chapter 4 Innovation efforts by enterprises in Flanders (CIS results) .....</b>		<b>95</b>
1	CIS: global results.....	96
2	Process and product innovation.....	96
3	Organizational and marketing innovation .....	97
<b>Chapter 5 STI productivity or STI output?.....</b>		<b>99</b>
1	Introduction.....	100
2	Scientific publications .....	100
3	Citations .....	102
4	Co-publications.....	102
5	Social sciences & humanities.....	103
6	Patents .....	104
<b>Acronyms and abbreviations.....</b>		<b>107</b>
<b>Websites (non-comprehensive list).....</b>		<b>112</b>





# Foreword

The Department of Economy, Science and Innovation of the Flemish Government is pleased to present its fourth edition of the “STI in Flanders”. The aim is to present in-depth information about Science, Technology and Innovation policy in Flanders, highlight important figures or indicators, describe the broad context and the performance of the research and innovation landscape, and list both the main actors and the public entities engaged in the field of R&D and innovation. The publication will be updated on a regular basis.

The Government of Flanders is aware of **the importance of research and innovation** as a necessary condition for maintaining wealth and well-being in Flanders. As early as the mid-1990s, it started to elaborate a broad-based strategy for STI policy, which has since been developed through a whole series of initiatives, treaties, parliament acts, decrees, agreements, decisions, MoU’s and statements, which strive towards a common goal or seek to achieve other legislative measures that shape, implement and evaluate policy in the broad field of science, research and innovation. This is underpinned by **a substantial public budget for research and innovation**.

In 2016, the overall budget of the Flemish Government amounts to 40 billion euros. The budget (across all policy domains) for science and innovation policy of the Flemish Government reaches 2.22 billion euros, of which 1.40 billion euros for R&D in the strict definition. In addition to this Flemish budget, research actors in Flanders annually have at their disposal about 303 million euros from federal budgets, 160 million euros from the EU Horizon 2020 programme and about 23 million euro for initiatives on research and innovation within the EU Regional Policy 2014-2020 (an estimated 40% of the total ERDF budget available for Flanders). Hence, the total public budget for R&D in strict sense available in 2016 to the various R&D actors in Flanders was almost 1.9 billion euros.

Furthermore, public and private actors jointly spent 5.738 billion euros on R&D (GERD) in 2014, which represents an R&D intensity of 2.46% for Flanders (2014). In the latest Regional Innovation Scoreboard (RIS 2016), Flanders is part of the second group of “strong innovators”; consequently, its ambition to be among the top innovative regions in Europe requires further effort.

The new Flemish Government has confirmed in its governing agreement for the period 2014-2019 a **focus on a growth path for the 3% target of R&D intensity**, including the aim to achieve 1% R&D public outlays/GDP by 2020. To reach this goal, the government continues to **stimulate various stakeholders from government, civil society, business organizations and STI actors in Flanders** to join forces to develop initiatives, set policy targets, or maintain important efforts for the long term in the field of R&D and innovation.

A lot of information on R&D, science and innovation in Flanders is already gathered in various publications and reports. Examples are the “*Vlaams O&O Indicatorenboek*” (Flanders’ R&D Indicators Book), the “*Speurgids*” (Budget Browser), the VRIND (Flanders Regional Indicators Book), the Flemish and Belgian Reform Programmes for the EU 2020 strategy in the framework of the European Semester, the “3% note” (from ECOOM), the analysis of the Flemish participation in the EU programmes, the Flanders’ Outlook, and many STI policy documents or reports on Flanders at the EU or international level such as the Regional Innovation Monitor (RIM), the Regional Innovation Scoreboard (RIS) the smart specialisation strategy (S3) profile of Flanders, the Belgian ERAwatch reports, the Innovation Union reports on Belgium, the Belgian Competitiveness Report, the Belgian RIO report (Research and Innovation Observatory report), or the OECD STI Outlook for Belgium.

This “STI in Flanders” publication provides an **overview of Science, Technology and Innovation policy and organisations in Flanders for a broad public**. It bundles various types of information and statistical data of the Flemish R&D and innovation landscape.

I would like to thank Niko, Stefanie, Monica, Pierre, Peter, Ils and Emmelie for the preparation of this document.

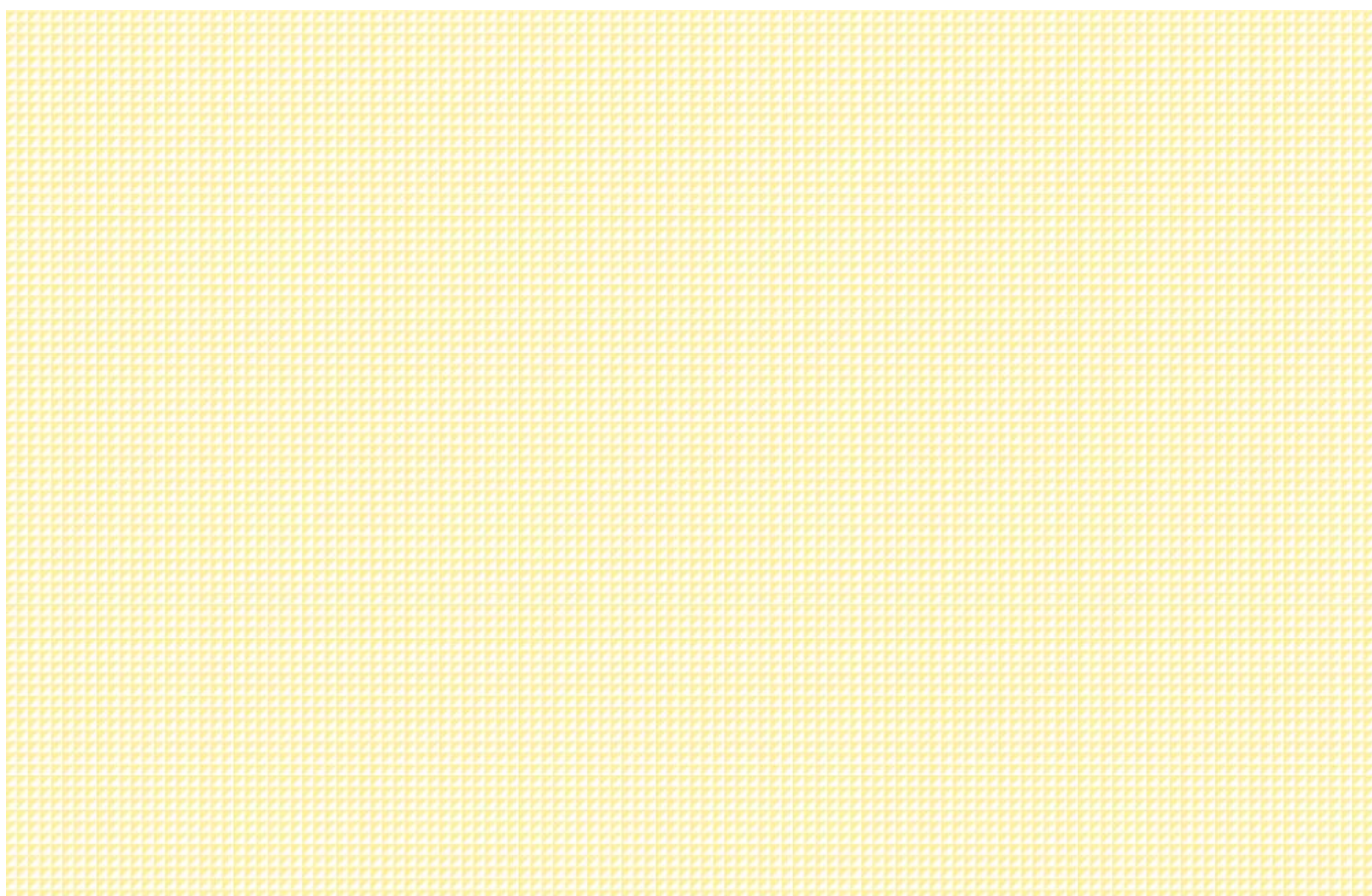
I wish you a pleasant reading of this fourth edition of “STI in Flanders”!



Johan Hanssens,  
Secretary-general  
Department of Economy, Science & Innovation

# Chapter 1

## Science, Technology and Innovation system in Flanders



# 1 Competencies in the field of science, research and innovation

## 1.1 Federalism in Belgium

Flanders is an autonomous region located in the northern part of Belgium, with Brussels as its capital. It manages important competencies and budgets in many policy fields. This is the result of a gradual process of change since 1970, resulting from 6 state reforms that have introduced a far-reaching degree of federalism in Belgium. Consequently, many competences have been transferred to the federalised authorities (Communities and Regions). Institutionally, Belgium is divided into four language areas (the Dutch-speaking, the bilingual Dutch/French, the French-speaking and the German-speaking), and is composed of three Communities (the Flemish, the French and the German-speaking) and three Regions (Flemish, Brussels Capital and Walloon). Consequently, policy-making within the country is prepared and executed by various authorities, based on three distinct pillars, each with their own range of competencies: a federal, a community and a regional pillar. The Belgian form of federalism is unique in the world. Its main characteristics are briefly:

- each entity has exclusive powers and competencies in a number of areas (no shared competencies);
- each entity has its own separately elected parliament, government, administration, legislation, advisory bodies, etc.;
- no hierarchy exists between the different entities regarding their competencies (no overruling is possible);
- since the fourth state reform of 1993, the principle of “in foro interno, in fore externo” has been applied, meaning that each entity executes its competencies both inside and outside Belgium.

In 1980, the regional authorities were established. Thereby, the Flemish authorities decided to merge the existing institutions of the Flemish Community and the Flemish Region. Since then, a single Flemish Parliament, Flemish Government, and administration, with consultative or advisory bodies, have managed and overseen both community and regional competencies in the various policy domains. The Flemish Parliament debates and legitimates all official legal decisions pertaining to both community and regional competence. Likewise, the Government of Flanders is charged with the execution and implementation of policy decisions of both the community and the regional competencies. This situation differs from the French-speaking part of the country, where the French Community and the Walloon Region are separate institutional entities with different parliaments, governments and public authorities.

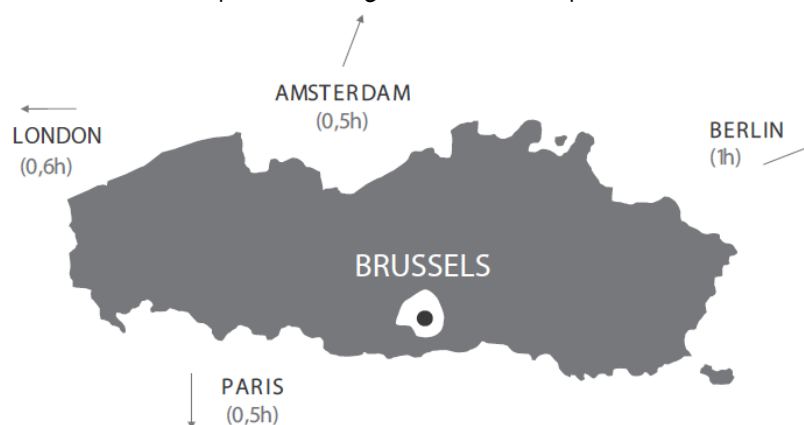


Table 1: Key figures on Flanders, Belgium and EU-28

	Year	unit	Flanders	Belgium	EU-28
Surface area		km <sup>2</sup>	13,521	30,528	4,381,376
Population	1/1/2015	million	6.44	11.21	508.29
GDP in current prices	2015	billion euro	239.2	409.4	14,693.0
Export	2015	billion euro	300.6	360.6	
GERD	2014	billion euros	5.738	9.875	271.559 (2013)
GDP per capita	2015	euros	32,000	36,500	28,800
R&D intensity	2014	%	2.46	2.47	1.98
Public R&D&I budget p.a. for Flanders, orig. from:	2016	million euro	2,703		
<i>Flemish authority:</i>			2,217		
<i>federal authority:</i>			303		
<i>EU Horizon 2020:</i>			160		
<i>EU ERDF + Interreg:</i>			23		
Employment rate (20-64 years of age)	2015	%	71.9	67.2	70.0

Flanders' population accounts for about 58% of Belgium's total population, whilst its surface area covers about 44% of the country. The majority of the companies and the working population of Belgium are located in its northern region, which also has a higher employment rate. As a result, the economy of Flanders represents about 58% of the Belgian economy (as measured in GDP). It is also a very open economy: according to the EU definition, exports from Flanders are worth almost 125% (2014) of its GDP (partly due to the trade of goods arriving in the harbour of Antwerp). On the other hand, the relative wealth of Flanders -as measured in GDP per capita- is about 20% higher than the EU-28 average but slightly lower than the Belgian average. The main reason for the latter is the "capital city" effect of the small Brussels Capital region, with its strong presence of company headquarters and public administrations. If the wealth generated by the daily commuters from Flanders into the Brussels Capital Region were attributed to their residence in the Flemish Region, the Flemish GDP per capita would rise above the Belgian value. Total expenditure on R&D (GERD) in Flanders, which reaches 5.8 billion euro, equates to over 64% of the Belgium total (2013) and the Flemish R&D intensity exceeds the national value for Belgium (for details, see chapter 2). The Flemish Government is the main source of public funding for R&D and innovation in Flanders, representing 82% of the total annual budget of 2.7 billion euro (2016).

## 1.2 Competencies in the field of science, research and innovation

While certain policy domains remain exclusively federal (e.g., defence policy, monetary policy, nuclear power research, social security), other domains have largely or even completely been transferred to either the Communities or the Regions. The latter is the case for the Science, Technology and Innovation (STI) domain: in terms of legislation and budget, scientific research is mainly a community competence, whereas innovation is almost completely a regional competence. In Belgium, over 3/4 of total public R&D and



innovation support is under the responsibility of the Communities and the Regions. After the 6<sup>th</sup> State Reform of Belgium, the overall policy budget of Flanders now adds up to 40 billion euro (of which 2.2 billion euro aimed at scientific research and innovation), which surpasses the federal policy budget of 32 billion euro.

The federal authority remains responsible for a limited number of research programmes (notably in the field of climate and sustainable development), the support of research infrastructures of national interest, a number of federal scientific institutes, and a small number of exclusively attributed research themes, including the Belgian space policy, 'sustainable' nuclear energy and polar research at the Antarctic station. In addition, framework conditions such as IPR, normalization, standardization, tax credits and scientific visas for researchers also are exclusively managed by the federal authority. Tax credits aimed at R&D have become very substantial in Belgium in recent years. There exists a 80% fiscal exemption of salaries' social contribution for R&D employees at research/scientific institutes and companies in Belgium which totals € 1.25 billion annually (2013). Then there is an increased investment deduction or tax credit for assets that stimulate R&D and innovation, and finally a measure exists to deduct income revenue from patents income (= IPR friendly measure).

In summary, page 2 of the OMC Belgian peer review report (29 September 2011) provides an accurate description, i.e.: *"the research and innovation system in Belgium has important specific characteristics by which it distinguishes itself of most other systems in Europe. (...) The Belgian research and innovation system is a combination of two large and one small research system that compete with each other and cooperate through a public governance system with six levels and federal as well as confederal elements. Consequently, there is not one Belgian research and innovation system; all regions (and communities) have almost complete autonomy to set up their own system."*

The various competencies, as well as the types of institutes for which Flanders is responsible in the field of science, research and innovation in practice, can be divided into the following areas:

### 1.2.1 Direct support for R&D and innovation in the broad sense

This includes:

- grants, fees, PhDs and subsidies or other support channels for basic, fundamental, cutting-edge and applied research that is conducted by researchers at universities, institutes, companies, knowledge networks, etc.;
- all business-oriented support (e.g., technology transfer, technology advice, technology scans, networking, dissemination of innovation, knowledge and technology, valorisation or research results, feasibility studies, knowledge vouchers, etc.);
- various forms of collective research (joint industry-science research, innovative networks, clustering);
- promotion and popularization of STI (in education, society, business, science centres, etc.), mobility of researchers, etc.

### 1.2.2 All research related to the community (= person-related) and the regional (= territorial related) competencies

This includes:

- broad innovation policy, as well as scientific research policy (fundamental, applied and strategic basic research);
- (research at) higher education institutions (university colleges, universities);
- (research at) public research organizations (PROs);

- (research at) scientific institutes and policy research centres of the Flemish Community;
- (research at) various institutes that generate knowledge or scientific output;
- infrastructure in the field of research and innovation (small, medium-scale and large-scale research infrastructure, such as supercomputers, data collections, networks, clean rooms, etc.);
- science parks, technology parks, incubator sites, etc.
- research in the policy fields for which Flanders is responsible: economic support, industrial policy, entrepreneurship, social economy, public works, employment, environment, nature conservation, forestry, agriculture, energy (except for nuclear energy), heritage, (primary, secondary and higher) education, water management, transport, vocational training, health, culture, tourism, care, health and well-being, data transmission, sports, media, youth, etc.

### 1.2.3 Access to finance

Support for start-ups, spin-offs, participations, seed capital, risk capital, guarantees, fast-growing or technology-oriented businesses, business angels, loans, etc.

In other words, apart from a number of competencies reserved exclusively for the federal level (space, nuclear energy research, IPR, normalization, etc.) and a certain number of institutions (federal scientific centres and various knowledge institutes), all competences and activities in the field of R&D and innovation are allocated to and implemented by Flanders.

## 2 General orientations of Flemish STI policy

### 2.1 Instruments of policy-making in the field of R&D and innovation

As previously stated, at the governmental level a single minister is charged with both scientific research and innovation. The public authority charged with STI policy is the EWI policy-domain. EWI (= *Economie, Wetenschap en Innovatie*) manages the broad field of Economy, Science and Innovation, through the EWI Department (that prepares, monitors, follows up, reports about and evaluates policy), and many agencies that execute and implement policy measures in the fields of scientific research, innovation, entrepreneurship and industrial policy (see part 4 in this chapter).

The Government of Flanders is aware of the importance of STI as a necessary condition for maintaining wealth and well-being in Flanders. From the mid-1990s onwards, it has elaborated a broad-based strategy for STI policy through various institutes, a broad instrument mix and appropriate budgets. This policy is developed through a number of agreements, initiatives and statements, including:

- the government agreement in which the various political parties that are part of the governing coalition outline their priorities for the five-yearly parliamentary term (currently 2014-2019);
- the policy note of the minister charged with scientific research and innovation for the five-year governing period (note: as of 2014, this theme has become a part of the policy note for Work, Economy, Science and Innovation);
- the annual policy letter of the minister, which further elaborates and specifies the initiatives for the general policy framework that is announced in the policy note (note: as of 2015, this theme has become a part of the policy letter for Work, Economy, Science and Innovation).

Moreover, a number of multi-annual strategic plans and targets are agreed with a broad-ranging group of stakeholders from government, civil society and industry. These plans set out targets across a range of policy fields, amongst which STI is assigned a clear priority. These major plans include the Flemish and the National Reform Programme for the EU2020 strategy (in the framework of the European Semester), and the Transversal Policy Note Flanders 2050 (VISIE 2050: a long-term strategy for Flanders). During the previous legislations, the 2020 future plan “Vlaanderen in Actie” or Flanders in Action (ViA), served as the long-term vision for Flanders.

Overall, policy in the field of science, research and innovation is being implemented through a whole set of relevant initiatives, treaties, parliament acts, decrees, agreements, engagements (e.g. the aim to reach the 3% R&D intensity goal), ministerial decisions, government communications, concept notes, MoU’s, inter-ministerial decisions, or similar legislation / soft law that elaborates the public policy of the minister or the government in general. The role and tasks of the major actors in the STI landscape of Flanders is defined in the “*Decreet betreffende de organisatie en financiering van het wetenschaps- en innovatiebeleid*” (Flemish Parliament Act on the organisation and support of the scientific and innovation policy), which was approved on 30 April 2009 by the Flemish Parliament (last modification: November 2015).

The coalition agreement for the 2014-2019 Flemish Government announced a number of changes in policy priorities, as well as in changes to the organizational structure of the STI-domain. It lists three focal points of policy:

- a **demand-driven and market-oriented public policy** in the field of economy and innovation;
- a **simplification and rationalization of structures and instruments** with faster and easier procedures, more transparency, better client-friendliness and a clear one-stop-shop function;
- a **higher focus on business-oriented innovation and valorisation**, strong knowledge organizations with excellent research and a **growth path for the 3% target for R&D**, whereby public outlays strive towards 1% by 2020.

A number of changes in the organizational structure of the policy domain of Economy, Science and Innovation (Economie, Wetenschap en Innovatie, EWI) are elaborated in a separate chapter on an “enterprise-friendly authority”.

The EWI policy field currently is the responsibility of the Flemish Minister for Work, Economy, Innovation and Sport, Philippe Muyters. His policy on scientific research and innovation is elaborated in the policy note 2014-2019 for Work, Economy, Science and Innovation (which also includes policy on public companies). The annual policy letters state the on-going situation and the implementation of policy for the parliamentary year concerned. The strategic and operational objectives of the policy letter 2015-2016 that are related to scientific research and innovation are listed below (with corresponding section in the policy letter):

#### **Invest in agile employees and companies (1)**

Invest in competencies (1.2.)

Focus on grounded education and professional choices - STEM (1.2.1.)

Invest in the framework conditions for innovation-driven entrepreneurship (1.3.)

Invest in knowledge building and innovation (1.3.1.)

Continue to focus on policy advice (1.3.5.)

#### **Invest in an excellent knowledge base (2)**

Strive towards a qualitative elaboration of the 3% target (2.1.)

Research at universities (2.1.1.)

The Strategic Research Centres (2.1.2.)

Stimulate knowledge institutions and companies to develop European and international cooperation (2.2.)

Strategy for research careers (2.3.)

Invest in state-of-the-art research infrastructure (2.4.)



- Hercules Foundation (2.4.1)
- Agency Botanic Garden Meise (2.4.2)
- Flanders develops a policy for open data and open access (2.5)
- Invest in a simplified and tailored delivery of services (3)**
  - An integrated contact point for the entrepreneur (3.1)
    - Digital desk (3.1.1)
    - Agency for Innovation and Entrepreneurship (3.1.2)
    - Renewed FWO (3.1.3)
  - Efficient instruments tailored to the specific needs of job-seekers, employees and companies (3.2)
    - Support to companies – economic support policy (3.2.1)
- Invest in European, international and interregional networks (6)**
  - ERDF Flanders and ERDF-Interreg (6.1.)
  - European representation (6.4.)
  - Academic diplomacy (6.6.)
- Activate the innovation potential in SMEs and in large companies (9.)**
- Innovative procurement at governmental level (10)**

## 2.2 Monitoring and reporting of the R&D and innovation policy

The policy initiatives, evolution, whereabouts, available budgets and statistics that describe the Flanders' research and innovation landscape are being monitored and reported on in a structural manner through various initiatives, publications, channels, presentations, reports, at different policy levels. Most of these are the responsibility of the EWI Department, but also other (government) entities produce STI data and information. Furthermore, the various EWI agencies involved in STI provide information and data about their own specific initiatives and budgets (e.g. through their annual report), or conduct studies (e.g. on innovation support, by the AIO), as does the advisory body VRWI (studies, advice, benchmarks). The main sources of policy initiatives and statistical data and indicators in the field of scientific research and innovation include:

- **“Speurgids Ondernemen & Innoveren”** (budget browser enterprise and innovation): provides an overview of the budget allocations for economy, science, and innovation within the whole Flemish authority, and the R&D intensity (annually);
- **“Flemish Reform Programme”** (VHP) and **“National Reform Programme”** (NHP) of the **EU2020 strategy** in the framework of the European Semester (both programmes are submitted in April to the European Commission): the part on R&D&I (annually);
- **“VRIND”** (Vlaamse Regionale Indicatoren): describes the demographic, macroeconomic and social context of Flanders in over 700 indicators, including a part innovation (annually);
- **“PACT 2020”**: 20 policy fields (including one on innovation) are monitored through a set of indicators (annually);
- **“Vlaams Indicatorenboek”**: publication from ECOOM with a well-developed R&D and innovation indicator system measuring the development of the Flemish potential in the STI-field (bi-annually). ECOOM is the Centre for Research and Development Monitoring, an interuniversity consortium with participation of all Flemish universities;
- The **“3% light nota”**: publication from ECOOM that calculates the official R&D-intensity for Flanders (annually);
- **“Flanders Outlook”**: socio-economic performance analysis of Flanders with a set of benchmark regions, including a chapter on innovation data (annually). It also includes a database containing the main statistics of 131 EU regions;
- The analysis of the **“participation of Flanders into the Framework programmes for RTD”**, and the analysis of the **“Flanders' participation in the EU support programmes 2007-2013”** (in case, FP7, CIP, Regional policy).

A selection of important key statistics and data is included further in this publication.

Furthermore, regular overviews of the state of being and evolution of the policy developments, budgets, the profile and initiatives from Flanders in the field of scientific research and innovation, are available through many publications and reports from the EU and the OECD in the field of R&D and innovation. These include the profile of Flanders described in the European Commission reports or in databases such as the report of the RIM (Regional Innovation Monitor), the RIM policy initiative database, the Vanguard Initiative website, the S3-website of the Joint Research Centre (JRC), and in the many country reports on Belgium such as the reports on ERA (ERA watch, ERA progress, ERA facts and figures, ERA country profile), the RIO report (Research and Innovation Observatory report) and the OECD STI Outlook (note: as of 2016, the new European Commission/OECD International Survey on Science, Technology and Innovation Policies (STIP) replaces the ERAC STI survey and OECD STI Outlook). Some of these reports include indicators that normally only exist at a country-level (NUTS0), but were calculated for Flanders specifically at NUTS1-level (e.g. the index of the innovation-output indicator (IOI)). Benchmarking the R&D and innovation performance is conducted by comparing the information and data available in the RIS (Regional Innovation Scoreboard), the Report on Economic, Social and Territorial Cohesion, the Belgian profiles in the IUS (Innovation Union Scoreboard, in 2016 the EC named the report again by its ancient name of European Innovation Scoreboard, EIS), the Innovation Union Competitiveness Report, the Belgian Competitiveness Report, etc. (most of which are managed by the European Commission). In-dept peer reviews that analysed and evaluated the general systemic setting of research and innovation include the “OMC peer review” of Belgium (2010), specific ERAC-reviews, or the two reports from the “Soete commission” (2007, 2013) that assessed the overall innovation landscape in Flanders.

### 3 Flanders, centre of innovation

The backbone of the Flanders’ knowledge actors is shaped by the 5 university associations, the 5 strategic research centres, and a number of other knowledge institutes in specific domains such as marine sciences, tropical health, agriculture research, and various collective research institutes active in specific fields. Several of these knowledge actors in Flanders are recognized as centres of excellence in their field of activity and conduct research integrated in renowned international networks and with partners throughout the world. Some of these, such as KU Leuven, UGent, IMEC, or VITO, have established subsidiary activities abroad (US, Asia), often involving local counterparts or partners (see part 6 in this chapter for further examples).

According to the **Times Higher Education World University Rankings** of 2015, 3 Flemish universities are among the best 100 in Europe, and one is among the best in the world. The KU Leuven is in 12<sup>th</sup> place in the ranking for Europe, followed by UGent at 52, and UA at 97. On the world list, KU Leuven ranks 35<sup>th</sup>, Ghent came in at 118 and Antwerp at 190. The **Times Higher Education** supplement lists KU Leuven as the most successful of Belgium’s universities in attracting private-sector financing, and the 14<sup>th</sup> in the world, with attracting 151,000 euro per member of academic staff from private sources. Belgium as a whole attracts 78,000 euro per member of staff on average, putting it in eighth place in the national rankings. The **Academic Ranking of World Universities** (the so-called “Shanghai ranking”) list two Belgian (Flemish) universities in the world’s top-100, namely KU Leuven (Catholic University of Leuven) and UGent. In the **Quacquarelli Symonds (QS)** ranking, KU Leuven is the only Belgian representative in the top-100, at nr 79. Other Flemish universities in the list are UGent (nr 131) and VUB (182). In the **Thomson Reuters ranking** of Europe’s most innovative universities, KU Leuven holds the nr.1 top position, ahead of Imperial College London and Cambridge University. Other Flemish universities in the list are UGent (nr 22) and VUB (nr 50). The ranking is composed by identifying the organizations that publish the most academic research, and then evaluating these on 10 different metrics, focusing on academic papers (which indicate basic research) and patent filings (which

point to an institution's ability to apply research and commercialize its discoveries). The **European Research Ranking** (which is based on the publicly available data from CORDIS on European research projects funded by the European Commission during the past years), contains three institutes from Flanders in the top-100: KU Leuven, iMinds and VUB. The results of the EC financial contribution allocated for signed grants under **Horizon 2020** (data until 1 Dec 2015) show that in the top-50 of Higher Education Institutes (HEI), KU Leuven ranks 7<sup>th</sup> and UGent 14<sup>th</sup>, while in the top-50 of Research Centres (REC), these Flemish institutes are listed: Imec (rank 12), iMinds (38), VITO (41), and VIB (43). The **QS World University Rankings by Subject** contains 14 programmes at Flemish universities in the top 50. The programmes are judged on academic reputation, impact of research and reputation as an employer. KU Leuven is the strongest university in Flanders at the subject level, responsible for 11 of the 14 finishes in the top 50. Its dentistry programme ended at seventh place. The three other Flemish top rankings were taken by programmes at Ghent University. The best scoring there was veterinary sciences, in 20<sup>th</sup> place. The **U-Multirank** lists universities based on multiple core tasks they fulfill, and is more context-related. Depending the criteria that are selected for comparisons, this overview results in a higher representation for criteria of the smaller Flemish universities that the "league tables" that are mentioned afore. The **Financial Times' Executive Education rankings** lists the Vlerick Ghent Leuven Business School as the number one business school in the Benelux, with a 16<sup>th</sup> place in the European table and a rank as the 29<sup>th</sup> best in the world.

The main contributors in the research and innovation landscape are businesses and industries. Companies in Flanders (and Belgium) are among the most innovative in the EU: 62% of all industrial companies and service businesses conduct a form of innovation, according to the bi-annual **Community Innovation Survey** or CIS. Only in 2 countries, Germany and the Grand-Duchy of Luxemburg, companies innovate more than in Flanders (EU-27: 53%). Of all people employed in Flanders, 9.4% is active in an innovative sector. The German **Centre for European Economic Research** (ZEW) in 2014 listed Belgium in the list of most innovative economies 4<sup>th</sup> behind Switzerland, Singapore and Finland. The share of workers in (medium) high-technology industry and high-technology services is 8.9% (2013), which is slightly higher than the EU-average. The industrial component scores higher (5.5%) than the services component (3.4%). The share of high-technology goods in the exports of Flanders (community concept) was 6.1% in 2014. It was lower in 2007-2011. Flanders is specialised in labour intensive (plastics, diamonds) and capital intensive (vehicles) goods. The main high-tech export product is pharmaceuticals which represented 61.3% of all high-tech exports in 2014.

Belgium – and Flanders as a region – ranks 23<sup>th</sup> in the 2016 annual **Global Innovation Index** (GII). Its strong points are education and the quality of scientific research. The GII focuses on two key indicators: the degree to which a country can renew itself through exceptional infrastructure and quality education, and how this is physically reflected in greater economic productivity, scientific achievements or cultural excellence. Belgium scores very good (reaching the top-10 of the world), for a number of criteria, including "Knowledge workers" and "University/industry research collaboration", and "Computer software spending in % GDP".

The 2015 **WIPO (World Intellectual Property Organisation)** report on patenting and intellectual property to underpin economic growth and innovation, ranks Belgium 10<sup>th</sup> in the list of first patent filings for 3D-printing, and 11<sup>th</sup> in the list for nanotechnology.

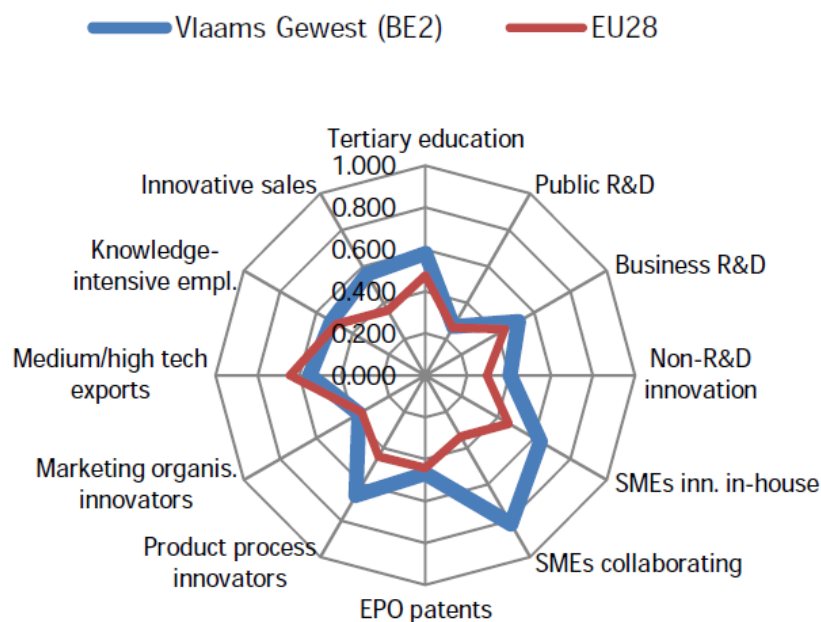
The 2016 EU **Innovation Union Scoreboard** (IUS), which the EC has renamed by its original name of "European Innovation Scoreboard", lists Belgium as the EU's seventh best country, and as the second country among the second set of "Strong Innovators" (note: until 2016 the EC called this the "innovation-followers".. Compared to its neighbouring countries, which are the main trading partners, Belgium ranks behind Germany and the Netherlands, but ahead of the UK and France. Considered by category, it ranks higher than the EU average on "Human Resources", "Open, excellent research systems", "Finance and support", "Firm Investments", "Linkages and Entrepreneurship", and "Innovators". Belgium scores beyond the EU average on "Intellectual assets" and "Economic effects". More in detail, the Belgian results are more than

twice the EU average score on “international scientific co-publications”, “innovative SMEs collaborating with others” and “public-private scientific co-publications”. The category of “Linkages and Entrepreneurship” shows the largest difference between the Belgian score and the EU-average.

The results of the 2016 **Regional Innovation Scoreboard**, RIS, classify Flanders into the second group of Strong Innovators (= performance between 90% and 120% of EU average). The radar graph displaying the different indicators (see figure 1) shows that relative strengths compared to the EU28 are in the categories of “Innovative SMEs collaborating with others”, “Sales due to new product innovations”, “SMEs innovating in-house” and “SMEs with product or process innovations”. The results of the Flanders’ indicators compared to the EU average belong to these categories:

- a) the top-group of Innovation Leaders (= above 120% of EU average):
  - Percentage population aged 30-34 having completed tertiary education;
  - Non-R&D innovation expenditures in SMEs as percentage of turnover;
  - SMEs innovating in-house as percentage of SMEs;
  - Innovative SMEs collaborating with others as percentage of SMEs;
  - SMEs introducing product or process innovations as percentage of SMEs;
  - Sales of new-to-market and new-to-firm innovations in SMEs as percentage of turnover;
  
- b) the second group of Strong Innovators (= 90% to 120% of EU average):
  - R&D expenditure in the public sector as percentage of GDP;
  - R&D expenditure in the business sector as percentage of GDP;
  - EPO patent applications per billion regional GDP (PPS€);
  - SMEs introducing marketing or organisational innovations as percentage of SMEs;
  - Employment in medium-high/high tech manufacturing and knowledge-intensive services as percentage of total workforce;
  
- c) the third group of Moderate Innovators (= 50% to 90% of EU average):
  - Exports in medium-high/high technology intensive manufacturing as percentage of total exports.

Figure 1: Radar graph of Flanders' RIS 2016 indicators compared to EU average



The RIS 2016 also demonstrates that Flanders is a region with a positive specialisation in Key Enabling Technologies (KET). The **KET Observatory** at the EC provides the data of the EU countries for the various KET domains, including the evolution in the past years, with the top-10 of the EU. Belgium ranks in 2 occasions in this top-10, namely for advanced materials and for industrial biotechnology. Flanders represents 49% of the Belgian patents in advanced materials and 68% of those for industrial biotechnology (2011 data). In the other domains it always holds over half of total Belgian patents.

A sector that is intensely research-driven, with a large critical mass as well as an international reputation, is the biotechnological industry. With about 120 Flemish companies that conduct R&D in the field of biotechnology or life sciences, representing 10,000 to 15,000 jobs, it is part of the European top-3. The chemical sector (mainly located around the Antwerp harbour) represents a major part of the Flanders' and Belgian economy with a portfolio of 300 different chemicals – the most diverse in the world – and over 500 chemical companies. It is the largest chemical cluster in Europe and the second largest worldwide (after Houston (Texas), USA). These companies increasingly innovate to generate new and better types of products. The chemical and pharmaceutical industry represents the major share of all foreign investments. In total, there are 450 enterprises in chemicals, plastics, pharmaceuticals, and biotechnology that represent 42 billion euro turnover and almost 60,000 employees. Foreign companies active in chemicals, pharmaceuticals, and life sciences invest about 1 billion euro per annum in Flanders.

The R&D expenditures in Flanders are concentrated in a number of large companies in the chemical industry and pharmaceutical sector. The top-50 R&D-active companies jointly represent 60% of all R&D expenditures in Flanders. Of all total foreign investments in Flanders in 2014 (representing 2.8 billion euro), 13.04% took place in the R&D sector (2013: 9.42%). Belgium also has a quite high proportion of acquired companies from the high-technology sectors, whereas in most western European countries this is medium-technology sectors (source: 2014 EU Industrial R&D Investment Scoreboard).

Leading businesses in Flanders active in the field of R&D&I include Agfa Gevaert, Janssen Pharmaceutica (Johnson & Johnson), Barco, Bekaert, Solvay, UCB, BASF Antwerpen, Atlas Copco, Biocartis, Xeikon, Cargill, Du Pont de Nemours, Umicore, Thrombogenics, ON Semiconductor Belgium, Alcatel-Lucent, Ablynx, Soudal,

Bayer Antwerpen, Picanol, Daikin Europe, Case New Holland, Punch Powertrain (Yinyi Group), Tessenderlo Chemie, ExxonMobile, TP Vision (ex-Philips), Bosal Emission Control Systems, Intel, Michel Van de Wiele, Newtec, Hansen Transmissions, Recticel, Siemens, and Galapagos.

Key elements of the innovation policy in Flanders include:

1. More resources for R&D
2. Focusing on “spearheads” and smart specialisation
3. More opportunities for research talent

### 3.1 More resources for R&D

Flanders is committed to the EU 2020 target of investing 3% of its gross domestic product (GDP) in R&D, one-third being funded by the government (the so-called 1% objective) and two-thirds by the private (business) sector. In 2014, total expenditure on research and development amounted to 5.738 billion euros, which represents almost two-thirds of all R&D expenditure in Belgium (GERD). Of this amount, 3.921 billion euros was expenditure on R&D by business (BERD), in which the chemical and pharmaceutical sector led the way with 34.7% (2013). Other main performers were motion pictures, video and TV production, computer programmes, engineering, technical testing and analysis activities.

In 2016, the Government of Flanders budgetary allocations for R&D amounted to 1.398 billion euros. The EWI policy domain (Economy, Science and Innovation) manages 70.8% of this budget, the remaining part being from the Education and Training policy domain (22.5%) and the other policy domains (6.7%). This amount represents just over half of Belgium’s total public allocations, the remaining half coming from the other four authorities (hence the sum of the budget allocations from the federal, French Community, Walloon Region and Brussels Capital Region authorities). To calculate the total public expenditure on R&D in the Flemish Region, it is necessary to add the federal and EU contributions. This federal contribution is assessed at 303 million euros (based on 35.5% of the federal ESA budget plus 56% of the remaining federal allocations) and the EU contribution is assessed at 160 million euros (based on the return for Flanders from participation in the EU FP on RTD and current Horizon 2020 programme). Hence, the total public R&D effort in Flanders (the sum of Flemish, federal and EU outlays) can be estimated as 1.861 billion euros in 2016. In addition to expenditure on R&D (as defined by the OECD), the Government of Flanders allocated a further 819 million euros for science and innovation, which is not R&D in a strict sense. The annual budget for research and innovation stemming from the EU’s 2014-2020 ERDF programme towards Flanders (including Interreg) is assessed to be 23 million euro.

Consequently, in 2016 total available public budget for R&D and innovation in Flanders that originates from both Flemish, federal and EU authorities, amounts to 2.703 billion euros. The Flemish Government’s part of this budget is 2.217 billion euro (the sum of 1.398 billion euro for R&D and 819 million euro for non-R&D innovation and science support). Disaggregated by funding authority, the total public R&D&I budget available in Flanders is being managed for the overall part by the Flemish Government: 82%, while the federal authority is responsible for 11%, the EU’s Horizon 2020 programme for 6%, and finally the ERDF-Flanders and ERDF Interreg programmes each represent 0.4% of the annual budget of 2.7 billion euro.

The R&D intensity (total R&D expenditure as % of GDP) in Flanders reached 2.46% in 2014. The R&D expenditure in the private sector (BERD) was 1.68% of GDP and in the public sector (non-BERD) 0.78%. Of all the R&D expenditures in 2013 (2.55%), 1.79% was privately funded and 0.77% was publicly funded. It is essential that the 1% objective for public funding is reached by 2020. Achieving this 1% public R&D/GDP target has already been an important focus of attention. From the mid-1990s onwards, substantial budget increases for R&D&I have been allocated by the Flemish Government. Studies have shown that achieving

the 1% objective has, through leveraging, a positive impact on private investment in innovation. In other words, higher government R&D funding leads to more private investment in R&D. The studies established a clear causal relationship and also concluded that no crowding-out effects would occur.

## 3.2 Focusing on strengths and “spearhead domains”

The relative specialisation index can be a useful indication to map the specialisation structure of the science, innovation and economy system, which in turn can be a starting point for the future potential for smart specialisation. This index compares the distribution of activities in resp. science production, technology production, economic performance from a region or a country with the average distribution of the same type of activities in the whole of Europe (or the world). The statistics on respectively the scientific publications, patents, and exports are used as proxies for these kind of activities that can be considered as successive steps in the innovation trajectory, from idea to market. A more than average share of these suggests a specialisation in that particular domain.

In the **field of science**, long-time series exist of **scientific publications** that can determine the specialisation domains, as well as series on scientific citations, and scientific co-publications.

To find the degree of **technological specialisation**, the number of patents for a given technology domain in Flanders is being compared to the share for that technology domain worldwide, which results in the **RTAN** (Relative Technological Advantage). Patent data provide an insight in technological progression since they represent an indicator that is used to get a picture of the innovation degree within an organisation, region or innovation system.

A similar calculation as the RTAN, but using the export per sector (NACE) data instead of the patent volumes per technology domain, results in the **RCA** (Revealed Comparative Advantage) as a proxy for the degree of economic specialisation.

In addition, the coherence of specialisations in the subsequent stages of the innovation trajectory for a specific industry, from idea to (export) market, can be considered as competitive advantage of a region or country for this specific industry. However, the correspondence between these classifications is only partially assured, hence there is no direct match between science classifications and technology classifications. Between technology and economic classifications this matching has been achieved on the basis of the so-called “Fraunhofer classification”.

### 3.2.1 Scientific specialisations

The scientific specialisation pattern of Flanders is rather typical for a mature economy with a long tradition in scientific research that covers the whole spectrum. The Flemish profile is similar to that of most Western countries, with life sciences and medical sciences as the dominant publications areas. Nevertheless, some other evolutions within this overall pattern are worth noting. For example, there was a strong growth during recent years in the fields of neuroscience (NEUR) (mainly in psychology, e.g. mathematical psychology) as well as in earth and space sciences (GEOS). Overall performance is good: in 2014 Flanders represented about 73% of all Belgian publications after a gradual increase during the past decade, and it comes thirteenth in a ranking of European countries.

According to the Flemish publication profile, output is significantly higher than the world standard in the areas of **biology** (organismic & supra-organismic level) (BIOL), **clinical and experimental medicine I** (general and internal medicine) (CLI1), and **neurosciences** (NEUR). It is higher than the world standard in these fields: life sciences (BIOS), agronomy and environmental sciences (AGRI), with strong sub-discipline in soil sciences, also in biomedical research (BIOM) and in experimental medicine II (non- internal) (CLI2) which has strong



sub-disciplines such as infectious diseases, tropical medicine, critical care medicine, gynaecology, radiology and medical imaging.

Flanders holds average-to-world level publication levels in engineering (ENGN) where different sub-disciplines have international specialisations, such as electrical and electronic engineering, medical informatics, nuclear science and technology, computer science and a fast growing transportation discipline. Because of the overrepresentation of life sciences, Flanders has a relative underrepresentation of scientific activities in the domains of physics (PHYS) (but strong in acoustics), geosciences and space (GEOS), although expanding considerably, mathematics (MATH) (with a strong specialisation in statistics & probability) and mainly in chemistry (CHEM), with strong sub-disciplines in analytical chemistry and medical chemistry. The latter is seemingly at odds with a strong economic specialisation in chemical industry. The absorption of science production in technology and eventually economic production is hard to measure straightforward, but there are clearly links with certain specific high-technology industries such as bio-pharmaceuticals, electronics and informatics, imaging, soil treatment and other niches.

Chapter 5 provides more details on the scientific publication performance (as well as on the citations and co-publications) and contains a spider web display that benchmarks Flanders to the world standard.

### 3.2.2 Technological specialisations

The technological specialisation of Flanders based on the EPO patents is displayed hereunder. It is mapped based on a grouping of patents in 35 technology domains (ISI, Fraunhofer Gesellschaft) and a specialisation-index RTAN that can vary between -1 (under specialisation) and +1 (maximal specialisation). The latter is based on the share of a given technology domain in Flanders compared to the share of the domain concerned in a reference group (composed by EU-15, US, Canada, Switzerland, Japan and South-Korea), which is the black line in the diagram below.

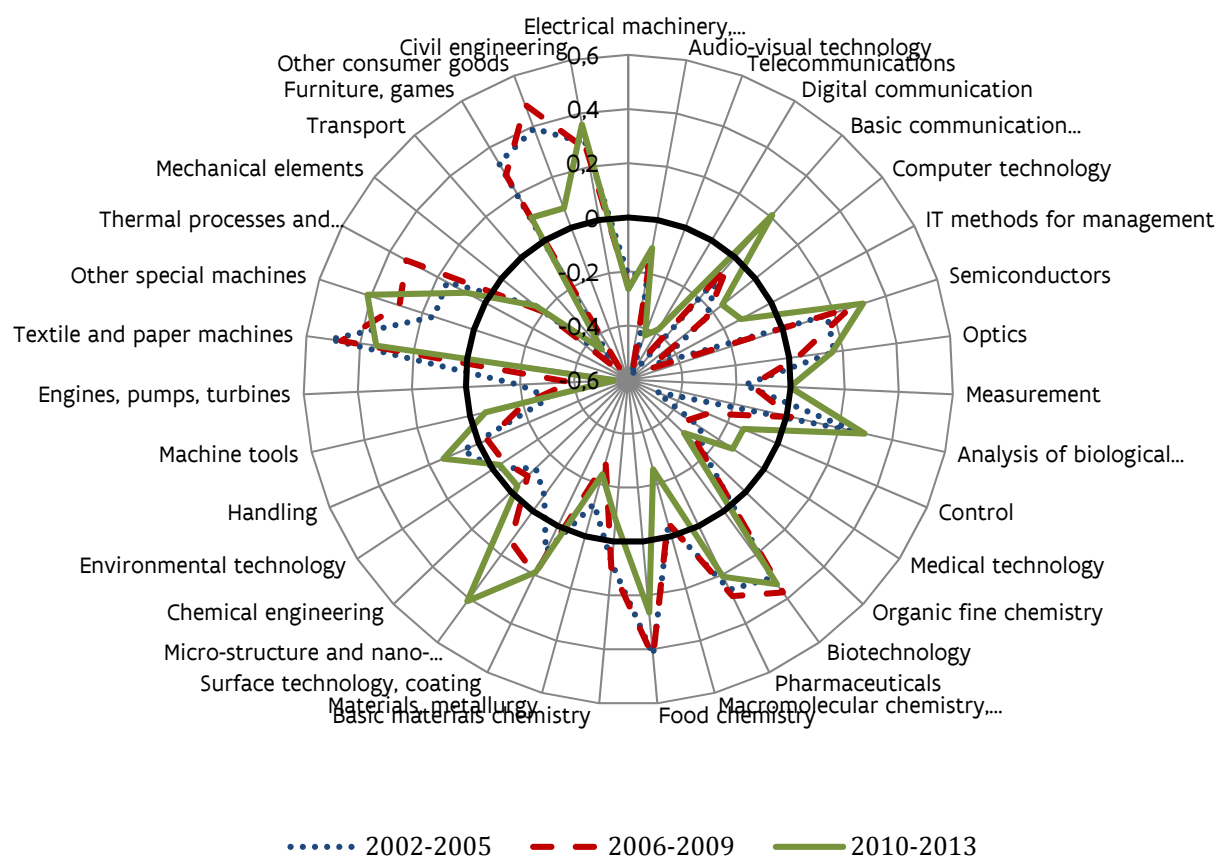
The design hereunder reflects the activities of a relatively small number of companies and research institutes. The specialisation patterns for technology are therefore more dispersed than the ones for science. Flanders has built up a relatively strong technological position in chemical domains (food chemistry, macromolecular chemistry and polymers, biotechnology and basic materials chemistry), as well as in textiles and paper machinery.

On the one hand, there are a number of companies with in-house R&D in sectors such as **machinery/mechatronics, food, materials, civil engineering** and in particular **pharmaceutics** (which is the largest high-technology sector in Flanders) that contribute to strong international specialisations of Flanders. But also **different niches** in consumer goods, furniture and games are specialized in technology production compared to their counterparts abroad. On the other hand these specialisations also reflect the activity of the different Flemish strategic research institutes as is the case for nanotechnology (IMEC), biotechnology (VIB), materials and energy (VITO) and specialised research departments at the five universities of the Flemish Community.

Flanders represents 67% of the total Belgian patent portfolio, and companies represent 78% of patent activity. The patent share of universities and knowledge institutes is over 10%, which puts Flanders worldwide on the top. Moreover, the technology activity is to a substantial degree internationally embedded since on the one hand 34% of all EPO applications with Flemish inventor(s) in the last decade imply foreign applicants (26% US, 16% German, 15% French), and on the other hand 45% of Flemish patents have at least one Flemish inventor and at least one foreign inventor. The top-5 patent applicants in Flanders are Agfa-Gevaert (including Agfa Healthcare and Agfa Graphics), Electrolux Home Products Corp., Janssen Pharmaceutica (part of Johnson and Johnson), IMEC and KU Leuven. (source and more information: Vlaams Indicatorenboek 2015 p.51-53).



Figure 2: Technological specialisation (RTAN) of Flanders based on the EPO patents



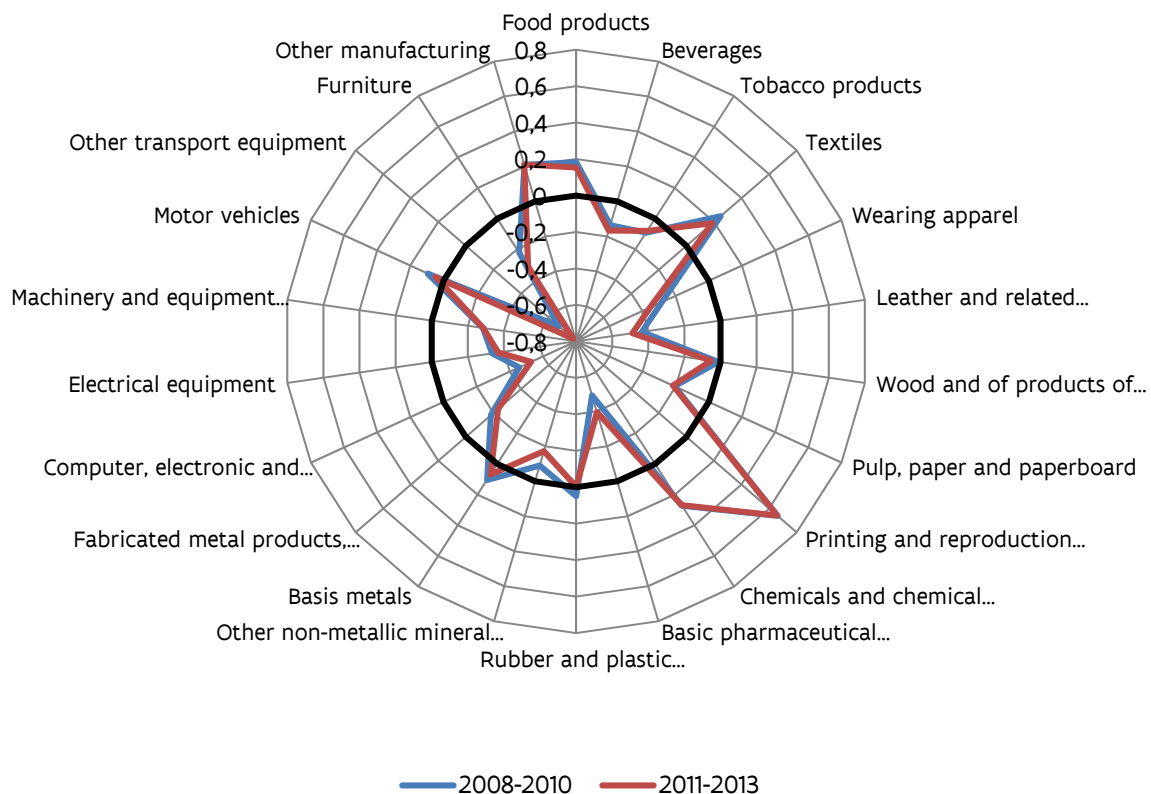
### 3.2.3 Economic specialisations

The economic specialisation pattern (based on the relative export shares) of Flanders reflects that of a mature economy as well as that of (still) highly diversified economy. In most sectors the Flemish economy has maintained a critical mass to remain competitive, while some do not appear as a specialisation due to the given conditions (e.g. mining).

There exist strong international specialisations in the **petrochemical sectors** (the area near the Antwerp harbour is home of the largest such cluster in Europe), **chemicals** (exc. pharmaceuticals), **basic metals**. These are usually sectors that are closely linked to the intermediate position of Flanders in international value chains that is linking Flanders to larger economies, in particular Germany. In addition, there are also competitive “traditional” sectors such as **foods and beverages**, which is the largest industrial sector in terms of employment with a wide set of specialisations in pork meat, frozen vegetables and potatoes, beer and chocolates. The **textiles sector** (and wearing apparel) is still relatively overrepresented in Flanders and has been undergoing for many years already a restructuring process to remain competitive and has thus strongly transformed. An increasing part in the turnover is taken by technical textiles for niche markets, besides the specialized carpet industry. Also **transportation products** (such as coaches) remain relatively high, though the mass automotive sector has been restructuring and delocalizing and hence has decreased its relative specialization. The Flemish industry is developing more and more **niches with international potential within the traditional sectors** (e.g. the treatment of soil and sludge in the construction industry).

Such innovation-driven transformations can help to maintain a position because of the increasing role of innovation, as is the case for rubber and plastics products. Some sectors may score under the benchmark when based on exports data, but can represent a high added value, as is the case for example with electrical machinery. Furthermore, the role of specialized logistic services (e.g. for pharmaceuticals, food) is a competitive advantage for the manufacturing sectors, and the development of **services** such as software is an important transformative power because artefacts are parts of 'solutions'.

Figure 3: Economic specialisation (RCA) pattern of Flanders based on the relative export shares



### 3.2.4 Combined technological - economical specialisation profiles

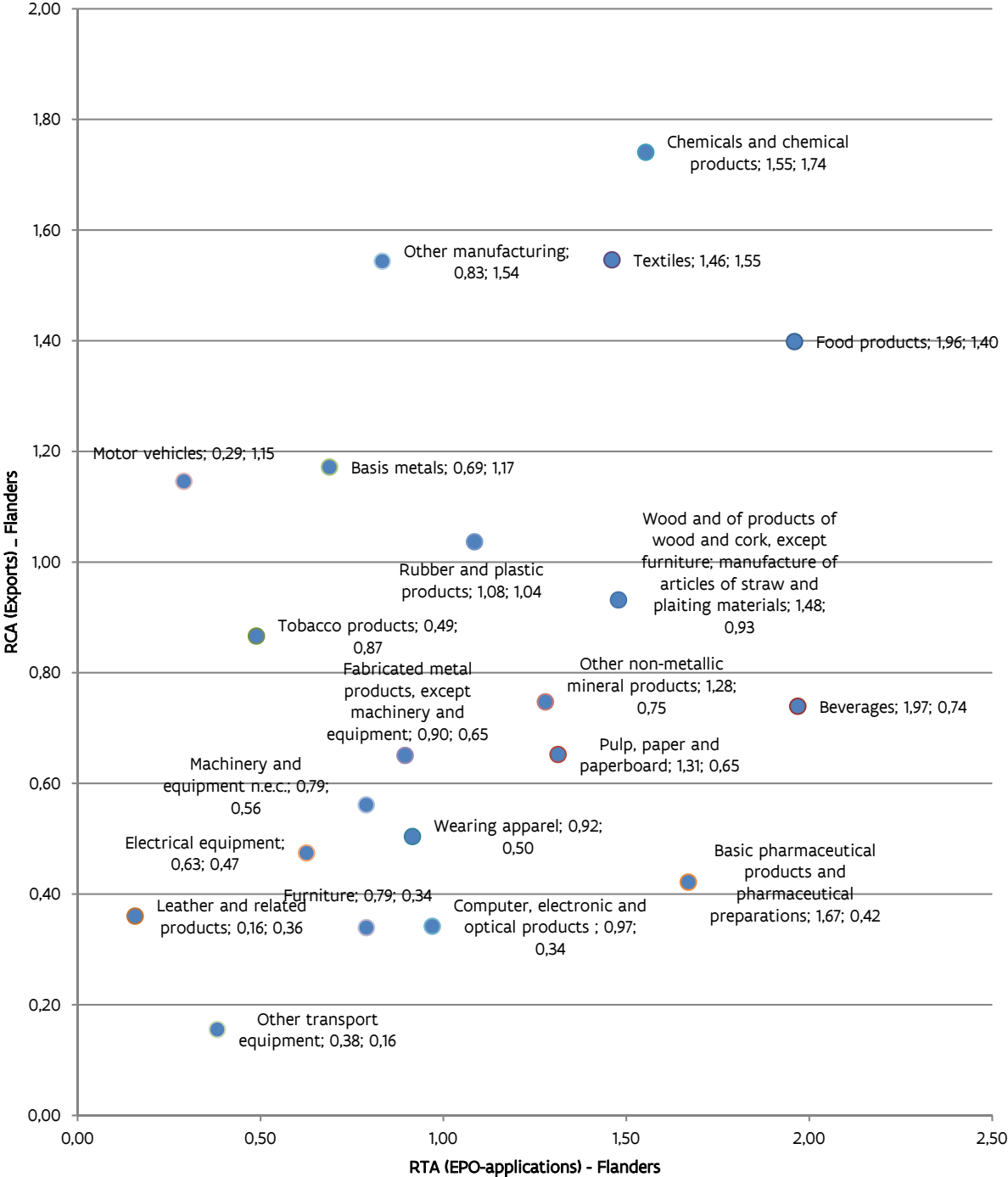
The figure below displays the combination of the relative technological specialisation patterns (RTAN) with those for economic specialisation (RCA). For most domains, these patterns overlaps in the sense that these are both respectively:

- high for Chemicals and chemical products (exc. Pharmaceuticals), Other manufacturing products, Textiles and Food products;
- low for Leather and related products, Machinery and equipment, Other transport equipment, and Electrical machinery.

Some exceptions are Pharmaceuticals/medical chemicals, pulp and paper products, beverages and wood products that have a considerable technological specialisation in Flanders that is however not translated into an economic specialization of the same extent. Conversely, the opposite is being observed for the sectors of motor vehicles, wearing apparel, tobacco products and basic metals: the economic specialization within these sectors contrasts with a relatively limited technological specialization in Flanders.

Chemistry and pharmacy are important technology areas; but whereas the specialisation in chemistry is being translated into an economic specialization, this is less the case for pharmaceuticals. The very strong pharmaceutical (biotech) sector is absorbing a large part of the life sciences and biotechnology research in Flanders (VIB) but it is not a specialisation as measured by the relative export of products. The challenge will be to have specialisations that build on each other by mutual reinforcement.

Figure 4: Combination of the relative technological specialisation patterns (RTA) with those for economic specialisation (RCA)



NACE 19 (Coke and refined petroleum products) is not included in the graph because for some EU-countries no export figures are available and the RCA values can be distorted. NACE 18 (Printing and reproduction of recorded media) has the highest RTA and RCA value (2,38; 4,91). These sector is not included in this graph for better visualizing all other sectors.

## 3.3 More opportunities for research talent

### 3.3.1 Science popularization

#### **STEM Action plan**

Too few young people opt for science and technology disciplines and obtain a degree in this area in higher education. Consequently, more attention must be devoted to science communication and popularization. Therefore, the popularization of science, technology and innovation is an important focus of attention. A marketing and communication plan “Science, Technology and Innovation in Flanders 2012-2014” has contributed to greater visibility and an increased perception of STI among the public in general and among (future) students in particular. The 2012-2020 STEM action plan aims to stimulate careers in Science, Technology, Engineering and Mathematics. In 2014, STEM education became more attractive thanks to improved STEM didactics. The focus is on strengthening competencies of teachers via refresher courses, encouraging school projects and deploying engineering coaches. The process of study and career choice is being optimised through study choice instruments such as “education selector” (onderwijskiezer) and the passion for STEM outside education is encouraged by means of founding a network of STEM academies. In addition, communication campaigns promote social appreciation of STEM professions and the sectors are encouraged to undertake actions about STEM. As of 2015, the Government of Flanders modified the world orientation learning area into two new learning areas: ‘science and engineering’ and ‘people and society’. Thanks to this, primary schools can focus more on science, technology and engineering. In secondary education, the share of STEM study certificates has risen compared with the past two years (44.6% of the total number of study certificates in the 2012-2013 school year), while in higher education the rise continues (25.8% of the total number of diplomas in the 2013-2014 academic year). Science, engineering and education will be stimulated from the infants class to higher education.

#### **Technopolis**

Technopolis is an initiative of the Flemish Government and a scientific do-centre aimed to bring science and technology closer to people. The Flemish Science Centre is a permanent platform for science and technology in Flanders. All initiatives have the same goal in mind: to inform and raise awareness about the importance of science and technology and to increase enrolment, graduation and advancement in the exact and applied sciences. In addition to operating the science centre in Mechelen, Technopolis is also responsible for coordinating certain initiatives or projects from the Flemish Community: Dag van de Wetenschap (Science Day), STEM academies, Wetenschapsweek (Science Week). Technopolis also organises a thematic exhibition on science in the royal palace of Brussels during its Summer opening. “Science Day” is organised annually and is the largest science event in Flanders and the Brussels Capital Region. The participants are very diverse: innovative companies, universities, university colleges, musea, science-centres, research institutes,.... The “Science Week” allows pupils from secondary schools to conduct various types of research in universities, scientific institutes etc.

#### **Leuven Health House / Leuven Mindgate**

A new initiative is Leuven Health House, opened in 2016 at the Arenberg science park. This joint initiative of KU Leuven, iMinds and the city of Leuven aims to help unlock the full economical and societal potential of health technology to concretize the increasing impact of technology on health care. It turns collaboration into innovation and stimulates knowledge-driven entrepreneurship by inviting its visitors to personally experience the future of health and care. Health House will be an experience centre where visitors can attend a virtual operation and virtual dissection table in a 3D-chamber, understand the impact of synthetic biology, or learn about diabetes. This initiative is part of a more comprehensive project called Leuven

Mindgate. This aims to increase the international visibility of Leuven as a knowledge and health metropolis, by presenting in a comprehensive way the research groups, bio-incubators, spin-off companies, and international networks of the Catholic University of Leuven, IMEC and the UZ Gasthuisberg (this university hospital is Europe's third largest). Leuven Mindgate will also build an International Centre that should become a meeting place with congress space.

### 3.3.2 Science careers

Working as a researcher could be made more attractive by the development of more transparent career paths and specific programmes to attract foreign talents or externally active Belgian (Flemish) researchers that offer perspectives. Flanders' ambition to be a successful knowledge society can only be realized if it continues to invest in high-level research and good researchers. 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), a number of specific initiatives were developed to encourage excellent researchers and support these in a long-term career path. These include budgets for the "Odysseus programme" (a brain gain initiative), "tenure track mandates" that lead to a position within the ZAP (autonomous academic staff), Methusalem (LT-support for excellent researchers), ... worth a total of about 46 million euros in 2015. 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 within the framework of the OJO-support (support of young researchers).

## 4 Instruments and actors of Flemish STI policy

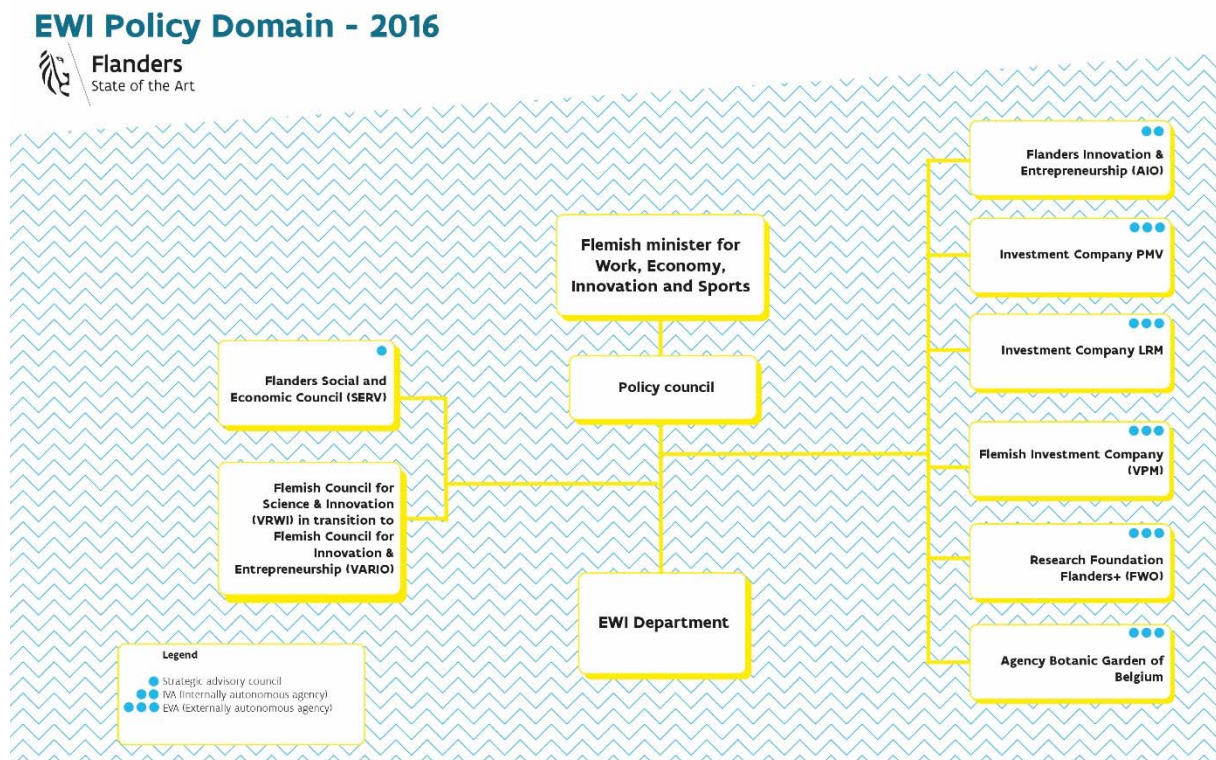
A wide range of actors and stakeholders are involved in the Flemish STI landscape: public administrations and agencies, advisory bodies, knowledge institutes and centres, universities, university colleges, scientific institutes, public research organizations (PROs), various networks active in (collective) STI, university hospitals, various collective research centres, data collection institutions, incubation centres, science and technology parks, technology transfer offices (TTOs), other intermediaries and (last but not least) many private companies and professional (technology and other) organizations.

At the public governance level, the field of science and fundamental research (= community competencies), as well as the field of innovation and applied research (= regional competencies), are dealt with by one specific commission of the Flemish Parliament and by a single minister in the government. Furthermore, there is a single advisory council and a single administration (department) responsible for preparing and monitoring policy within the policy domain. At the implementation level, there are agencies that manage the budgets and policy support instruments aimed at universities, university colleges, scientific institutes, research centres, knowledge institutes, and companies that are located in the Flemish Region or in the Brussels Capital Region if they are Flemish organisations.

The following schedule presents the public bodies that are active in the STI field as of 2016.



Figure 5: *Economy, Science and Innovation in Flemish Government, anno 2016*



The new governmental agreement of 2014-2019 announced a number of decisions that affect the organization of the overall EWI landscape.

The following section presents an overview of the missions and activities of the main (public) actors and some of their policy instruments.

#### 4.1 Government department

The **EWI Department** (EWI = *Economie, Wetenschap en Innovatie*, or Economy, Science and Innovation) of the Government of Flanders is responsible for the policy-making process in the field of STI. The department was established in 2006 as part of a major administrative reform, entitled BBB (Better Governance), initiated by the Flemish public authority. Previously, the competencies and activities of the current EWI Department were divided between two distinct departments and policy domains. By merging these competencies and activities, the Flemish Government wanted to emphasize the link between economy (industrial policy) and entrepreneurship on the one hand and scientific research and innovation on the other hand.

Like all other Flemish policy areas, the EWI policy area consists of a (policy preparation) department and several (policy executing) agencies.

The role of the EWI Department is to prepare, monitor, evaluate and report on public policy in the field of enterprise (economic support including entrepreneurship), science and innovation, 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 regarding STI are:

- create a sustainable economic tissue and facilitate entrepreneurship;
- stimulate innovation and creativity;
- stimulate knowledge creation and knowledge valorisation;
- putting Flanders on the map internationally in the field of economy, science and innovation;
- develop itself as 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 STI field, the EWI Department:

- prepares all legislative initiatives in the field of science, research and innovation;
- promotes close co-operation between research institutions, HEIs and companies;
- prepares multi-annual management agreements with a number of organizations, such as the Flemish strategic research centres (PROs), the FWO (Research Foundation Flanders), or the Flanders Marine Institute (VLIZ), etc...;
- evaluates policy instruments and organizations that receive governmental and public support;
- coordinates all STI topics inside and outside the Flemish Government;
- monitors the execution of policy measures and reports on policy developments in the STI domain towards the Flemish, federal and international (mainly EU and OECD) policy level;
- holds responsibility for the direct implementation of a number of policy (support) instruments, specific on-off initiatives, participation fees, or representational positions. Examples are the BOF (Special Research Fund) and IOF (Industrial Development Fund), governmental representatives in strategic research centres / public knowledge organisations, or membership fees e.g. of EMBRC (European Marine Biology Resource Centre).

## 4.2 Policy advice

The Vlaamse Raad voor Wetenschap en Innovatie (VRWI, Flemish Science and Innovation Policy Council) is the advisory body of the Flemish Government and the Flemish Parliament for science and innovation policy. In 1985, the VRWB (Flemish Science Policy Council) was established as the formal advisory body, later transformed into VRWI to encompass innovation policy. The governing agreement for the period 2014-2019 announced that VRWI would cease to exist and in 2016 the Flemish Government decided to integrate the VRWI into a new entity: “**Vlaamse Industrieraad voor Ondernemen en Innovatie (VARIO)**”. This is new Flanders’ Industry Council for Enterprise and Innovation is the result of a merger of the VRWI with the Industry Council of Flanders. Compared to the tasks of the VRWI, this institution will tackle a broader array of topics, including entrepreneurship and the transition towards industry 4.0. Administratively, the VARIO will be embedded in the EWI Department but maintain an autonomous position.

## 4.3 Other bodies of public interest in the field of science and innovation

A number of other long-standing public institutions of the Flemish Community, which are related to science policy in a more academic context, play a promotional or advisory role. Although they are not directly involved in policy-making, they are part of the broader Flemish STI domain:

- Koninklijke Vlaamse Academie van België voor Wetenschappen en Kunsten (KVAB, Royal Flemish Academy of Belgium for Arts and Sciences), established in 1772;
- Koninklijke Academie voor Geneeskunde van België (KAGB, Royal Academy of Belgium for Medicine);
- Koninklijke Academie voor Nederlands Taal- en letterkunde (KANTL, Royal Academy for Dutch Language and Literature), established in 1886;
- STV Innovatie en Arbeid (Stichting Technologie Vlaanderen voor Innovatie en Arbeid) (the Flanders Foundation for Technology Assessment in Innovation and Work), which is a part of the SERV (Sociaal-Economische Raad van Vlaanderen, Flanders Social and Economic Council);
- Vlaamse Academische Stem (VLAAS, Flemish Academic Centre for Science and the Arts) is a non-profit organization supported by both the KVAB and the KANTL.

## 4.4 Funding agencies

Whereas the Flemish Government's departments prepare, monitor, report about and evaluate public policy, a number of agencies are charged with the implementation of the policy decisions. In the STI field, the responsible agencies have established a wide variety of initiatives and support instruments to implement R&D and innovation policy. These agencies are:

- AIO: Flanders Innovation and Entrepreneurship;
- FWO: Research Foundation Flanders;
- PMV: Flanders Holding Company (to a limited degree);
- LRM: Investment Company LRM.

### 4.4.1 Flanders Innovation & Entrepreneurship (AIO)

Agentschap voor Innoveren en Ondernemen (Flanders Innovation and Entrepreneurship) is charged with implementing the economic and enterprise policy in Flanders. It helps companies with the start-up of their activities, the grow and continuity of their business, but also with the search for the right location, information on permits, financing, investments in innovation and ecological technologies, and other topics. The AIO also hosts the Enterprise Europe Network (EEN) Flanders, and acts as the managing authority for the EU ERDF calls and support in Flanders.

AIO was established on the 1st of January 2016 after merging Enterprise Flanders (AO) with the Agency for Innovation by Science and Technology (IWT). The IWT was initially set-up in 1991 by the Flemish Government and acted as the one-stop-shop for all industrial R&D and innovation support in Flanders. The establishment of the AIO was announced in the Governing Agreement 2014-2019 of the Flemish Government. This new structure is part of a wider simplification exercise within the EWI domain. As of 2016, the AIO acts as the **one-stop-shop for companies**, hence the economic and innovation support at the benefit of businesses in Flanders.

In the field of innovation, AIO continues to exercise the duties of the IWT until 2014 (except for 3 programmes which were transferred to the FWO). Basically this involves assisting companies, research centres and



knowledge centres in realizing their research and development projects, by offering funding, advice and a network of potential partners in Flanders and abroad. More precisely, AIO encourages and stimulates innovation through:

- **Direct funding:** supporting the innovative projects of companies, research centres, collective research initiatives, organizations and individuals through assignments set by the Flemish Government;
- **Advice and services:** offering support to all Flemish SMEs and large companies and research centres by helping them with their applications or by providing technological advice during their innovative projects;
- **Co-ordination and networking:** stimulating cooperation by bringing innovative companies and research centres into contact with Flemish intermediate organizations that stimulate innovation; to this end, the AIO manages the Flemish Innovation Network (VIN) and 5 provincial innovation centres;
- **Policy development:** supporting the Flemish Government in its innovation policy; for **example**, by studying the effectiveness of the innovation initiatives and different support programmes.

The AIO 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 (e.g. innovation platforms, innovative co-operation networks) are also eligible for innovation support. The AIO also launched a call for innovative business networks end 2015, which led mid-2016 to a decision to support 13 projects (details see 5.4.), and will select proposals for spearhead clusters in 2016;
- **Individual researchers and research centres** can apply to the AIO for the appropriate support and can also receive funding, advice and contacts with potential partners for innovative scientific research, applied research and technology transfer;
- **Organizations of various types (e.g. collective research centres) that stimulate innovation** in Flanders can receive financial support; AIO also brings these organizations together via the VIN to facilitate active support of innovation.

The agency applies a bottom-up approach: subsidies and advice are typically awarded to initiatives proposed by the actors themselves and any project including a technological innovation component is eligible for funding. Apart from direct financial support through a wide range of support measures, the policy mix of AIO also consists of various forms of indirect support and services (advice, technology scans, partner search, networking, etc.). There are relatively few thematic Flemish research programmes and to a large extent support is awarded through generic initiatives. Each year, the Flemish Government provides the AIO with a budget to finance R&D by and for businesses. The AIO continues to adapt its policy instruments to broaden and deepen the innovation trajectory, as well as adapting this trajectory to specific demands.

The main support schemes aimed at innovation within Flanders Innovation and Entrepreneurship, AIO, are: R&D business support, SME feasibility studies and SME innovation projects (part of the kmo-programma, or SME programme), SPRINT-projects, innovation mandates, Flemish cooperative innovation networks (VIS) / innovation platforms (which will gradually phase-out and transform partly into the projects for innovative business networks or spearhead clusters), agriculture research, TETRA-fund, Baekeland-mandates, support for living laboratories,.... It also manages the VIN (Flemish Innovation Network) and the 5 provincial innovation centres.

#### 4.4.2 Research Foundation Flanders (FWO)

The FWO (Fonds voor Wetenschappelijk Onderzoek Vlaanderen) supports fundamental and strategic scientific research, stimulates international cooperation and promotes equal opportunity. Its main mission is to deepen knowledge about people and their environment. 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 proposal. Researchers can apply for support from the FWO through a broad range of funding instruments, providing they are affiliated to a university within the Flemish Community.

The two main instruments of the FWO are support to fellowships (PhD students, postdoctoral researchers, etc.) and to research projects. Furthermore, extensive means are available for promoting international cooperation and mobility, including participation in multilateral initiatives (e.g. the European Molecular Biology Laboratory) or in “big science” research facilities, such as CERN-CMS and CERN-ISOLDE. The FWO also awards scientific prizes to distinguished researchers, often in collaboration with private companies.

The Governing Agreement 2014-2019 of the Flemish Government announced the incorporation of the Hercules Foundation (supporting research infrastructure) into the FWO. In addition, from 2016 on, 3 programmes of the IWT (innovation support for businesses) were transferred to the FWO as well. This new structure is part of a wider simplification exercise within the EWI domain. Consequently, the FWO now manages four main (regulatory) types of activities, namely, support for:

- Fellowships and for research projects (“ancient FWO”);
- Strategic basic research;
- Clinical-scientific research;
- Research infrastructure.

As of 2016, the renewed FWO acts as the **one-stop-shop for researchers in Flanders**.

Starting from 2018, the FWO, in collaboration with FNRS will be responsible for the management of the IUAP-program (Inter University Attraction Poles). This programme was previously situated on the Federal level and was aimed at competitive funding of fundamental research networks of Flemish, French Community and international universities. Before the start of the new program a major revision will have taken place.

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 organized a number of 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. The FWO now has 29 of these specialised committees and one interdisciplinary committee, which cover all the scientific research disciplines of Flemish concern. Each committee consists of 16 experts, the majority being affiliated to a non-Flemish university.

The FWO actively stimulates international cooperation and promotes scientific mobility. Flemish researchers are offered a choice of numerous funding schemes for financing short or long-term stays abroad and research teams are offered logistic and institutional support for their collaboration with foreign colleagues. The latter is often necessary to participate in major international projects or to co-ordinate research networks or platforms. Foreign researchers can apply for a visiting postdoctoral fellowship to undertake research at a university in the Flemish Community.

The FWO's **support regarding research infrastructure** is aimed towards medium-scale and large-scale research infrastructure. This infrastructure serves for cutting-edge and strategic basic research in all scientific disciplines, including the humanities and the social sciences. Applications may be submitted following a call for funding for:

- **medium-scale infrastructure:** proposals submitted by HEIs (higher education institutions: universities and university colleges);
- **large-scale infrastructure:** proposals submitted by HEIs and other knowledge institutes, such as the Flemish strategic research organizations (IMEC, VIB, VITO, iMinds), the ITM (Institute of Tropical Medicine) and the Vlerick Leuven-Ghent Management School.

The Flemish Government funds 70 to 90% of the costs of the investment. If a third party is part of the consortium, 100% of the eligible costs can be funded. These third parties can be either private or public bodies (such as companies or other organizations) and need not necessarily be based in Flanders.

The overall part of the annual budget of the FWO is granted by the Flemish Government. In addition, there is a small part stemming from the federal authority, as well as an amount generated by federal fiscal and para-fiscal measures.

#### 4.4.3 PMV – Flanders Holding Company

The Flanders Holding Company, **PMV** (Participatie Maatschappij Vlaanderen), provides financial leverage to projects that are important for the future of Flanders, acting both as an “entrepreneur” and as a facilitator. It supports investment projects that strengthen the structure of the Flemish economy and fit the government’s economic policy objectives. The organization creates, structures and manages co-operation with private partners. Its goals are to support innovative starters, facilitate the growth of Flemish companies, stimulate “spearhead” sectors, support specific sectors and solve the temporary liquidity problems of creditworthy companies. The PMV invests in companies, projects and sustainable development. The PMV’s activities consist of three main pillars: risk capital, loans and mezzanine finance. It has developed a wide range of instruments aimed at different purposes and various target groups, ranging from the pre-start phase to the international growth phase. Innovative companies are eligible for support through these instruments, with complementary incubation support being managed through the AIO. The total value of the amounts managed by the different PMV instruments exceeds 1 billion euros.

Among its instruments, there are several innovation-oriented initiatives. The “Vlaams Innovatiefonds” (Vinnof, Flemish Innovation Fund) is specifically aimed at innovative start-up companies. It provides risk capital for the early stage of a company’s development, in the expectation that entrepreneurs will find it easier to attract private investors in later phases. Vinnof invests seed capital during three stages: pre-start, start and initial growth. The PMV also manages the TINA Fund, a 200 million euro fund aimed at assisting innovative projects that support the transformation of the economy in Flanders. The SOFI and SOFI2 Fund has been established to support the setting up of spin-off companies from research results produced by one of the Flemish PROs (IMEC, VIB, VITO, iMinds) or by the universities. Flanders’ Care Invest is another PMV initiative, designed to invest in innovative companies in the care sector. Finally, the Innovation Mezzanine scheme provides subordinate loans for starting companies that have already received a grant from the AIO. The new Flemish Government in 2014 decided that the Vlaams Energiebedrijf (VEB, Flanders’ Energy Company) will become a part of PMV. In 2016, PMV launched its “PMV/Z” division aimed at self-employed, start-up companies and SME’s. It provides a standardised solution that is tailor-made and regroups the existing PMV support measures of Startlening+, kmo-cofinanciering (SME co-funding), Waarborgregeling (Guarantee regulation) and Winwin-lening (win-win loan). This will allow to simplify the offer towards this specific target-group.

#### 4.4.4 Investment Company LRM

LRM is an investment company that develops and stimulates economic growth in the Flemish province Limburg. LRM targets all sectors and companies, from starting companies to growing SMEs and larger businesses.

LRM provides venture capital to growth-oriented companies who are related to Limburg and is a catalyst for the transition of the Limburg manufacturing economy towards an innovative and technological economy. LRM is developing qualitative clusters within the spearhead sectors in Limburg.

LRM invests in companies in the following five business areas:

- Technology & Services;
- Health & Care;
- Sustainable Societies;
- Space & Experience;
- Smart Manufacturing.

## 4.5 Innovation intermediaries

A number of intermediaries and co-operation networks are active between, on the one hand, the government agencies that offer instruments and budgets aimed at innovation and, on the other hand, the companies and industries that conduct research and initiate innovative projects.

### 4.5.1 Infrastructure: science parks and incubators, and support for spin-off companies

In Flanders, several science parks, research parks and incubators offer facilities for research-based young companies and innovative enterprises. Often, these are spin-off companies from a university or a PRO and are located close to the knowledge centre in question. In some cases, an incubator is specifically oriented towards a particular scientific area. A good example of this is the Ardoyen Science Park, which is part of the Zwijnaarde Technology Park (near Ghent). It hosts the incubation and innovation centre of Ghent University (UGent), the bio-incubator of the VIB (biotechnology) and a bio-accelerator supported by Ghent University and catalyzed by VIB.. As a result, the majority of its 40 companies are spin-offs from UGent and start-ups of the VIB, of which Innogenetics, the first European biotech company listed on the EASDAQ. Another example is the Arenberg Science Park and the Haasrode Business and Research Park in Leuven, where several of the actors are related to the Catholic University of Leuven (KU Leuven) and IMEC, including the KU Leuven bio-incubator, the Arenberg ICT cluster, the Leuven Incubator and Innovation Centre, and the Leuven Spin-off Centre. At the Greenbridge science park in Ostend, UGent can support activities to foster 'Blue Growth' of those maritime activities which are undergoing rapid innovation (blue energy, aquaculture, marine biotechnology, deep sea mining, coastal engineering).

Universities and strategic research centres are increasingly able to professionally guide spin-off companies, e.g. with finding the appropriate CEO, financial structure, and administrative issues. An important trend is the establishment and elaboration of different types of incubators. The Flemish Government supports these science parks and incubators through both regulatory measures and financial means, mainly through the AIO (Flanders Innovation & Entrepreneurship). A list of the science/ technology parks and the incubation centres is included in part 6 of this chapter.

## 4.5.2 Financial intermediaries

**BAN Vlaanderen**, the Business Angels Network in Flanders, is a platform in which starting or growing entrepreneurs seeking risk capital are matched with informal private investors, the so-called “business angels”. The latter 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.

**GIMV** (Flanders Investment Company) is Belgium’s most important provider of private equity and venture capital, and is also a major European and international market player. It makes venture capital investments in promising high-tech companies and also focuses on buyouts and growth financing, in order to support companies in their development and growth. As a recognized market leader in selected investment platforms, Gimv identifies entrepreneurial and innovative companies with high-growth potential and supports them in their transformation into market leaders. Gimv’s four investment platforms are: Consumer 2020, Health & Care, Smart Industries and Sustainable Cities. Each of these platforms works with a skilled and dedicated team across Gimv’s home markets of the Benelux, France and Germany and can count on an extended international network of experts. Initially, it was set up by the Flemish Government, which still holds a minority stake in the company. Gimv is listed on Euronext Brussels and currently manages around 1.8 billion euros (including co-investment partnerships) of assets under management. Gimv currently has 60 companies in portfolio, which jointly realise a turnover of more than 6 billion euros and employ over 26,000 professionals.

**Biotech Fonds Vlaanderen** (BFV) was established in 1994 as Flanders’ public fund aimed to further stimulate the biotechnology sector in Flanders with venture capital. The operational management was conducted by the GIMV with whom BFV co-invested. Companies such as Ablynx, Cropdesign, Devgen, Galapagos, Innogenetics, and Plant Genetic Systems were setup or could grow thanks to investments from BFV. The Flemish Government decided to transfer in 2016 the management of BFV to PMV, which will allow to better coordinate the investments in the biotechnology sector and hence increase the impact. PMV started in 2008 with direct investments in the Flemish biotechnology sector.

The various private risk capital funds providers in Flanders (that manage seed capital, start-up capital, growth funding, MBO funding, take-over funding,...) include the large banks in Belgium, and specific funds such as Capital@Rent, Capricorn, Down 2 Earth Capital, Falcon Fund, Hummingbird Ventures, etc. There also exist a number of funds that are linked to the Flemish universities or the strategic research centres. KU Leuven has a seed capital fund, the Gemma Frisius fonds, which was set up with a number of banks. Other universities have taken similar initiatives, e.g. UGent had a seed capital fund in the past (Baekeland Fonds). IMEC supports the establishment of spin-off companies through its subsidiary company FIDIMEC NV. In 2016, IMEC setup an investment fund, imecXpand, aimed at start-up companies in the sector of Internet of Things (IoT). The Flemish Government decided to invest €30 million in imecXpand, for which IMEC strives to collect 100 million euro for this fund from private partners and the European Investment Fund (EIF). VIB has its own technology fund and also launched the V-Bio Ventures Fund 1 (of at least 63 million euro), which will invest in European start-up companies and young companies in biopharmaceuticals, diagnostics, and agricultural improvements. iMinds has its iStart Business Incubation programme that offers coaching, support and infrastructure to (future) technology start-up companies. iStart was awarded the 2<sup>nd</sup> place by UBI Global in its category “European Top University Business Accelerators” and the 4<sup>th</sup> place in the “UBI Globals’ worldwide ranking”. Almost 90 start-up companies are involved in iStart. The incubation activity from iMinds is worth 300 FTE and generates a total turnover of 16 million euro, spread over 100 companies. Every euro invested by iMinds leads to 3.6 euro external investments (24 million euro in 2010-2014), which puts iMinds in the top-3% incubators worldwide in this respect. The **Qbic Fund** is a multi-sector fund supporting spin-off companies of the Ghent, Brussels and Antwerp university associations and of VITO. Through its strategic partnership with these institutes it has early and privileged access to promising

research projects at these partner universities. The fund mainly targets life sciences, new materials, cleantech and ICT start-ups. Qbic is the first interuniversity seed and risk capital fund from Belgium, and supported by the KBC bank. After an increase of its capital in April 2015, the Liège University (ULg) of the French Community has also become eligible for initiatives from the fund.

**FINMIX** is a project from Flanders Innovation and Entrepreneurship aimed at companies with innovative challenges, growth ambitions or take-over plans, that use risk capital for their plans. It provides the possibility to these businesses to propose their plan to a panel of funding experts who will provide advice on the best funding mix.

An overview of risk capital providers in Flanders is available at URL:  
<http://www.vlaio.be/content/overzicht-van-de-risicokapitaalverschaffers-vlaanderen>

### 4.5.3 Innovative networks

Collaboration is an important aspect of Flemish innovation policy. It enables companies and knowledge centres to develop their internal know-how and allows them to tackle common technological issues efficiently, by using a shared platform for the demand and supply of R&D and other innovative matters. Two major public players in this field are the VIN and the TTO Flanders.

#### **Vlaams Innovatienetwerk** (VIN, Flemish Innovation Network)

The VIN is a network of intermediary organizations and knowledge centres that are active in the field of innovation support. The network is coordinated by the AIO. 1548 people from 260 different organizations/divisions offer a broad range of expertise to support the innovative efforts of entrepreneurs. Each province from Flanders, hosts an innovatiecentrum (provincial innovation centre (PIC), respectively located in Kortrijk, Ghent, Antwerp, Leuven and Hasselt), where every company or entrepreneur / self-employed may seek advice. Since 2008, the VIN has also organised “VIN voor VIN” (VIN for VIN) sessions, which look at practical cases and provide mutual networking opportunities.

Other related networks that support companies and entrepreneurs, but are not primarily oriented towards innovation, are the VON (Vlaams Ondernemerschapsbevorderend Netwerk or Flanders Network for Entrepreneurial Stimulation), Competento (Kenniscentrum Ondernemersvorming or Knowledge Centre for the Vocational Training of Entrepreneurs) and the various initiatives launched by FIT (Flanders Investment and Trade).

#### **TTO Flanders (Technology Transfer Offices - Flanders)**

TTO Flanders is a joint initiative by the five Flemish universities that offers a unique portal to the knowledge and technology available within the different Flemish universities and university colleges. It aims to:

- be a unique point of contact for industry looking for research expertise and licensing opportunities;
- maximise the valorisation of the available knowledge and technology;
- further improve the collaboration between the TTOs of the Flemish universities;
- strengthen the performance of the TTOs by developing common means and sharing best practices;
- become a player on the European and international innovation scene.

The various strategic research centres in Flanders also have services that fulfil a similar role as the TTO's in each university of the Flemish Community (see below).

## Local and thematic 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, or Ghent Bio-Energy Valley (GBEV) and BBEU (Bio-Base Europe). Thematic or sector-oriented organisations and networks exist in a broad variety. Examples include the FlandersBio network (life sciences – biopharmaceuticals, medical technologies or agricultural / industrial biotech products), Agoria Flanders (federation for the technology industry), MedTech Flanders (medical technology). The “Agoria International Business” helps technology companies increase their international market share and profitability by identifying business opportunities abroad.

### 4.5.4 Research – business links

Considerable effort has been made to increase and broaden the links between the academic world and the business sector. With this aim in mind, the Flemish Government has developed a number of initiatives to increase the valorisation of research results, to better diffuse technology, and to strengthen the direct links between companies seeking to innovate and researchers from higher education institutions. Support can be made available to companies, institutions, networks and private individuals (researchers). In addition, several promotional campaigns (such as “Ik innoveer!” - “I innovate!”) focused at low-innovation intense companies and SMEs have also been set up.

Examples of recent measures include support through the AIO for Baekeland mandates, doctoral (PhD) grants for strategic basic research, and innovation mandates allowing researchers to conduct research with a specific business-oriented purpose. Other examples are the subsidies for interface activities from the five participating university associations (in practice, these are the different TTOs), support via the TETRA Fund (aimed at applied-oriented projects), and the various IOF mandates and projects. Calls for support were launched by the AIO for setting up “roadmaps” leading to value creation for KETs (Key Enabling Technologies) and specific value chains in which knowledge organizations and companies are involved. Networking in the field of innovation takes place primarily through the VIN (underpinned by its five PIC) and the TTOs of the five university associations (and the similar services of the strategic research centres). In order to develop strategic alliances with companies, the Flemish universities have created dedicated expertise centres. These expertise centres are divided in a number of research domains. Each expertise centre is coordinated by a business developer that one can contact. The business developers have a full overview of the expertise within their research domain and can refer efficiently within the university. The domains are divided into six groups:

- Food & Agriculture;
- Health;
- Materials & Chemistry;
- ICT & Electronics;
- Cleantech & Energy;
- Engineering.

For example, the domain for “Materials and Chemistry” includes:

- Applied Physics and Photonics (B-PHOT - VUB)
- Chemical Engineering (CHIS - VUB)
- CHEMTECH - Chemistry Technologies (UGent)
- CleanChem: Cleantech for sustainable chemical production (UGent)
- Composites: innovative platform for composites (UGent)
- DuraBUILDmaterials - Innovative technologies for durable cementitious and mineral building materials (UGent)
- Electrochemical and Surface Engineering (SURF - VUB)
- EMAT - Electron Microscopy for Materials Research at UAntwerp



- IMO: Institute for Materials Research (Hasselt University)
- Industrial Valorisation of Research on Non-Destructive Testing and related Materials Characterisation within the KU Leuven Association (KU Leuven)
- L-MRC - Leuven Materials Research Centre at KU Leuven
- Materials research overview (VUB)
- Metals Consortium (UGent)
- SIM<sup>2</sup> - Sustainable Inorganic Materials Management (KU Leuven)
- SusChemA - Sustainable Chemistry Network Antwerp (UAntwerp)
- Sustainable Chemistry (KU Leuven)
- Sustainable Chemistry overview (VUB)
- TANC - Applied and Analytical Chemistry - Services and Collaboration (UHasselt)
- SPARC: Sustainable Polymers and Applications Research Cluster (UHasselt)

## 5 Main research and innovation performers

### 5.1 Higher education institutions

The universities represent the first pillar of the higher education system and play a major role in (the output of) Flemish R&D. The universities generate almost 90% of all non-private scientific output in Flanders. The five universities of the Flemish Community are: the Katholieke Universiteit Leuven (KU Leuven), Universiteit Gent (UGent), Universiteit Antwerpen (UA), Vrije Universiteit Brussel (VUB), and Universiteit Hasselt (UHasselt). Public funding for the universities can be categorised into three budgetary flows; namely, a basic allowance (from the department Onderwijs en Vorming (OV), or the Education and Training department), support granted on a competitive basis, and a variety of (project-based) external (private) sources.

The FWO (Fonds Wetenschappelijk Onderzoek - Research Foundation - Flanders) and the BOF (Bijzonder Onderzoeksfonds - Special Research Fund) mainly support academic fundamental, basic research: FWO support is granted on the basis of competition between the different universities, while BOF support is a performance based research funding system of which the funds are allocated and distributed based on fixed competitive parameters the Flemish universities. FWO also manages as of 2016 the support for strategic basic research, and doctoral grants for strategic basic research, which were previously managed by the IWT (now AIO). The AIO and the IOF (Industrial Research Fund) mainly support industrial and strategic research. AIO support is granted on a competitive basis, whereby applicants are evaluated on a number of criteria. The AIO also provides support at academic level for research conducted at the request of companies; for example, through innovation mandates and Baekeland mandates. IOF support is a targeted subsidy for applied and strategic basic research, allocated on fixed criteria and then granted on the basis of intra-university competition.

In addition to FWO and BOF funding, the EWI policy domain provides extra support aimed at further strengthening academic working conditions and research excellence; for example, via the tenure track system, the Methusalem programme (long-term structural support for top researchers), and the FWO (previously Hercules Foundation) for research infrastructure. The major budget sources for 2016 are consequently these: FWO (331.6 million euro), of which 48 million euro for strategic basic research including doctoral grants, and 26.6 million euro for research infrastructure; BOF (155.8 million euro), and IOF (27 million euro).

As well as the main support pillars offered by the FWO, BOF, AIO and IOF, the 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 Horizon 2020, but also from other EU programmes such as ERDF-Interreg, although these budgets are relatively limited compared to the other sources).

Apart from the EWI domain (via the EWI department, FWO and AIO), the HEIs receive a considerable budget for science and innovation from the Department Education and Training of the Flemish Government . This reaches 1.030 billion euro in 2016, of which 314.9 million euro allocated for R&D-related initiatives (the largest part is being allocated for education and training purposes). Funding sources from commercialising research results has also increased in recent years. In 2015, the KU Leuven earned 118 million euro through this channel (representing one 10th of its total income), ahead of UGent with 1 to 2 million euro million, and the 3 other universities that each make a few hundred thousand euros or less through this channel.

All information relating to on-going research conducted at the Flemish universities can be consulted via the FRIS (Flanders Research Information Space) research portal by browsing through the database using several search options (by research projects, organisations or persons) at [www.researchportal.be](http://www.researchportal.be).

The other pillar of the Flemish higher education system is the “hogescholen” or university colleges. These colleges provide higher education and advanced vocational training, and their mission includes research and the provision of other services to society. Since the academic year 2013-2014, the academic education of the university colleges has been integrated in the university system. This took place within the framework of the so-called “associations”: cooperation agreements between one university and one or more university colleges. These associations were set up at the introduction of the Bachelor-Master structure in 2004 and are the result of the Bologna process. The bachelor qualification is the highest obtainable at the university colleges; master diplomas (and higher) remain the preserve of the universities. Several university colleges have merged with each other, affiliated to one of the **five associations**: KU Leuven, Ghent, Antwerp, Brussels and Limburg.

Only statutorily registered universities and university colleges can take part in this system and receive government funding to support their educational and research activities. Apart from universities and university colleges, a limited number of other officially registered institutions, such as the Vlerick Leuven-Ghent Management School, the Institute of Tropical Medicine (Antwerp) and the Antwerp Management School, are also allowed to participate. Within the field of (higher) education, there are a number of advisory bodies, most notably the **VLOR** (Vlaamse Onderwijsraad, or Flemish Education Council), the official advisory body on the education and training policy of the Flemish Community, and the **VLIR** (Flemish Inter-university Council), which defends the interests of the universities, advises the Flemish Government on university matters, and organises consultation between the universities. The **VLHORA** (Flemish University College Council) fulfils the same role for the university colleges. The “Vlaamse Universiteiten en Hogescholen Raad” (**VLUHR** or Flemish University and University College Council) integrates all the actors at the higher educational level within the Flemish Community.

## 5.2 Business enterprise sector

The companies are of major importance within the STI system in Flanders. 70% of R&D in Flanders is privately funded (by the business enterprise sector). However, they are a very heterogeneous group. Most large companies are clearly innovation-active. Some of them have significant research budgets. Given the industrial texture in Flanders, most of these large enterprises belong to multinational groups, so that their research policy is not exclusively determined in Flanders. The main sectors that conduct research are life sciences and chemistry, ICT and communications, and the electrical machinery and apparatus industry.

Alongside the large, innovation-intensive companies, a group of high-technology SMEs has arisen in recent years and continues to grow steadily, notwithstanding the setbacks (and the failures) that have been caused as a result of the difficult economic climate. Moreover, even though the large majority of SMEs do not conduct research directly, many of them outsource research to some extent, so that they can also be regarded as innovation-oriented. According to the Community Innovation Survey (CIS) carried out in 2013, 56% of all companies (2012) in Flanders can be called innovative (= introduction of new or renewed product or process innovations, or organizational or marketing innovations). Nevertheless, innovation continues to be largely concentrated in industry and large companies. The results of the CIS further demonstrate that in 2012 the average Flemish company generated 8% of its turnover from innovative goods or services. Almost half of this stems from new-to-market goods and services, while the remaining part comes from goods or services that are only new to the company itself (the so called “imitation” products). For more detailed information, also see chapter 4. International comparisons demonstrate that the share of people employed in (medium) high-tech industry and high-tech services in Flanders is higher than the EU average (8.9% versus 8.4% for the EU-28 in 2013). R&D activities (expenditure) within companies in Flanders are mainly focused on the following high-tech sectors (2013): chemicals and pharmaceuticals (NACE 20-21) account for 34.7% of total BERD expenditure on R&D (based on a sample); information technology, electronic products, optical products and electrical equipment (NACE 26-27) account for 14.9%; motion picture, video and TV production, computer programmes, engineering, and technical testing and analysis activities (NACE 59-63, and 71) account for 12.2%; and machinery and transport (NACE 28-30) account for 14.7%. Part 3 above lists companies that have important R&D activities. In 2013, the R&D intensity in the business sector was 1.75% and likewise in 2012. Flanders therefore ranks higher than the EU-28 average and the Netherlands, but much lower than the Scandinavian countries, Germany, the USA and Japan.

### 5.3 Strategic research centres

Flanders aims to be a front-runner in the European knowledge society and economy by continuing to build on and utilize its existing knowledge base and by increasing its innovation potential. Apart from the universities, the leading Flemish research and innovation actors are the five strategic research centres (SRC) or ‘Strategische Onderzoekscentra (SOC)’ in Dutch, sometimes referred to as public research organizations (PRO). Each of the centres is active in a specific research area and they have co-founded several spin-off or start-up companies (in total 109), often based on breakthrough research. The Flemish Government concludes with each of these SRC a multi-annual management agreement including key performance indicators, in return for an annual grant. Total budget of these public grants reaches 182 million euro in 2016.

#### 5.3.1 IMEC

**IMEC** was set up in 1984 and performs world-leading research in the field of nano-electronics and nano-technology. This research includes digital components, organic electronics or scaling-driven nano-electronics and is applied in healthcare, smart electronics, sustainable energy and transport. Its 1,900 staff includes over 500 industrial residents and guest researchers of over 73 nationalities. With its state-of-the-art infrastructure, strong worldwide network and clean-room facilities, it is well-placed both to conduct research at the nano-scale and bridge the gap between research and industry. The spin-off companies that have been set up are active in photovoltaics, analogue chip design, satellite navigation and infrared detectors. IMEC is also very well integrated internationally and has a set up a number of subsidiary establishments abroad, including in the US, Taiwan and China.

*Key figures IMEC: total revenue: 393.6 million euro (2015); 47.7 million euro public funding from the Flemish Government (2015). Output: 40 spin-off companies (1984-2015), publications: 10,504 journals and proceedings, WoS databases (2000-2014); patents: 981 applications and 476 grants, EPO, PCT and USPTO (2007-2014).*

### 5.3.2 VIB

The mission of the **VIB**, the Flemish Inter-university Institute for Biotechnology, is to conduct frontline biomolecular research in diverse fields of the life sciences for the benefit of society. It was founded in 1996 and its main task consists of acquiring new knowledge through strategic basic research, based on the use of advanced molecular biological technologies to study the functioning of human cells, plants and microorganisms. Another of the institute's core tasks is to translate this knowledge into useful applications, such as diagnostics, medicines or agricultural usages. The VIB's third core activity consists of informing the people of Flanders about discoveries and developments in the life sciences. 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's total number of employees intra muros and extra muros is 1,470 (2015) and it manages 2 bio-incubators and 1 bio-accelerator in Ghent and Leuven.

*Key figures VIB: total revenue: 101.2 million euro (2015); 44.97 million euro public funding from the Flemish Government (2015). Output: 18 spin-off companies (1995-2015) 683 employees, 820 million euro capital investments. Publications: 6,559 journals and proceedings, WoS databases (2000-2014); patents: 245 applications and 60 grants, EPO, PCT and USPTO (2007-2014). Publications: 646 publications (206 top 5 publications) (2015), income from industry: 27.7 million euro (2015).*

### 5.3.3 VITO

**VITO** was founded in 1991 and is the largest and best-equipped multidisciplinary research centre for energy, materials, chemistry, health, environmental and terrestrial observation in Flanders. As an innovative customer-oriented research organization, it wants to create technological solutions and give independent scientifically-based advice and support that will strengthen the economic and social fabric of Flanders and make an essential contribution to sustainable development. The scientific research includes energy technology (renewable energy, biofuels, smart grids), environmental and process technology (reuse of waste water), research into sustainable materials and chemistry, environmental measuring (water and air quality), environmental toxicology and earth observation, as part of its integrated environmental studies programme. VITO has 772 employees (2015) of in total 24 nationalities.

*Key figures VITO: total revenue: 112 million euro (2015), 46.4 million euro public funding from the Flemish Government (2015). Output: 8 spin-off companies (1991-2015), 256 publications (2015), patents: 25 applications (2015).*

### 5.3.4 iMinds

The Interdisciplinary Institute for Broadband Technology (IBBT) was established in 2004, but since October 2012 has been known as **iMinds**. This strategic research institute engages in research into information and communication technology (ICT) in general and the development of broadband applications in particular. The research is interdisciplinary and demand-driven, and is conducted in close collaboration with both industry and government. Its objective is to offer solutions to complex problems and thereby assist society to meet future challenges. iMinds stimulates research that addresses key social and economic issues: e-Health, new media, mobility and logistics, enabling technologies, and e-Government. It drives digital innovation for society and economy, through strategic and applied research on key digital technologies and turns digital know-how into future-proof products and services. The institute also aims to help create a sustainable society by enhancing the social, environmental and economic aspects of ICT services and developing a green ICT strategy. The total staff of iMinds of 976 (2015) represents in total 55 nationalities.

*Key figures iMinds: total revenue: 58 million euro (2015), 27.3 million euro public funding from the Flemish Government (2015). Output: 38 spin-off companies (2004-2015), publications: 3,902 journals and proceedings, WoS databases (2005-2014), incubation and entrepreneurship of 101 (start-up) companies (320 jobs and 16 million euro turnover).*

### 5.3.5 Flanders Make

In 2013, the Flemish Government decided to establish a new SRC under the name “Slimme Maakindustrie” (Strategic Research Centre for Smart Manufacturing). The centre’s activities focus on production technology and know-how in the field of smart assembling. It is known as **Flanders Make** and was officially launched in October 2014. The aim of this centre is to support companies from various industries by conducting research into product and production technology and processes. Flanders Make’s mission is to strengthen the international competitiveness of Flemish manufacturing industry in the long term, through industry-driven, pre-competitive, excellent research in the field of mechatronics, product development methods, and advanced production technologies. The excellence centres of Flanders’ DRIVE and the Flanders Mechatronics Technology Centre (FMTC), as well as the laboratories from the five Flemish universities have been integrated into Flanders Make, to further support the transformation of industry. Clean energy-efficient motion systems, Smart monitoring systems, High-performance autonomous mechatronic systems, Intelligent product design methods, Design and manufacturing of smart and lightweight structures, Additive manufacturing for serial production, Manufacturing of high-precision products, Agile and human-centered production and robotics systems. The number of employees is 89 (payroll only). Total staff for 2015 is +- 450).

*Key figures Flanders Make: total revenue: 15.9 million euro (2015), 13.2 million euro public funding from the Flemish Government (2015).*

## 5.4 Collective research and clustering initiatives

The Government of Flanders supports several innovative networks, involving various knowledge actors and industries, usually including companies from a specific sector.

### 5.4.1 VIS-scheme

The main policy instrument thereto is the “VIS-scheme” (VIS = Vlaamse Innovatiesamenwerkingsverbanden, or Flemish Cooperative Innovation Networks), albeit on a rather ad hoc basis and varying goals depending the case. This provides a legal structure for various types of networks/projects that offer innovative solutions to a specific problem or a demand-driven opportunity relating to a collective of companies, resulting in a clear (economic) added value for a broad target group. Since 2009, a number of these have been streamlined and some types are in quenching scenario.

### 5.4.2 Excellence centres and Innovation Platforms

Since 2001, the VIS-scheme has supported so-called “Competentiepolen” (excellence centres) or “Lichte Structuren” (innovation platforms) after 2011. These organizations structure cooperation between actors (such as industrial partners, PROs, universities, professional organizations) of a specific industry, by providing relevant research and innovation potential and create and diffuse knowledge in Flanders. Currently, these **innovation platforms** are supported: FISCH (sustainable chemistry), Flanders’ DRIVE (automotive industry), a division of Flanders Make as of end 2014; VIL (logistics – Flemish Institute for Logistics); MIX (innovative media); SIM (materials); Flanders’ Food (innovative food industry); VIM (mobility – Flemish Institute for Mobility); Flanders Inshape (product development and industrial design); Flanders’ Synergy (innovative labour organization); Flanders Innovation Hub for Sustainable Chemistry (FISCH); MIP3.0

(environment); Sociale Innovatiefabriek (Social Innovation Factory, for social entrepreneurship and social innovation).

Several consolidations of innovation platform have taken place. The former FLAMAC (Flanders Materials Centre) was incorporated in 2011 into the SIM (Strategic Initiative on Materials). October 2014, the activities of Flanders' Drive, the FMTC (Flanders' Mechatronics Technology Centre) and research divisions of 5 universities of the Flemish Community were integrated into a new strategic research centre for the manufacturing industry (Flanders Make - see above). Finally, Flanders' PlasticVision (plastic processing industry) became a part of FISCH (Flanders Innovation Hub for Sustainable Chemistry).

### 5.4.3 Cluster policy

The 2014-2019 governing agreement of the Flemish Government calls for a cluster policy as the lever to deal with the innovation paradox in Flanders and focus more on marketisation of innovation. In 2014, the policy note 2014-2019 for Work, Economy, Science and Innovation refers to a cluster as a cooperation whereby actors from the triple helix engage to develop innovative value chains in specific domains. As a result, the Flemish Government approved in July 2015 a Concept Note on a Cluster policy. This described the framework of a more general Flemish cluster policy. By way of strategic cooperation networks, companies and knowledge institutes should set up projects, and add an international dimension. The aim is to unlock unused economic potential and to increase of competitiveness among Flemish companies through an active and continuous cooperation of actors, to contribute to a solution for societal challenges with an economic added value for companies. The concept note included initiatives that reshuffle the existing landscape, among other by adapting funding criteria, and direct future innovative cooperation among companies' networks into two types of clusters: on the one hand spearhead clusters and on the other hand innovative business networks. **Spearhead clusters** will be complementary to the strategic domains (these are the fields of research activities conducted by IMEC, VIB, VITO, iMinds, Flanders' Make), large scaled, limited in number, strictly selected, supported for a 10-year period with a 50% public support part, require a triple helix model, and make in future a difference from economic point of view. The 2 VRWI foresight studies (2006, 2013) represent a solid basis in this respect. Proposals in a number of fields (such as materials and sustainable chemistry) have been submitted Spring 2016 to Flanders Innovation and Entrepreneurship for an evaluation. The decision-making process is expected to lead towards the support of a limited number of initiatives as of 2017.

The **innovative business networks** (IBN) will be shaped on a smaller scale, bottom-up, have a future potential and come from emerging markets or the bundling of various small initiatives. During a 3-year period, a 50% public support part will be available. A simplification and streamlining of the large number of intermediaries, structures and innovation actors are leading principles. Resulting a call at the end of 2015, and a first selection, the Hermes Beslissingscomité (decision committee), following an advice from Flanders Innovation and Entrepreneurship, decided July 2016 to propose support for a three-year period towards these 13 projects for innovative business networks (IBN):

- **Euka vzw** (drones)
- **Innovatieve Coatings** (coatings)
- **Flanders' Bike Valley vzw** (bicycle industry)
- **Platform Power to Gas** (hydrogen)
- **Offshore Energie** (off-shore energy)
- **Digitising Manufacturing** (Industry 4.0, manufacturing, digitalisation)
- **IBN Composieten** (composites)
- **Groen Licht Vlaanderen** (lightening, digitalisation)
- **BIM** (Bouw Informatie Modellen) (construction teams, digitalisation)
- **Off-Site Construction** (building)

- **Air Cargo Cluster** (air freight)
- **Smart Digital Farming** (agriculture, ICT)
- **Eggsplore** (financial technology, internet of things).

The introduction of the cluster programme leads to a phasing-out of the support for Lichte Structuren (Innovation Platforms) and VIS-trajectories.

#### 5.4.4 Support for research performed by collective (research) centres

The AIO has accredited a number of research centres under the VIS scheme, some of which are **collective (research) centres**. Their main activities are collective research, various services of a scientific or technical nature (provided individually to their members), dissemination of technical information and training. The collective centres were founded many decades ago by the Belgian business federations, usually by way of an association, and are mainly active in the field of applied research relevant to the companies in their sector. In addition, they often participate in European, federal and Flemish research programmes and carry out self-generated research in order to maintain their overall levels of knowledge and expertise.

More specifically, in the context of support from the AIO, the centres define and conduct such research. At the request of individual companies, they also carry out contract research (funded by the AIO). The centres accredited by the AIO in this manner are: the Belgian Institute for Wood Technology and the Wood Training Centre; the Belgian Welding Institute (BWI); the Belgian Research Centre for the Cement Industry (CRIC); the Belgian Road Research Centre (BRRC); the Scientific and Technical Service Centre for the Belgian Textile Industry (Centexbel); the Belgian Building Research Institute (BBRI); the Scientific and Technological Research Centre for Diamond (WTOCD); and the Collective Centre for the Belgian Technology Industry (SIRRIS).

## 5.5 Policy research centres

In 2001, the Flemish Government launched the policy research centres (“Steunpunten”) programme to provide a scientific basis for policy. The focus of the policy research centres is both on problem-driven, short-term research and on fundamental, long-term basic research on themes that the Flemish government regards as priorities and relevant to its policy. The task further includes the transfer of knowledge, the provision of scientific services, the building up of data collections, the unlocking of data sources and data analysis.

In the period 2012-2015 twenty-one policy research centres were receiving support. In 2015 the Flemish Government decided to a decentralized approach of the policy research centres from 2016 onwards. In doing so, every policy domain is made responsible for setting up, funding and following up its own centres. The department of Economy, Science and Innovation, though it still advises the other policy domains in the matter, is no longer coordinating, nor is it funding the policy research centre programme in this decentralized approach. Although the organizational approach has changed, the regulations and general goals of the programme remained. EWI continues to support the centres that are active within its own policy fields: the Expertisecentrum Onderzoek en Ontwikkelingsmonitoring (expert centre Research and Development monitoring) and the Steunpunt Economie en Ondernemen (Policy research centre Economy and Entrepreneurship).



## 5.6 Scientific institutes

Within the Flemish Community, there are five scientific institutes, each managed by a department of the Flemish Government. One of these is a part of the EWI policy domain, namely the Agentschap Plantentuin Meise (Agency botanic garden Meise). These perform scientific research in a specific policy field. Apart from building up and diffusing the knowledge gained from scientific research, the institutes also provide advice and assistance to policy-makers, 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; for example, through membership of EU research networks.

The five institutes are:

- **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 many cases this research is conducted in collaboration with various international partners;
- **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;
- **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 a number of pieces from other schools;
- **Agency for Archaeological Heritage** (Agentschap voor Onroerend Erfgoed, AOE) conducts research into the immovable heritage of Flanders (archaeology, monuments, landscapes), focusing on themes such as the restoration of historic gardens, sea wrecks, historic organs, parks, industrial and maritime heritage, etc.;
- **Agency Botanic Garden Meise** (Agentschap Plantentuin Meise) is an international scientific research institute that operates 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.

## 5.7 Other knowledge institutes, and networking platforms for R&D and innovation

Apart from the aforementioned organizations, which are part of a clear category such as the universities, the public research organisations (PROs), innovation platforms, collective research centres or the (Flemish or federal) scientific institutes, there exist a variety of other institutions and organizations in the public domain with activities that primarily focus on (scientific) data collection, research and/or knowledge generation. In most cases, they are mainly of 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**, ITM (Instituut voor Tropische Geneeskunde, ITG): is one of the world's leading institutes for training, research and support in the field of tropical medicine and health care in developing countries, providing (reference) clinical services for the management of tropical diseases;
- The **Flanders Marine Institute**, VLIZ (Vlaams Instituut voor de Zee): is renowned for supporting coastal and marine scientific research; it operates the Simon Stevin research vessel and manages the InnovOcean site and the Flanders Marine Data and Information Centre, which is active in



international networks, such as the IOC of UNESCO, the European Marine Board and supports the European-level initiatives EMODnet and JPI Oceans;

- The **Centre for Research and Conservation (CRC)**: is the research department of the Royal Zoological Society of Antwerp (RZSA), which conducts research activities in four disciplines: ethology and animal welfare, functional morphology, veterinary sciences and conservation biology; this research takes place in Flanders (Antwerp Zoo, Planckendael Wild Animal Park in Mechelen), in other zoos and associated institutions, in Cameroon and in Brazil;
- **Neuro-electronics Research Flanders, NERF**: this basic research initiative is a collaborative venture between IMEC, the VIB and KU Leuven, which aims to unravel the neuronal circuitry of the human brain by dealing with fundamental neuro-scientific questions through research that combines nano-electronics and neurobiology;
- **Energyville vzw**: is a collaboration between research actors who aim to excel in the field of innovative European energy research (for example, by developing human capital to build a sustainable energy future for society) and who wish to drive the transition towards a sustainable energy infrastructure for large urban areas;

Other initiatives include the so-called “Proeftuinen” (**Living Laboratories**, or test beds), which have been set up in various domains. These are structured test environments in which organizations can test innovative technologies, products, services and concepts, using a representative sample of individuals, who are used as testers in their normal living and working environments. A living laboratory consists of one or more experimental platforms on which various projects are executed. Living Labs were set up in the field of **house renovation / building, care innovation**.

Some organizations that do not perform research as such but nevertheless have a role in supporting or stimulating innovation or act as knowledge cluster in specific thematic areas. These organizations include:

- **I-Cleantech Vlaanderen vzw**: aims at the internationalization of clean technologies developed in Flanders, by establishing innovative projects, promoting strategic initiatives and stimulating entrepreneurship;
- **FlanSea** (Flanders Electricity from the Sea), and **Gen4Wave Energy platform** (research on and development of wave energy in Flanders);
- **Tecnolec** (previously Flemish Electro Centre; technical knowledge centre for the electro technical sector);
- **DSP Valley** (cluster of excellence in smart electronic systems and embedded technology solutions);
- **Smart Grids Flanders**: innovation platform for actors in the field of smart (electricity) grids;
- **Flanders DC** (District of Creativity): stimulate entrepreneurial creativity through innovation;
- **Flanders Care**: increase care quality through innovative entrepreneurship in care economy;
- **Microsoft Innovation Centre Vlaanderen (MIC Vlaanderen)**, involved in ICT in the care sector and e-health).

## 5.8 Institutes governed by other authorities

### 5.8.1 Federal authority

Belgium has ten federal scientific establishments, which are of diverse types and cover a wide variety of research activities and collections; these include museums, libraries, weather and space observatories, as well as research institutes dealing with crime, African culture, geology and public health. Some of these bodies not only perform research in specific fields of expertise, but also have a publicly orientated scientific mission. At the administrative level, they are managed by various policy fields and under the overall responsibility of the federal Minister for Science, as part of the Programmatory Public Service (PPS) for Science Policy.

These scientific establishments have a two-fold mission: a scientific public service mission (the development, maintenance and dissemination of scientific, technical and cultural information and documentation, collection conservation, etc.) and a research mission (through research often conducted in partnership with the universities of the Flemish and/or French Community). As such, these establishments interact with and enhance the scientific potential and outcome generated by the actors in the Flemish STI landscape, particularly the researchers in HEIs who are active in the same field of activity. The federal scientific institutes in the field of nature and space are (excluding the domains of arts and documentation): the **Belgian Institute for Space Aeronomy**; the **Royal Belgian Institute of Natural Sciences**; the **Royal Meteorological Institute**; the **Royal Museum for Central Africa**; the **Royal Observatory of Belgium** (including the Planetarium).

In addition to these institutes, there are also a number of federal partner institutions and other organizations subsidized by the PPS (for example, the University Foundation), whilst some of the federal scientific institutes report to other federal public services (in the field of public health, for example, there is the **Scientific Institute of Public Health** and the **Veterinary and Agrochemical Research Centre**). The Federal Government also has responsibility for two other research organizations: the **National Institute for Radio-elements**, and the renowned **Nuclear Energy Centre** (SCK or CEN). The latter is located in Mol, alongside the Flemish VITO, which is responsible for the non-nuclear aspects of energy research, and one of the eight JRC of the EU, the IRMM (reference materials).

The new federal government (2014) has decided to reorganize the science policy field at the federal level, as a result of which the Programmatory Public Service (PPS) for Science Policy will be merged into another administrative unit from a federal public service.

### 5.8.2 International institutions, organizations or platforms in the STI field

Apart from institutes related to or managed by the Government of Flanders and the Federal Government, there are also a number of other EU or international institutions that collect scientific data or conduct research, and are located in Flanders. Some of these receive funding or support from the Flemish Government. Examples include:

- the **Von Karman Institute** for fluid dynamics (located in Sint-Genesius-Rode);
- the EU's joint research centre (JRC) known as the **Institute for Reference Materials and Measurements** (IRMM), located in Mol (close to the Flemish VITO and the federal SCK/CEN);
- **United Nations University Institute on Comparative Regional Integration Studies** (UNU-CRIS), located in Bruges;
- the **ESA Business and Innovation Centre**, located in Geel;
- the **Project Office** of the **Intergovernmental Oceanographic Commission** (IOC) of UNESCO for the International Oceanographic Data and Information Exchange (IODE) programme (located in Ostend);

- the European Marine Board (EMB) and European Marine Observation and Data Network (**EMODnet**), both located in Ostend.

Other examples of international research-related establishments are the executive offices of the EU's joint initiatives for Innovative Medicines (IMI), Clean Sky, ECSEL (previously ENIAC (nano-electronics), ARTEMIS (embedded systems)), Fuel Cells and Hydrogen (FCH), all of which are located in Brussels.

## 5.9 Cooperation among different knowledge actors within Flanders

Apart from cooperation between research performers and the academic world on the one hand, and business or societal actors on the other hand, or between collaborations between knowledge institutes and their foreign partners or counterparts, the various Flemish R&D&I performers also cooperate increasingly among each other. This may develop via scientific networks or ad hoc projects. Yet in a number of cases, this takes place through formal institutes or cooperation agreements as well.

Universities are closely connected via the involvement of entities of their different faculties in VIB and iMinds. In other cases, there exist cooperation between universities and strategic research centres or scientific institutes. Examples of these is NERF (Neuro-Electronics Research Flanders), an academic research initiative that is set up as a long-term collaboration between three Flemish institutes (IMEC, KU Leuven and VIB) that receives structural funding from the Flemish Government, and actively collaborates with UA and UGent. In EnergyVille (located in Genk), the KU Leuven, VITO and IMEC are united for research on sustainable energy and intelligent energy systems. Another example is the strategic cooperation agreement signed in 2016 between VIB and ILVO to bundle their complementary expertise of basic and applied research in related fields of activity.

Cooperation may also take place on a project-basis and include federal or international institutes that are located in Belgium. For example, ILVO (agriculture research, located in Melle and Ostend) cooperates with UGent, the federal scientific institute for public health, and the Federal Public Service (FPS) Public health, Safety of the food chain, and Environment. The InnovOcean site in Ostend is home to an array of actors in the field of marine issues: the province of West-Flanders, VLIZ (Flanders), IODE (UNESCO/IOC Project Office), the secretariats from the European Marine Board (EMB) and from the European Marine Observation and Data network (EMODnet). The EC's JRC cooperates in Belgium with, among other, VITO, IMEC, KU Leuven, VLIZ, and UGent.

## 6 Overview of the various actors in the STI domain in Flanders

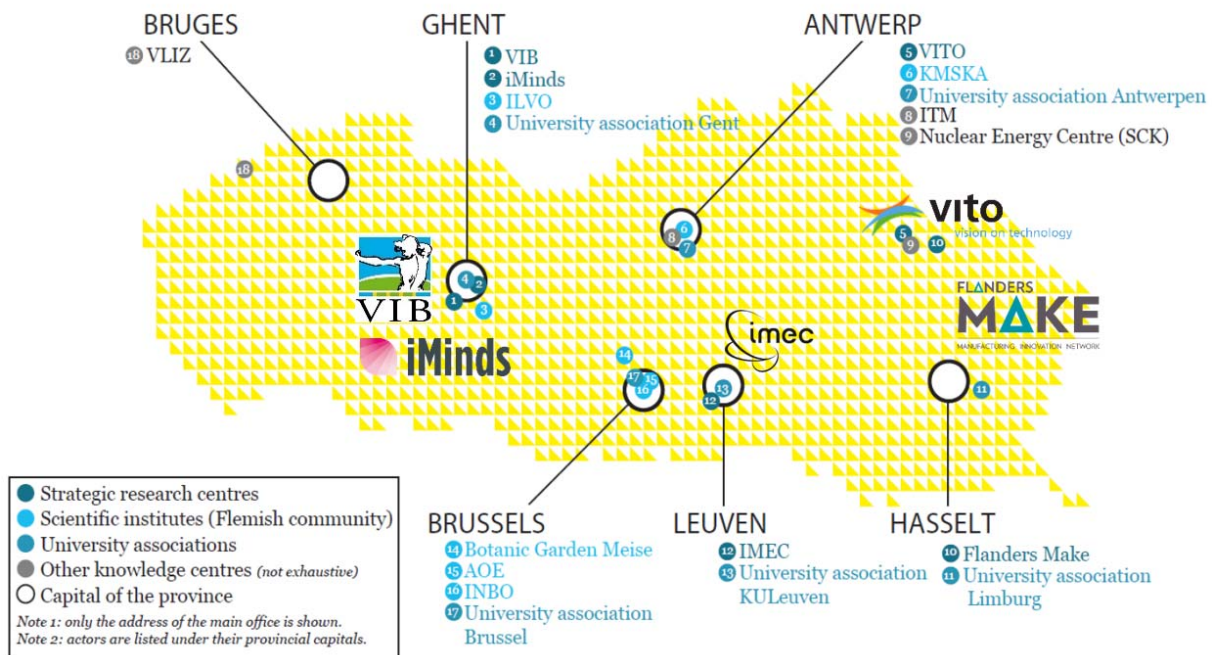
The following table presents a brief overview of the main (types) of institutes and players acting within the research and innovation system in Flanders:

Type of organization	Actors
Public authority: policy preparation, monitoring and evaluation	<i>EWI Department</i>
Public authority: policy execution (agencies)	<i>AIO, FWO, PMV, (FIT)</i>
Advisory council	<i>VARIO</i>
Strategic research centres	<i>IMEC, VIB, VITO, iMinds, Flanders Make (including Flanders Drive and FMTC) [Note: Autumn 2016, IMEC and iMinds merge into one new organisation]</i>
Scientific institutes (Flemish Community)	<i>Agency Botanic Garden Meise, ILVO, INBO, KMSKA, AOE</i>
University associations (one university with one or more higher education institutions)	<i>Antwerpen, Brussel, Gent, KU Leuven, Limburg</i>
Other knowledge institutes	<i>ITM, VLIZ, Energyville, CMI, NERF, CRC, BioBase Europe.</i>
Spearhead clusters (being elaborated in 2016)	<i>Proposals being prepared for possible clusters in the fields of Materials, Sustainable Chemistry, Agro-Food, Logistics, Smart Energy (non-exhaustive listing)</i>
Innovation platforms	<i>FISCH (including Flanders Plastic Vision), Flanders Drive (now a division of Flanders Make), Flanders FOOD, Flanders Inshape, Flanders Synergy, MIX, SIM (including Flamac), VIL, VIM, MIP3.0, Social Innovation Factory</i>
Innovative business networks (IBN) (start-up of projects for IBN is currently on-going)	<i>Euka, Innovatieve Coatings, Flanders' Bike Valley, Platform Power to Gas, Offshore Energie, Digitising Manufacturing, IBN Composieten, Groen Licht Vlaanderen, BIM (Bouw Informatie Modellen), Off-Site Construction / Bouwindustrialisatie, Air Cargo Cluster, Smart Digital Farming, Eggsplora</i>
Mixed initiatives: innovative networks, technical knowledge centres, knowledge clusters	<i>I-Cleantech, DSP Valley, Tecnolec, FlanSea, Smart Grids Flanders, Gen4Wave Energy platform, Microsoft Innovation Centre, Flanders DC, Flanders Care, Living laboratories (in the fields of house renovation, care innovation)</i>
Technology transfer offices (TTO) from the 5 universities, and from the 5 strategic research centres	<i>Universities: KU Leuven Research &amp; Development, UGent Tech Transfer, Tech Transfer Office UHasselt, Interface AUHA, VUB Technology Transfer Interface</i>
Provincial innovation centres (PIC)	<i>One in each of the five Flemish provinces with and an overarching VIN, run by the AIO</i>
Federal scientific institutes	<i>Belgian Institute for Space Aeronomy, Royal Meteorological Institute of Belgium, Royal Observatory of Belgium, Royal Belgian Institute of Natural Sciences, Royal Museum for Central Africa</i>

Federal research centres	<i>Scientific Institute of Public Health, Veterinary and Agrochemical Research Centre, National Institute for Radio-elements, Nuclear Energy Centre</i>
Collective research centres	<i>Belgian Institute for Wood Technology and Wood Training Centre; Belgian Welding Institute (BWI); Belgian Research Centre for the Cement Industry (CRIC); Belgian Road Research Centre (BRRC); Scientific and Technical Service Centre for the Belgian Textile Industry (Centexbel); Belgian Building Research Institute (BBRI); Scientific and Technological Research Centre for Diamond; Collective Centre for the Belgian Technology Industry (SIRRIS)</i>
International institutes, organisations or platforms in the STI field, located in Flanders	<i>Von Karmann Institute (Sint-Genesius-Rode), IOC for the IODE (Ostend), EMODnet (Ostend), EMB (Ostend), IRMM (Mol), UNU-CRIS (Bruges), ESA Business and Innovation Centre (Geel)</i>
Science / technology parks	<i>Greenbridge (Ostend), Evolis (Kortrijk), Ardoyen, Eiland Zwijnaarde (Ghent), Waterfront (Niel), Zellik (Asse), Arenberg, Haasrode (Leuven), Feed Food Health (Tienen), Thor Park (Genk), Research Campus Hasselt (Hasselt), Greenville (Houthalen-Helchteren)</i>
Innovation and incubator centres (IIC)	<i>Greenbridge IIC (Ostend), IIC Kortrijk (Kortrijk), iCubes – iMinds Incubator, IIC UGent 1&amp;2, VIB Bio-incubator and Bio-accelerator (Ghent), Textile Innovation Centre (Ronse), IIC Brussels (Asse), Bio-incubator KU Leuven, Creative Minds - De Hoorn, Greenhill Business Incubator, ICT-cluster Arenberg, IL Research Building Haasrode, IIC Leuven, Spin-off Centre (Leuven), UBCA UA (Edegem), Innotek (Geel), Technology House of Environment (Mol), C-Mine, Energyville (Genk), Kaai 16 (Hasselt), Incubator Science Park Limburg, Bioville (Diepenbeek), IIC Lokeren (Lokeren), Bio-generator Tienen (Tienen), Agropolis (Kinrooi), Incubator Darwin (Niel), Greenville, Bike Ville (Paal), IncubaThor (Genk), CordaINCubator (Hasselt), Watt Factory (Gent) (*)</i>

(\*) source: Enterprise Flanders (Agentschap Ondernemen), 2012, and Flanders Innovation and Entrepreneurship (AIO, 2016).

Figure 6: Geographical presentation of the main public actors in scientific research and innovation in Flanders



## 7 Flanders in the international STI field

The international aspects of STI cover a wide range of activities and institutions, embedded at the public, semi-public and private level. Consequently, no single administrative entity or agency has been set up to specifically manage these international aspects. This means that all the different public and private actors that are interested or eligible can initiate their own policy initiatives and programmes at the international level. The following overview lists the main types of activities and initiatives that are carried out in the field of international scientific research and innovation.

### 7.1 Policy preparation, support and follow-up

Since 1993, the Belgian Communities and Regions have been able to execute their competencies at the EU and international policy level. Since then, a substantial effort has been made to internationalize STI policy. More concretely, this policy is shaped by the preparation and follow-up of policy initiatives at the bilateral (towards a region or a country), inter-regional, inter-governmental, EU and international (OECD, UN) policy levels. The overall focus of policy lies at the (supranational) EU level, in casu the decisions and actions of the European Council and the European Commission.

In the European Council meetings dealing with research and innovation policy, Belgium is represented by its Communities/Regions, whilst the federal authority acts as assessor. Consequently, Flanders is one of the authorities directly involved in the preparation of decisions within this 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 representative 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 EU 2020 strategy, the Framework Programme for Research and Technological Development (FP on RTD), the Horizon 2020 Programme for 2014-2020, the European Research Area (ERA) objectives, the Innovation Union flagship initiatives, and all related R&D and innovation matters in the broadest possible sense (for example, SFIC, ESFRI, etc.).

Active involvement in the EU's research and innovation policies includes:

- The preparation and follow-up of the ministerial decisions within the EU Competitiveness Council (Research);
- the EU's Horizon 2020 and COSME programmes: preparation of the programme themes, act as National Contact Point (NCP), involvement as programme committee members in H2020, the ERA networks, OMC networks, and other support actions;
- preparation and participation in the meetings of the ERAC, the entity in which the EU member-states are gathered to advise the European Commission on its research and innovation policy;
- preparation for the meetings of the Enterprise Policy Group (EPG), the body of the EU member-states that advises the European Commission on enterprise and industry policy and the non-R&D innovation);
- the participation in the bilateral meetings between the Commission and Belgium for the European Semester (Fact Finding Mission) and preparation of the bilateral meeting at ministerial level for the R&D&I themes;
- preparation and follow-up of the decisions relating to various EU initiatives in the field of R&D and innovation, emanating from the Council or the Commission, such as the JTI (Joint Technology Initiatives), the JU (Joint Undertakings), ESFRI (large research infrastructure), the KET (Key Enabling



Technologies), the EIT (European Institute for Technology, now a part of Horizon 2020) and the JPI (Joint Programming Initiatives), etc.;

- contributions to or revision of the many reports and consultations involving the European Commission and the Committee of the Regions in the field of scientific research and innovation (for example, the Flemish and Belgian National Reform Programmes for the EU 2020 strategy (European Semester), the various ERA reports, , R&I Country report, the report of the Research and Innovation Observatory (RIO), the EC/OECD STI Policies report, the ERDF R&D and innovation actions, the progress reports on the Innovation Union, thematic/specific questionnaires from ERAC, EPG and peer reviews of the STI system, R&D legislation, the ERA roadmap progress, the research conducted by PROs and universities, etc.).

Other involvement in EU policy networks includes membership of ERRIN (European Regions Research and Innovation Network) and the Vanguard Initiative for new growth by smart specialisation.

In addition to the EU level, Flanders also has representative functions linked to the preparation and follow-up of the policy-making of various international organizations and other specific support initiatives. This includes the Organization for Economic Cooperation and Development (OECD) and the United Nations (UN). More precisely:

- OECD: participation in the CSTP (Committee on Science and Technological Innovation Policy), the TIP (Technology and Innovation Policy), NESTI (National Experts on Science and Technology Indicators) group, and in thematic subgroups on e.g. ICT, biotechnology, and researchers' mobility. A substantial contribution is provided for the OECD's STI Outlook report (as of 2016: the STI Policy (STIP) report, jointly from the OECD STI Survey and European Commission ERAC survey);
- UN: support for the Flanders UNESCO Science Trust Fund (FUST: capacity building in development countries), the Flanders UNIDO Science Trust Fund for Industrial Biotechnology (FUSTIB), UNU-CRIS (United Nations University – Centre for Regional Integration Studies, located at the Europa College in Bruges) and the project office of the IOC (Inter-governmental Oceanographic Commission) for IODE at Ostend.

## 7.2 Bilateral and international co-operation and agreements

Many institutions and organizations in the field of STI have developed international links; are part of international networks; have established representations; have set up joint initiatives; or have concluded bilateral agreements with a foreign partner in the host country. Such initiatives are the result of a gradual trend towards greater internationalization, whereby companies, universities, research institutes or knowledge centres develop bottom-up cooperation with foreign partners in a network context. These initiatives can either be independent of or complementary to the initiatives of the Flemish, federal or EU actors in respect of these foreign countries or regions.

### 7.2.1 STI actors: universities, university colleges, strategic research centres, scientific institutes and other knowledge organizations

At the level of the universities, for example, KU Leuven (Catholic University of Leuven) provides grants for students to visit developing countries. It cooperates with partner universities in the Netherlands, Poland, the US, Japan and South Africa, and for decades has maintained intensive contacts with China through cooperation programmes with top universities, the Ministry of Education, bilateral agreements and memoranda of understanding. Furthermore, KU Leuven is also a member of various international networks, such as the Coimbra Group, the LERU (League of European Research Universities), the IAUP (International Association of University Presidents), the EUA (European University Association), the IMHE (International

Management in Higher Education) programme of the OECD, the EAIE (European Association of International Education) and the EUCEN (European Universities Continuing Education Network). It has also concluded a number of agreements with foreign institutes, for example with Cambridge and Heidelberg Universities (the Health Axis Europe). In 2016, it signed with six universities in Hungary, Slovenia and Czechia, the Central Europe Leuven Strategic Alliance (Celsa), a co-operation agreement to set up joint study programmes and work together to find solutions for major European problems.

Similarly, Ghent University has concluded bilateral framework agreements outside Europe with various institutions in every continent. It has a formal representation in Peking (China) and even a Chinese alumni network in both Peking and Shanghai. It has concluded partnerships with other European universities (U4 with Groningen, Göttingen, Uppsala; with the University of Kent; and with Université de Lille) and takes part in international organizations, including the Santander Group, the EAIE, the EUA, the European Centre for Strategic Management of Universities (ESMU), the European Association of Institutions of Higher Education (EURASHE), the UK Research Office (UKRO), the Association of European Science and Technology Transfer Professionals (ASTP), the Magna Charta Observatory of Fundamental University Values and Rights, and the United Nations Academic Impact Programme. Its India and China platforms also include industrial partners. Since 2014, UGent offers an academic degree in Songdo (South Korea).

Among the Flemish strategic research centres or PROs, IMEC in particular has been very active at the international level. Apart from its home-based offices in Leuven and Leper, it has also agencies in the Netherlands, Taiwan, China, India, the US and Japan. VITO has set up an Asian office in Hong Kong and is developing activities in India and Vietnam. In 2011, it established a joint venture with a counterpart institute in Peking and it also signed a cooperation agreement with the Tianjin Academy of Environmental Sciences (TAES). VITO also has an establishment in Qatar and cooperates with local partners in the UAE. Self-evidently, these organizations take part in the activities of various networks within their field of activities. For example, DSP Valley is Chair of the Silicon Europe Alliance, in which IMEC and KU Leuven are active, and which unites 12 world-class clusters from 10 leading micro- and nano-electronics regions to strengthen the leading role of the European semiconductor industry in the global economy and value chain.

In addition to the universities, the university colleges, the five SRC (strategic research centres) and the five scientific institutes, all the other knowledge organizations in Flanders are at liberty to cooperate with international partners in various initiatives or actions. For example, the VLIZ concludes cooperation agreements with international universities, research institutions and individual research groups, and participates in international networks and projects in the field of marine sciences. The ITM works with many scientific institutions, governments and organizations all over the world for the long-lasting improvement of health care and disease control in developing countries. VIB has set up together with international partners EU-life and Core For Life. Eu-life is an alliance of top research centres in life sciences to support and strengthen European research excellence. Core4Life aims at exploring the potential of coordinating and bundling core facility expertise and resources across institutes and countries in order to advance knowledge and to benefit the entire scientific and technological community.

The knowledge institutes of the Flemish Community, and the various public and private organisations in Flemish Region are eligible for or involved in a number of public support measures. The part hereunder gives an overview of the main types of these instruments.

## 7.2.2 Public authority level: the EWI policy domain and the International Flanders (IV) policy domain

### a) EWI policy domain: FWO, AIO, EWI Department

Different entities from the EWI policy domain act as a (national) contact point in various EU or international STI initiatives. Within the EWI landscape, the Flanders Research Fund, FWO, is a crucial actor to stimulate internationalisation of research. Basically, its actions can be divided into these types: international mobility including research projects, international collaboration, international contacts, and involvement in international policy.

The **FWO support schemes** for, and involvement into, internationalisation are listed hereunder:

#### *i) International mobility:*

Incoming:

- Odysseus programme: a “brain-gain” programme to attract Flemish and other top researchers from around the world (back) to the universities of the Flemish Community;
- Pegasus Marie Curie Fellowships: attract excellent postdoctoral researchers to Flanders in order to contribute to the advancement of Flemish research. From September 2015 on, the scheme is altered and includes incoming and outgoing possibilities;
- Postdoctoral fellowship: to support (visiting) researchers who have only recently completed their PhD, in developing an independent, international research career.

Outgoing:

- Grants or fellowships: for participation in an international conference, for a short stay abroad, for participation in an international workshop or course, for a long stay abroad, Belgian Historical Institute in Rome, fellowship Japan, Scientific Prize Gustave Boël Sofina.

#### *ii) International collaboration:*

- Exchange agreement: scientific collaboration with other countries through the exchange of researchers via bilateral agreements with academies from: Czechia, China, Romania, Slovakia, Slovenia (Science Foundation);
- Scientific cooperation: agreements with a number of countries for the funding of potential exchange projects, namely with: Japan, Bulgaria, Poland, China, Brazil, Argentina, France, South-Korea, Taiwan, Turkey, Mexico, France-Tournesol, Hungary;
- Bilateral research cooperation: with Brazil, China, Ecuador, Vietnam, South-Africa, Québec (Canada);
- Big Science projects: the “Big Science” programme supports researchers at institutes of the Flemish Community who want to conduct research projects at major international research facilities, the membership for which is paid for by the Belgian Federal or Flemish government. Examples of these include: CERN-CMS and CERN-ISOLDE (Genève), ESRF-DUBBLE (Grenoble), the Mercator telescope (La Palma, Spain), Spiral2 (Caen), and Ice Cube (the Arctic area).

#### *iii) International contacts:*

- International Coordination Action: support for coordination activities of international collaborative associations (= those created in the context of multilateral and supranational entities such as EU, OECD, UN, UN-Unesco, WHO, etc.);
- Organisation of scientific meetings: support for researchers for the organisation of scientific conferences where the international and inter-university dimension is a central element of the programme;

- Scientific Research Network (WOG): support for researchers with the coordination of scientific research networks (= international networks of researchers that encourage national and international cooperation at postdoctoral level).

*iv) European programmes:*

FWO acts as National Contact Point (NCP) in Horizon 2020, as contact point (along with the EWI Department) for COST, participates in joint calls for ERA-Nets, and provides a “top-up” budget for participations (of ongoing FWO projects) into joint calls for Joint Programming Initiatives.

*v) Involvement in international policy:*

The FWO cooperates with its European and international sister organizations in various networks and with other European research organizations or similar institutions; for example, the European Science Foundation (ESF), Science Europe, CECAM and the ECT. At the level of international (policy) collaboration, the FWO has signed so-called lead agency agreements with the Netherlands (NWO), Austria (FWF), Slovenia (ARRS) and G-D of Luxemburg (FNR). This demonstrates a high degree of transnational confidence between the institutes involved.

The FWO (previously Hercules Foundation) supports the participation in ESFRI-initiatives. In 2015, an amount of 7.4 million euro was allocated thereto for ESS, ICOS, SHARE, LifeWatch, AnaEE, EMBRC, DARIAH, INSTRUCT and Eurobioimaging It also follows-up the participation from the Flemish Community into PRACE.

In the field of international innovation, the **AIO** (Flanders Innovation and Entrepreneurship) provides co-funding for participants from Flanders to take part in EUREKA projects. EUREKA is an inter-governmental initiative to promote international cooperation through projects (as well as clusters and “umbrellas”) for applied and market-oriented industrial R&D, based on a bottom-up principle. After a quality check, the projects that are approved receive a EUREKA label. Participants from Flanders in the EUROSTARS innovation programme, which is aimed at innovative cross-border SMEs, are likewise supported by the AIO. The agency is also the NCP (national contact point) for Flanders for supporting applications relating to thematic programmes within Horizon2020, the ERA nets, the INNO nets, EUREKA, and some Joint Technology Initiatives (JTIs). Moreover, the AIO shares best practices with other European agencies in the innovation domain (such as TEKES from Finland or VINNOVA from Sweden) and is involved in various international networks and actions. For example, it is a member of the Association for Technology Implementation in Europe (TAFTIE), which fosters an exchange of best practice between eighteen government agencies supporting innovation in Europe. Another example is FLAG-ERA, the network of funding agencies for the Future and Emerging Technologies Flagships, of which both AIO and FWO are a member.

In the field of international cooperation via the EU Regional Fund, there are a number of ERDF-Interreg initiatives in which STI actors, public authorities and private partners from Flanders jointly support(ed) multi-annual projects. For the period 2007-2013, these included BioBase Europe, Waterstofregio Vlaanderen - Zuid-Nederland (Hydrogen Region Flanders - South Netherlands), NanoSenseEU and Organext, Food2Market, InnoFun (Funding of Innovation), TANDEM, ECO-LASERFACT, GCS, SCINNOPOLI (“Scanning Innovation Policy Impact”), en SPIDER (“Supporting Public Service Innovation using Design in European Regions”), or AMCER (“Advanced Monitoring and Coordination of R&D policies at European level”, within ESPON). For 2014-2020, examples of new Interreg projects with the Netherlands are Hydrogen Network 2.0, CrossRoads2, Link2Innovate and Crosscare. Furthermore, cooperation with the neighbouring regions of North Brabant (the Netherlands) and North Rhine-Westphalia (Germany) takes place within the framework of the ELAt (Eindhoven-Leuven-Aachen triangle). In recent years, collaboration has been extended to the domain of sustainable chemistry.

The Enterprise Europe Network (EEN) for Flanders consists of the AIO (and in the past both the IWT for innovation, and the Enterprise Agency (AO) for entrepreneurship) and the FIT (Flanders Investment and Trade), and provides companies with information about (innovative) internationalization.

The **EWI Department** manages a number of multi-annual agreements and their accompanying budgets to implement action within the framework of the United Nations (UN). These are:

- the **Flanders UNIDO Science Trust Fund for Industrial Biotechnology** (FUSTIB);
- the **Flanders UNESCO Trust Fund** (FUST);
- the **UNU-CRIS** (United Nations University - Centre for Regional Integration Studies).

It also manages the financial support for the European Marine Ocean Data & Information Network (EMODnet) and the IOC-IODE project office (Inter-governmental Oceanographic Commission), both located in Ostend close to the VLIZ.

The EWI Department prepares and monitors the memoranda of understanding (MoU) that are concluded directly between the administrations or ministers charged with R&D and innovation. These include, for example, agreements with Slovenia (2008) and China (2012). During ministerial missions abroad or during the official visits of foreign delegations to the Flemish minister or to public EWI entities, such agreements may be discussed and/or signed officially.

In a number of cases, treaties that include topics relating to scientific research exist or are being prepared between Belgium and another country. These may impinge on either Community or Regional competencies in the field of STI. Whenever it is required, the EWI Department acts as the responsible entity to monitor such agreements, if public or private STI actors from Flanders are the subject of the agreement.

Finally, the EWI Department also acts as a host for foreign visitors. For example, it coordinates the input from the EWI domain and the overall Flemish authority, and is the Flanders' contact point, for the European Commission's annual Fact Finding Mission (FFM) to Belgium in the framework of the European Semester. In 2015, the EWI Department was the Belgian coordinator and the hosting authority for this bilateral Belgium-EC meeting. In 2016, the EC decided to change the meeting procedure. As a result, a meeting took place in the field of R&D and Innovation separately and directly between the EC and Flanders, while for economy, the EWI department was part of the Belgian delegation that met with the EC. Through initiatives as the "Flanders Inspires International Visitors Programme" (FIIVP), the EWI Department presents Flanders' strengths in the fields of economy, science and innovation, and learns from other countries and regions too. The FIIVP has been on-going since 2010 and is inspired by the US "International Visitor Leadership Programme". Its aim is to establish long-term relationships with high-level international opinion makers and decision makers by organising (once or twice a year), a broad multi-sectoral programme, usually focussed on a specific theme. Visitors come from all over the world and represent a region, country, or institution from the EU (or an international organisation). The FIIVP visit of October 2014 focussed on the topic of New Industrial Policy and Innovation, a theme successful in the two previous years with in particular the topics of "renewable energy and biotechnology", "smart specialisation", and "transformation by greening". The EWI Department hosted guests from - among other - Basque Country, Canada, Catalonia, Estonia, South-Africa, and the US. Autumn 2015, the topic of clustering was presented to visitors from Bavaria, Czechia, Hungary, Latvia, South-Africa, and Taiwan. The delegations thereby visit, or are given a presentation of, STI institutes or innovative companies in Flanders such as VLIZ, FlandersBio, VITO, IMEC, UGent, KU Leuven or VIB.

#### b) IV (Internationaal Vlaanderen) policy domain

The IV Department (Flanders department of Foreign Affairs) is the responsible administration for bilateral treaties, agreements and declarations of intent, as well as the framework agreements of the Flemish Community. At overall governmental level, Flanders (meaning the Flemish Community, the Flemish Region, or both jointly) has concluded many bilateral treaties over the years with foreign regions or countries. These general treaties are often elaborated through multi-annual working programmes that cover various policy domains, one of which is scientific research and innovation. Consequently, the treaties foresee collaboration between EWI actors and one or more of their foreign counterparts. These agreements are managed by the Flanders Department of Foreign Affairs, of the IV policy domain. The current active agreements include those with Estonia, Latvia, Russia, South Africa, Rumania, Lithuania, Croatia, Slovenia, Hungary, Bulgaria, North Rhine-Westphalia (Germany), Catalonia (Spain) and the German-speaking Community (Belgium). A number of other agreements are currently being negotiated and various meetings are taking place with other regions and countries. Previously, general agreements were concluded in the field of R&D&I between Flanders and various non-European partners; for example, with Israel for cooperation in R&D in industry (2000) or with Alberta (Canada) for scientific and technological cooperation (1990).

Since 2011, the minister-president of Flanders has offered Flemish STI actors (universities, university colleges, research organizations, other knowledge institutes, etc.) the possibility to participate in his official missions abroad, based on the so-called “academic diplomacy” principle. During these missions, the opportunity sometimes arises to conclude general or specific cooperation agreements with actors from the region or country being visited. Examples of this include the mission to Québec (Canada), during which a project agreement was signed between KU Leuven and McGill University (Montréal), and a visit to China (with the universities of Antwerp, Brussels, Ghent and Leuven among the delegates), during which the VITO concluded cooperation agreements with two Chinese partners. The new governing agreement for the period 2014-2019 puts even greater emphasis on both academic diplomacy and economic diplomacy.

Another important actor in the IV policy domain is the agency known as Flanders Investment and Trade (FIT). FIT has appointed since 2007 a number of technological attachés to focus on future-oriented, innovative and technological fields of development, specifically in growth markets outside Europe. Each attaché is active in a number of technological sectors that are most relevant and offer opportunities for the region concerned: Los Angeles (US): ICT; New York (US): biotechnology and life sciences; Tokyo (Japan): biotechnology and nanotechnology and life sciences; Singapore: clean technology, mechatronics and ICT.

Flemish STI actors (universities, innovative companies, knowledge institutes) can also participate in Belgian economic missions or other official missions (e.g. State visits) that take place all over the world. These missions can be led by the King of the Belgians, the Belgian Foreign Affairs Minister, or a Belgian prince or princess. Examples include missions to China and South Africa. Conversely, official visits of foreign head of state, prime ministers, ministers or other officials to Belgium may also lead to cooperation with Belgian (including Flemish) actors in the field of research, or signing of agreements at the public level or bilaterally among STI actors. This was the case, for example, during the visit of the President of India to Brussel in 2013 during which a number of MoUs were signed between the key Belgian universities and their Indian counterparts, such as the JNU, the University of Delhi and the University of Hyderabad, to collaborate on improving India’s research capabilities in cutting-edge areas such as molecular biology.

### c) VLEVA

The aim of the Flanders-Europe Liaison Agency (VLEVA) is to provide greater visibility for Flanders in Europe (the EU) and to emphasize the importance of Europe for Flanders. In particular, VLEVA monitors the calls from various EU initiatives, in order to provide maximal information on opportunities for EU programme participation for actors from Flanders. To this end, VLEVA cooperates with the AAVR (Office of the General Representative of the Government of Flanders to the EU within the Permanent Representation of Belgium to the EU), but it cannot express any formal point of view, since this is the domain of the permanent representation and the administrations in charge. The AAVR is therefore the “front office” that closely follows up the European dossiers and reports on recent EU developments, in order to draft an official Flemish point of view. To make this possible, it interacts with the respective administrations (the “back offices”) and the EU cabinets that are responsible for the content.

## 7.3 Participation in EU and international programmes, networks and initiatives

Flanders needs to adjust its priorities in the field of R&D and innovation to coincide as much as possible with the priorities defined at the EU-level regarding the grand challenges, the European Research Area, the Europe 2020 strategy and Horizon 2020 / COSME programmes. Such goals can be achieved by striving towards excellence, increasing budgets, facilitating researcher mobility and participating in EU and international cooperation programmes and networks. This is particularly relevant for the future well-being of Flanders, given its open economy (with an export-to-GDP ratio of almost 100%) and the high proportion of international companies active in R&D. In addition to funding from the Flemish and the federal authorities, research actors also receive important amounts from various EU programmes (mainly Horizon 2020 and, to some extent, COSME and ERDF).

Researchers can participate in the previously mentioned international or bilateral programmes and initiatives (see part 7.2 of this chapter), for which purpose the Flemish and/or federal authorities have set up support channels or assured formal access (for example, the European Space Observatory, CERN). Institutes and companies from Flanders are likewise active in the long-standing international research initiatives known as COST and EUREKA (including Eurostars). For example, experts from organizations in Flanders participate in more than 230 COST actions of the 340 on-going actions, while the AIO each year provides support for about a dozen companies active in EUREKA initiatives. The AIO has also opened up its business support programmes for (innovative) international cooperation projects and provides budgets to foreign partners participating with Flemish companies in a consortium.

A major focus for attention - and a major source of R&D budget – lies at the EU level; namely, the participation in the EU’s Horizon 2020 programme (until 2013: Framework Programmes for Research and Technological Development (FP on RTD)) for the promotion of competitive and excellent research. Framework programmes (FPs) have been the main financial tool through which the European Union supports research and technological development activities in almost every scientific discipline.

### 7.3.1 EU Framework Programme for Research and Technological Development (FP for RTD), Horizon 2020, and the EU Competitiveness and Innovation Programme (CIP)

FPs for RTD have been implemented since 1984 and cover a period of several years, with the last year of one FP overlapping with the first year of the next one. Since 2014, Horizon 2020 and COSME are the follow-up programmes of FP7, CIP, and EIT. The participation data (status at October 2014) on the FP7 programme show that actors in Flanders are participating strongly. With a financial return of 2.50%, Flanders is scoring above the expected level (also see chapter 2.7). The percentages for FP6 and FP5 were 2.12% and 2.19%



respectively. Regarding FP7, Flanders participated in total with 490 participants some 2,884 times into 2,232 projects, which generated approximately 1,125 million euro during the whole period or about 160 million per annum. KU Leuven is the strongest Flemish (and Belgian) participant, and the only Belgian university in the top-10 of academic participants. Behind the KU Leuven, the UGent and IMEC complete the top-3 of Belgian participants and together they represent 483 million euro, which is more than 40% of the total FP7 contribution to Belgium. In total, 7 Flemish knowledge institutes rank in the Belgian top-10: KU Leuven, UGent, IMEC, VIB, UA, VUB and VITO in decreasing order. The top-5 of countries with who Flemish actors cooperated in FP7 consist of Germany, the UK, France, Italy, and the Netherlands (Belgian partners/authorities rank 9<sup>th</sup>), whereas the top-5 regions consists of Ile-de-France, Bavaria, Baden-Württemberg, North-Rhine Westphalia, and Comunidad de Madrid (the Brussels Capital Region is 7<sup>th</sup>).

The first results of the participation on the Horizon 2020 programme for 2014-2020 demonstrate again a very successful participation from behalf of actors in Flanders. KU Leuven and UGent rank in the top-50 of the participations from higher education institutes, whereas Imec, iMinds, VITO and VIB rank in the top-50 of all participations from research centres. More details are in Chapter 2, section 7.

Evidence of the allocated budget for the participation in the CIP, the EU's Competitiveness and Innovation Programme 2007-2013, shows that about 47 million euro went towards various actors from Flanders, including the Enterprise Europe Network Vlaanderen. This represents 3% of all the EU's CIP-allocations towards EU member states for the period 2007-2013.

### 7.3.2 EU Regional Policy

Some EU support for R&D and innovation is also granted through the ERDF and INTERREG programmes of the EU Regional Policy Funds. Under the latter, cross-border cooperation is set up in specific areas with research actors from neighbouring regions and countries. Examples from the 2007-2013 period were BioBase Europe, NanoSensEU, Photovoltaic, Waterstofregio (Hydrogen Region), and Organext.

In the new multi-annual programming period 2014-2020, Flanders is entitled to a budget of 345.5 million euros from the ERDF, of which 173.5 million euros is allocated to initiatives within Flanders and 172 million euros is foreseen for actions in the various Interreg programmes (Flanders - The Netherlands, Euregio Meuse-Rhine, Flanders – Wallonia - France, Two Seas, North-West Europe, etc.). The budget for R&D and innovation stemming from the ERDF budget in the ESIF (European Structural and Investment Fund) amounts to 138.2 million euros (note: this figure is based on the assumption that 40% of the total ERDF budget will be focussed on innovation and on the budgets allocated in the Objective2 and Objective3 Programmes for innovation topics). A new focus for policy initiatives and budget allocations for which the EU will use for the ERDF budget from 2014 onwards is smart specialisation strategy.

In particular, Flanders has developed an intensive cooperation with the Netherlands in the field of STI and this country is a priority partner. Cooperation examples include the FP projects in which both sides participate, the Holst Centre (Leuven and Eindhoven; IMEC and TNO), the ELAt (Eindhoven-Leuven-Aachen triangle) and a number of important EU Interreg projects such as BioBase Europe and Hydrogen Region.

### 7.3.3 EU initiatives that are inter-governmental and complementary to the topics and initiatives in the EU programmes for R&D and innovation

Since 2007, various variable geometry initiatives have been set up at the EU level, whereby certain countries can participate in research complementary to the EU-FP/Horizon2020 themes. These are all initiatives to strive towards the accomplishment of an ERA, European Research Area. In several cases, actors from Flanders have joined in these projects and have occasionally received public support (from the EWI Department, the AIO (previously IWT) or the FWO (previously also the Hercules Foundation). The initiatives in which research actors participate or that are followed-up are these:

- **JTI (Joint Technology Initiatives):** Clean Sky 2, AAL;
- **JU (Joint Undertakings):** IMI2, Fuel Cells and Hydrogen 2, ECSEL (previously ENIAC and ARTEMIS), BBI (BioBased Industries), Eurostars;
- **JPI (Joint Programming Initiatives):** Neurodegenerative Disease Research (JPND - Alzheimer), Cultural Heritage and Global Change, A Healthy Diet for a Healthy Life (HDHL), More Years, Better Lives (demographic change), Antimicrobial Resistance (AMR), Oceans, etc.);
- **ESFRI (European Strategy Forum on Research Infrastructures):** support to participate in the European Social Survey (ESS), the Survey of Health, Ageing and Retirement in Europe (SHARE), the Integrated Carbon Observation System (ICOS), LIFEWATCH (biodiversity), and PRACE (Partnership for Advanced Computing in Europe). AnaEE (Analysis and Experimentation on Ecosystems) and the preparatory phase of the ESFRI initiatives Eurobiomaging, EMBRC (European Marine Biological Resource Centre), DARIAH (Digital Research Infrastructure for the Arts and Humanities) and INSTRUCT (Integrated Structural Biology Infrastructure for Europe). ELIXIR (A distributed infrastructure for life-science information).
- **COST (European Cooperation in Science and Technology):** Flemish knowledge actors are involved in 230 of the 340 on-going actions;
- **EUREKA:** companies (as well as business-oriented organisations such as collective research centres) from Flanders are / were participating in many initiatives from EUREKA, including 4 EUREKA clusters (CATRENE, ITEA 3, EURIPIDES, CELTIC) and access to 3 EUREKA umbrellas (ENIWEF, FACTORY and EULASNET);
- **Big Science (CERN, ESRF,...):** participation from Flanders in CERN-CMS and, CERN-ISOLDE (European Organization for Nuclear Research, located in Geneva), ESRF-DUBBLE (European Synchrotron Radiation Facility, located at Grenoble), Mercator telescope (La Palma), Spiral 2 (Caen), Ice Cube (Antarctic), with an outlay of 3.37 million euro from FWO (2015);
- **ESO (European Southern Observatory,** located in La Palma (Spain) and the Atacama desert (Chili)): Flemish researchers are active in projects;.
- **ESA (European Space Agency):** Belgium has always been committed to space research as an active member of ESA. Therefore Flemish research groups and industry participate actively in ESA programmes. An ESA Business and Innovation Centre has been located in Flanders (Geel) since 2012;
- **EMBO/EMBL (European Molecular Biotechnology Organisation/Laboratory,** located in Heidelberg): Flemish research groups from the universities and the strategic research centre VIB are involved in its actions in the domain of molecular biotechnology;
- Related to the FP on RTD and Horizon 2020:
  - many **ERA-nets as well as ERA-net co-funds** (20 in total) in which Flanders was / is active, with Dep EWI, FWO and AIO (and certain other departments) acting as the partner and various organisations as participants in the network e.g. universities, strategic research centres, scientific institutes, companies;
  - **ERC-grants:** 126 participations in FP7 on RTD and to date 45 participations in Horizon 2020;
  - **Marie-Curie grants:** 403 participations in FP7 on RTD and to date 190 participations in Horizon 2020;

- **EIT-KICs (European Institute of Technology - Knowledge Innovation Communities)**, with in each case the participants / partners from Flanders that are involved:
  - a. KIC InnoEnergy: Eandis, KU Leuven, VITO. Genk hosts the co-location centre for the KIC InnoEnergy Benelux;
  - b. Digital (previously known as ICT Labs): IMEC, iMinds;
  - c. Raw Materials: KU Leuven, UGent, Umicore, VITO, CRM Group, IMEC, JM Recycling nv, Ocas NV. Leuven will host the Western Co-location Centre on the KIC Raw Materials;
  - d. Health (consortium Innolife): KU Leuven, UGent, iMinds, IMEC, Barco, Gimv;
  - e. Food4Future (KIC-call 2016): on-going contacts among stakeholders in Flanders;
  - f. Added-value Manufacturing (KIC-call 2016): intended participation of Flanders' Make.
- **EIP (European Innovation Partnerships)**:
  - o Raw Materials: Flemish authority takes part in the sherpa group;
  - o Smart Cities and Communities, Water: stakeholders' participation.
- **FET (Future and Emerging Technologies) Flagships**:
  - o Graphene: IMEC;
  - o Human Brain: UGent, KU Leuven;
  - o FLAGERA: FWO and AIO (previously IWT) are member.
- **Runner-up FET flagship pilots**:
  - o Guardian Angel: IMEC, KU Leuven, NXP Semiconductors;
  - o ROBOCOM (Robot Companions for Citizens): VUB, UA, KU Leuven.
- **SET Plan**: follow-up of the European Industrial Initiatives (EIIs) in the various themes (wind, solar, electricity grids, bio-energy, smart cities).

The formal decision of accession/adhesion for a set of new ESFRI-ERIC initiatives is still pending. In other related EU initiatives to stimulate the European Research Area, Flemish actors are involved or are following up the state of play; as is the case, for example, with the EU Innovation Partnerships for Active and Healthy Ageing (AHA), Agricultural Productivity and Sustainability (AGRI), as well as the ETP (European Technology Platforms) and the KETs (Key Enabling Technologies). With regard to the KETs, a call was launched in 2013 for the possible participation of Flemish actors, which resulted in five roadmap exercises; namely, in the fields of micro-electronics, photonics, factories of the future, materials and industrial biotechnology. In the Vanguard Initiative, Flanders takes part in the pilot line "High Performance Production with 3D Printing" in 4 cases and leads the 3DP smart bike case (see further in 8.2, Chapter 1.).

Occasionally, one-off budgets are available for initiatives that stimulate internationalization in a broad sense and build on existing strengths in specific fields or with certain foreign entities.

The table hereunder provides for the field of internationalisation of R&D and innovation, an overview of the different responsibilities and types of involvements from the 3 EWI actors (the EWI Department, FWO, AIO).

Figure 7: Overview of the different responsibilities and types of involvements from the 3 EWI actors

Policy-related	Dep EWI	FWO	AIO		Dep EWI	FWO	AIO
ERAC, EPG / EC	+			STI bilateral cooperation	+	+	+
CSTP, CIIE /OECD	+			STI multilateral cooperation	+	+	
(WG) Council EU	+			STI inter-governmental cooperation	+	+	
NCP, National Contact Point		H2020	H2020, Interreg	VLA international cooperation incl. a part on STI	+		
PC, Programme Committee delegate	H2020, COSME			JRC, Eureka, COST		+	+
Policy projects e.g. ERA, OMC, R4R	+	+	+	Various internat. policy networks (e.g. ESF, Taftie)	+	+	+
ERDF Mgt authority			calls, RIS3	ERRIN	+	+	+
Reports, positions to FED, EC, OECD, CoR, AGS, EU Semester	+			JPI, JTI, JU, EIP, KET, ESFRI, EIT-KIC,.... follow-up / budget	+	+	+
E.E.N. Vlaanderen			+	Vanguard Initiative	+		+

Note: participation in the EU Council WG takes place by way of an EWI department staff member who is detached to the AAVR, the Office of the General Representative of the Government of Flanders to the EU within the Permanent Representation of Belgium to the EU.

## 8 Smart Specialisation in Flanders

### 8.1 More targeted approach in policy design

Structural change and economic transformation have been on the policy agenda for a decade. In 2005, the Flemish Government launched a discussion on a “new business plan for Flanders” as a consequence of increasing pressure on the competitiveness position, resulting in accelerating de-industrialisation (in electronics, automotive and several other branches) while not enough new innovative branches could take the relief. In 2006, the VRWI (Flemish Science and Innovation Council) conducted a SWOT analysis of the scientific and technological potential of Flanders in comparison with the EU (assessing the scientific, technological, innovative and economic characteristics of the Flemish region), combined with a European foresight study of 15 key areas. By means of a wide expert consultation, **six thematic clusters** were identified that would be prioritised for further STI support by “spearhead initiatives”. These clusters were:

- logis-tech (transport, logistics, services and supply management);
- i-health-tech (ICT and services in health);
- medi-tech (Healthcare, food, prevention and treatment);
- nano-tech (new materials, nanotechnology, manufacturing industry);
- socio-tech (ICT for socio-economic innovation); eco-tech (energy and environment for services and industry).

The initiatives were intended to strengthen research and innovation base in domains with economic potential to initiate breakthroughs. Therefore the focus was mainly technology-driven and the thematic domains were very broadly defined.

In the course of 2012-2013, the VRWI conducted a **foresight study** with a time horizon up to 2025. This study -building on its 2006 foresight study- aimed at establishing scientific, technological and innovation priorities to help address grand societal challenges, such as energy, mobility, ageing population, health, environment and climate change. An inventory was made of both (1) national and international societal trends and (2) trends with regard to Science, Technology and Innovation (STI). Subsequently, a matching exercise was performed on the basis of a foresight workshop to link (1) and (2), resulting in a model with different areas of transition. Running parallel with this, a strengths/weaknesses analysis of the current situation in Flanders was performed with regard to scientific research, technological development, innovation, economic activity and societal developments. On the basis of the results of the transition areas and the strengths/weakness analysis, a steering committee including Captains of Industry and Captains of Society set **seven priority transition areas** for Flanders.

Consequently, this resulted in a transition model consisting of:

- one horizontal transition area: Society 2.0;
- six vertical transition areas: (a) E-Society, (b) Food, (c) Health - Well-being, (d) Smart Resources Management & Manufacturing Industries, (e) Urban Planning, Mobility Dynamics & Logistics, (f) New Energy Demand and Delivery.

Smart specialisation was adopted by the Flemish Government as a guiding strategic policy principle for innovation and industrial policies in the Concept Note “**Smart Specialisation Strategy** for a Targeted Cluster Policy” of 8 March 2013. The policy note of the EWI Department “Strategic framework for Smart Specialisation in Flanders” (December 2014) described the policy process towards the designation of prioritised areas in the evolving innovation and transformation strategy of Flanders. It provides an overview of the specialisation structure in Flanders, the policy evolution, the policy design, the policy discovery process and

the strategic focusing process for smart specialisation. Given its intertwining with initiatives/organisations of R&D and innovation, some of these findings are relevant in this context. The 2014-2019 new governing agreement calls for a cluster policy as the lever to deal with the innovation paradox in Flanders and focus more on marketisation of innovation. The policy note 2014-2019 for Work, Economy, Science and Innovation mentions cluster as a cooperation whereby actors from the triple helix engage to develop innovative value chains in specific domains. As a result, the Flemish Government approved July 2015 a Concept Note on a **Cluster policy**. By way of strategic cooperation networks, companies and knowledge institutes should set up projects, and add an international dimension. The aim is to unlock unused economic potential and to increase of competitiveness among Flemish companies through an active and continuous cooperation of actors, to contribute to a solution for societal challenges with an economic added value for companies. In 2015-2016 further steps were taken towards the elaboration of 2 types of clusters to be developed as a result of these intentions: (large-scaled) **spearhead clusters** and (smaller-scaled) **innovative enterprise networks** (see further details in 5.4 of Chapter 1). These are all steps in the development of a more focused demand-driven approach.

## 8.2 Smart specialisation spearhead domains in the EU context

In 2012, following the Communication 'Regional Policy contributing to smart growth in Europe 2020', the EC set up its **S3 Platform** to assist EU countries and regions to develop, implement and review their Research and Innovation Strategies for Smart Specialisation (RIS3). The EC's Joint Research Centre maps the profiles forwarded by various authorities in Europe. In total, the Flanders' profile consists of seventeen priorities that are part of a smaller group of specialisation domains. These focus on various target markets (e.g. "Manufacturing & industry"; "Computer, electronic & optical products"), correspond with different capabilities (e.g. "manufacturing and industry; "Energy production & distribution"), and are in line with the major EU priorities such as the KETs, Digital Agenda etc. The complete overview of all priorities and corresponding targets and capabilities for Flanders is available online at the S3 platform <http://s3platform.jrc.ec.europa.eu/regions/be2>. Examples of the Flemish specialisations include:

- "Micro- and nano-electronics and embedded systems, mechatronics (part of 'Smart systems' smart specialisation domain");
- "Pharmaceutical applications of biotechnology, with focus on clinical trials, neuro-degenerative and infectious diseases, molecular diagnostics, and nanotechnology for medical applications (part of 'Sustainable chemistry' smart specialisation domain");
- "Sustainable energy technologies with focus on hydrogen, wind energy and electrical vehicles (part of 'Sustainable living' smart specialisation domain");
- "Specialised industrial value chains and logistical services for food, pharmaceuticals, recycling, offshore maintenance (part of 'Value-added logistics' specialisation domain)".

In 2013, the European Commission conferred the EU member-states to include in their Operational Plans 2014-2020 for the European Structural and Investment Funds (ESIF) a number of specialisation domains, to become focus of a "**Smart Specialisation Strategy**" or **S3**. These domains would be the focus of initiatives and budgetary allocations for the European Regional Development Fund (ERDF). Based on the analysis of comparative economic/technological advantages and responding to policy developments in recent years in the field of an oriented innovation policy, Flanders identified eight spearhead domains with a potential for a smart specialisation strategy. These domains are also important for societal challenges.

They will be the focus of strengthening of R&D and promotion of transformation of knowledge into economic and societal valorisation. These are (Source: The strategic policy framework for smart specialisation in Flanders; policy note of the Department Economy, Science and Innovation (rev. 12/2014)):

- a) **Sustainable chemistry:** cluster domain for the transition in the chemical industry, connected to clusters in plastics, sustainable construction or technical textiles. Innovation will drive new bio-based value chains (enabled by advances in materials sciences, industrial biotechnology). FISCH is a possible model for establishing a spearhead cluster for smart specialisations;
- b) **Specialised manufacturing solutions:** cluster domain for customized production in ‘factories for the future’ ( e.g. niches in specialized components, intelligent textiles, new materials, graphics, urban mining) that emerge thanks to new business models (e.g. for open manufacturing, value-added logistics, recycling of materials and energy efficiency) and new production technologies (such as mechatronics, 3D printing). The new strategic research centre, Flanders’ Make, will be supportive for the modernization of manufacturing;
- c) **Personalised cure and care:** cluster domain connected to a well-developed health system, an ecosystem for clinical trials and a strong pharmaceutical industry, with specific focus domains such as neuro-degenerative diseases and infectious diseases, and new opportunities in molecular diagnostics and other medical technologies. This value-chain is supported by VIB, CMI, Flanders Care;
- d) **Value-added logistics:** cluster domain with strong connections to specialised industrial value chains in food (frozen products, meat, chocolate) or pharmaceuticals, and providing specialized services, e.g. for recycling (reverse logistics, urban mining) or the off-shore cluster (maintenance);
- e) **Specialised agro-food:** cluster domain with diverse value chains in meat, vegetables, fruits that are capitalising on values such as life quality (health and experiences) and the reduction of food waste as competitive advantages;
- f) **Integrated building-environment-energy cluster:** cluster domain seeking affordable solutions and new ways of housing in smart and sustainable cities (including smart grids and utilities).
- g) **New ICT-platforms:** cluster domain for hardware and software developments (including embedded systems, based on micro-electronics and photonics) for smart systems and services (including mobile applications, internet of things, e-health or digital media, which are enabling the ecosystems that produce smart specialisations), often in new product-service combinations; also crucial for increasing productivity of service sectors (including public services). This domain is supported by strategic research centres such as IMEC and iMinds.

The efforts within this smart specialisation strategy will specifically be oriented on the elaboration of the missing links in the Flemish innovation instruments; namely, living laboratories and demonstration projects that contribute to the stimulation of product development and to the market introduction/dissemination of innovative products and services. The challenge for the smart specialisation strategy in Flanders is to specialisations in unique combinations of Flemish strengths, e.g. cross-fertilisation between nanotechnology and health sector for the emerging industry of molecular diagnostics in personalised medicine (Nano4Health). The knowledge base in informatics (iMinds) or material research (VITO) are also important fertilizers of new activities, such as applications for mobile services or recycling. Thereby, the challenge is to find the possible linkages and mutual strengthening of scientific, technological and economic specialisations.

An important initiative in the development of a more focused demand-driven approach is the so-called “**Vanguard Initiative**”, that was initiated at the end of 2013 by Flanders. The “Vanguard Initiative for new growth through smart specialisation” is a platform of European regions that strive to be frontrunners in applying “smart specialisation” as a strategic principle in the EU innovation and industrial policy to promote new growth by a bottom-up dynamics stemming from the regions. The EWI Department acts as the secretariat for the initiative. Among these regions are for example Baden-Württemberg, the Basque Country,



Lombardy, North-Rhine Westphalia, Rhône-Alpes, Catalonia, and Scotland. As a result, a number of EU regions are engaged into interregional cooperation based on clustering and the principle of smart specialisation. The purpose is to contribute to the European agenda of industrial transformation by innovation, as well as set up networks among regions in a number of domains. The cooperation of the regions also aims at generating an evidence base to support the Commission in the development of Smart Specialisation Platforms in key growth areas. The first area of exploration has been Advanced Manufacturing. In “leading by example” these regions established 3 pilot lines of activity where the Vanguard Initiative seeks to develop pan-EU projects of scale, joining efforts with regions who share similar ambitions. Flanders takes part in the pilot line “High Performance Production with 3D Printing” aimed at developing a European demonstration and piloting network. It is part of 4 cases and leads one of these, namely 3DP smart bike.

# Chapter 2

## Funding of R&D



# 1 Introduction

At the European Summit in Barcelona (March 2002), the Heads of State or Government decided on the objective of increasing total R&D expenditure (GERD) to 3% of GDP (gross domestic product) in the EU (the “3 % objective”) by the year 2010. As an additional objective, they decided that one-third of R&D expenditure should be publicly funded, with the other two-thirds coming from the business community. This target was one of the headlines of the Lisbon Strategy from 2000. Flanders translated this objective within the Flemish context through the so-called Innovation Pact. This pact was signed in March 2003, and it contains a formal engagement by all the actors involved in the Flemish research and innovation landscape to jointly reach this 3% objective by means of complementary efforts.

In 2009, the Flemish Government and the Flemish social partners took the initiative to conclude the “Pact 2020”, which specifies and implements the broader societal objectives of the Flanders in Action (ViA) plan that was concluded in 2006. ViA was replaced in 2015 by the Visie 2050 plan (a long term strategy for Flanders). The importance of STI is reflected by the Pact 2020 target to spend 3% of GDP on R&D, in accordance with the EU 2020 Strategy. The Pact 2020 contains twenty thematic chapters with concrete targets and actions to be achieved by 2020, which are monitored on an annual basis. The specific targets include:

- innovation will be more widely and better distributed across all industries, business types and segments of society;
- an increase of turnover from new or improved products and services;
- a year-on-year increase of the number of patent applications;
- to be among the EU’s top-5 regions for public spending on eco-innovation.

## 2 GERD

In 2014, Flanders spent over 5,738 million euros on R&D (GERD). Two-thirds of the research cost was paid by companies (the Business Enterprise Sector or BES) and one-third by public research institutes (PNP, GOV en HES). The R&D effort for Flanders represented almost two-thirds of the GERD for the whole of Belgium in 2013.

The R&D intensity (measured as the percentage of GERD related to GDP) of Flanders was 2.46% in 2014 (compared to 2.33% in 2011 and 2.53% in 2012 and 2.55% in 2013). Flanders ranks higher than the Netherlands, France and the EU-28 average, yet much lower than the USA, Germany, Japan, Korea and the Scandinavian top countries for the total R&D intensity of GERD in 2014.

When the total R&D intensity of the GERD (2.55% for 2013) is broken down by source of funding, 1.79% comes from private funds and 0.77% from public funds (federal, regional, community, European and international funds), which equates to 70% and 30% by private and public sectors respectively.

Figure 8: Evolution of total R&D spending (GERD) and the R&D intensity of the GERD in Flanders from 2009 to 2014, in million euros (current prices)

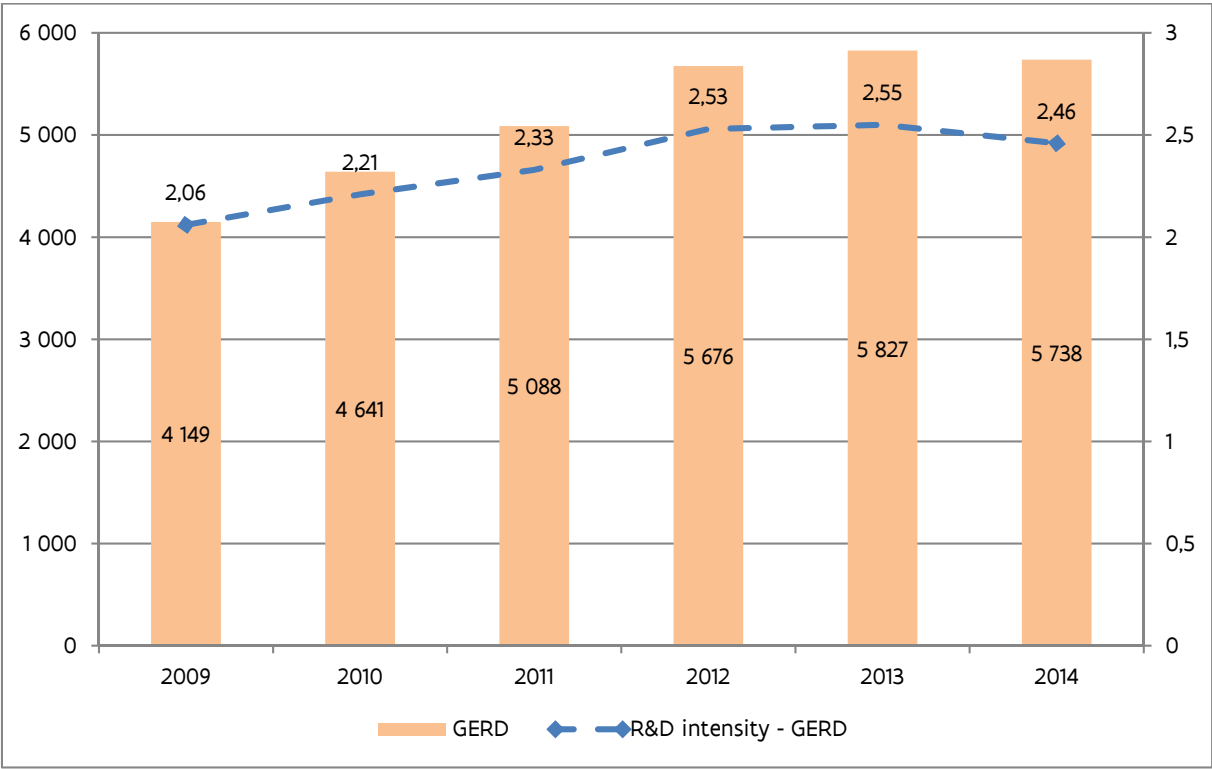
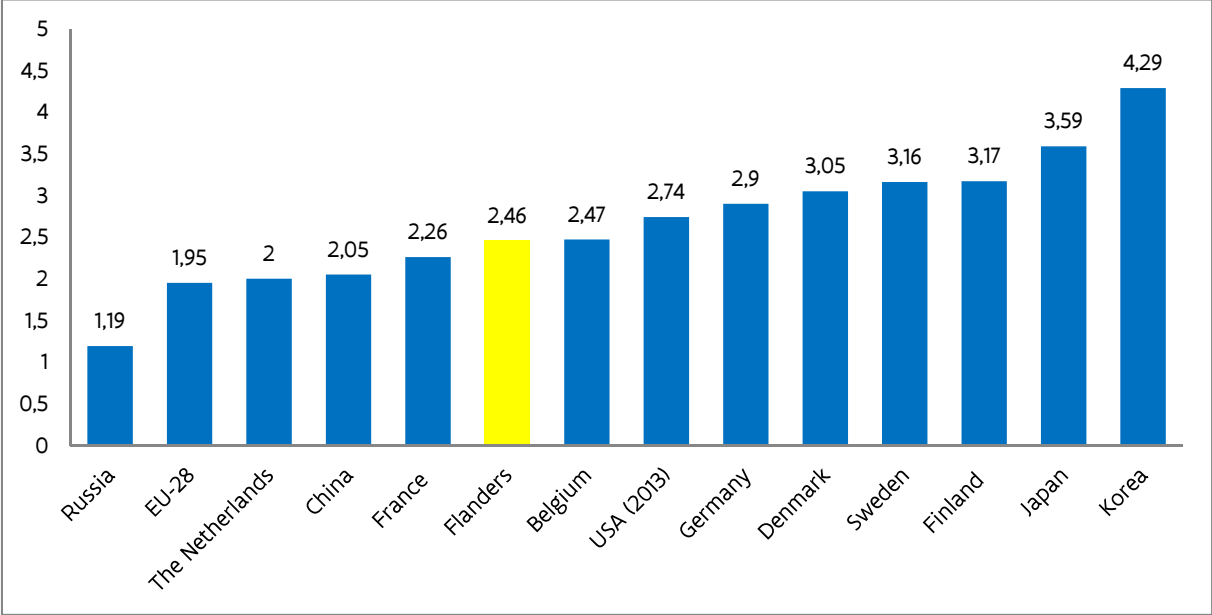


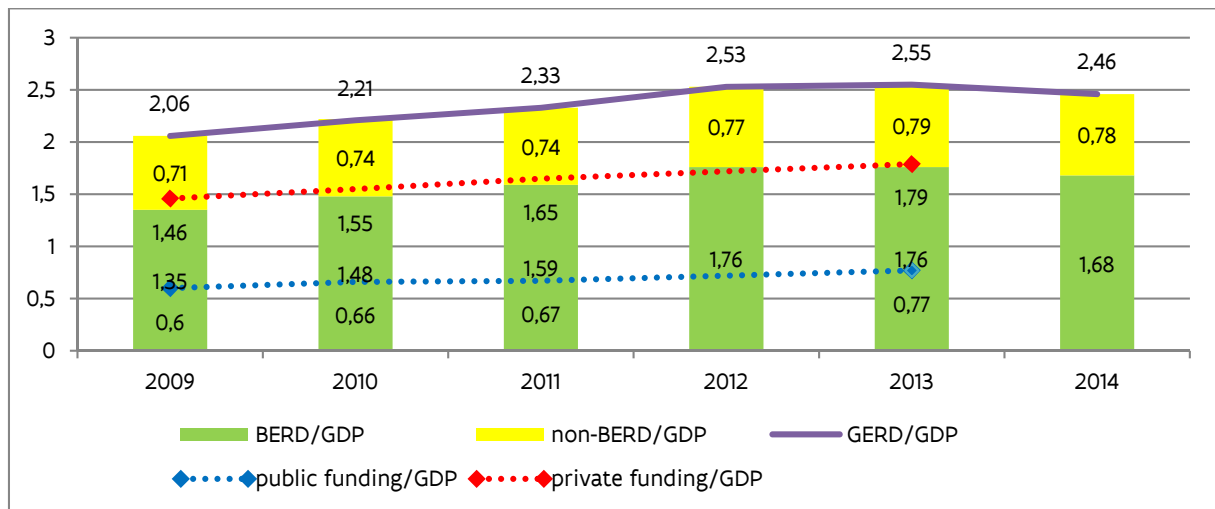
Figure 9: International comparison of the R&D intensity of GERD for 2014



Source: OECD database, Main Science and Technology Indicators

Denmark: national estimate; Sweden, France and Belgium: provisional figure; USA: provisional and excludes most or all capital expenditure; Japan, Russia and Korea: based on National Accounts; EU-28.

Figure 10: R&D intensity broken down by sector of performance or source of funds for Flanders, 2009-2014



### 3 BERD

In 2014, the business enterprise sector spent 3,92 1million euros on R&D activities in Flanders, measured at current prices. This is the Business Expenditure on R&D (BERD), which corresponds to a R&D intensity (BERD as a % of GDP) of 1.68%. This level represents a decrease for the GERD compared to 2013 and 2012( both 1.76%) When the total R&D intensity of the BERD is broken down by source of funding, 1.59% comes from private funds and 0.17% from public funds (2013). The share of the BERD in the GERD was 68% in 2014.

Figure 11: Evolution of the R&D spending by companies (BERD) and R&D intensity for the BERD, from 2009 to 2014, in million euros (current prices)

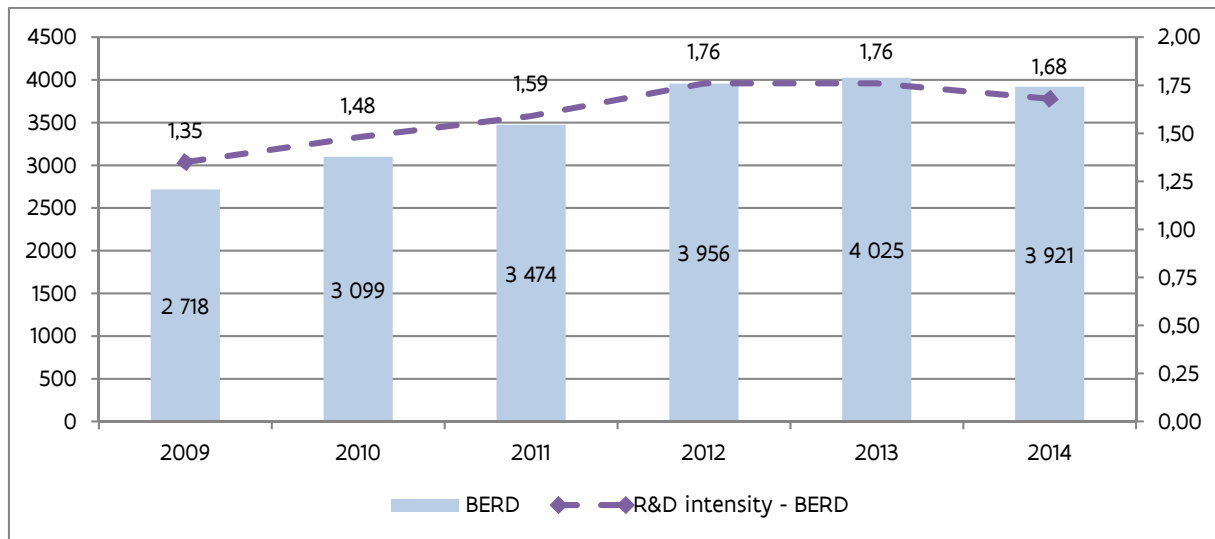
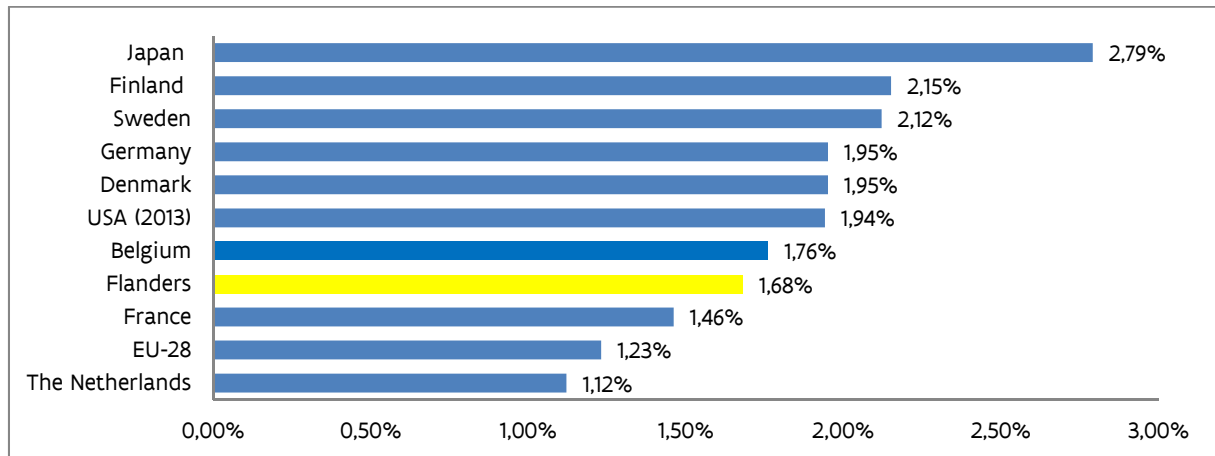


Figure 12: International comparison of the R & D intensity of BERD for 2014



Source: OECD database, Main Science and Technology Indicators

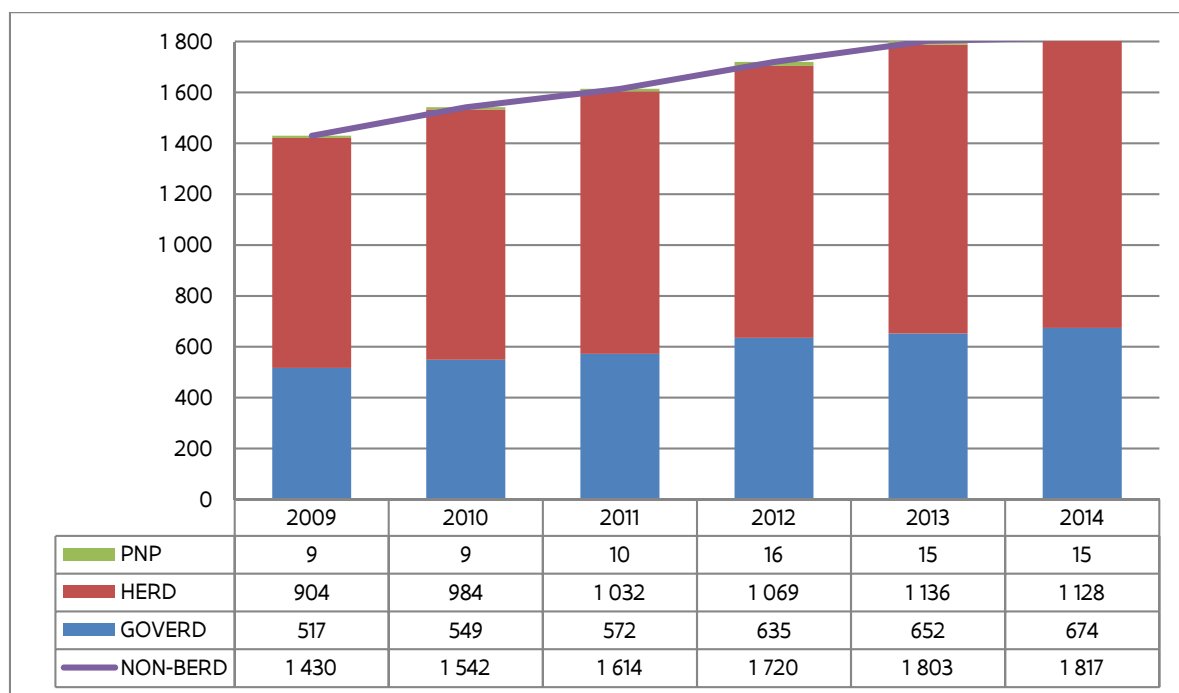
Sweden, France and Belgium: provisional figure; EU-28: secretariat estimate; USA: provisional and excludes most or all capital expenditure; Denmark: national estimate or projection; Japan: based on National Accounts

The R&D activities (expenditure) within companies in Flanders are mainly focused on the following high-tech sectors (2013): chemicals and pharmaceuticals (NACE 20-21) account for more than 34% of total BERD expenditure on R&D (based on a sample); information technology, electronic products, optical products and electrical equipment (NACE 26-27) account for about 15%; machinery and transport (NACE 28-30) account for more than 14.5% and motion picture, video and TV production, computer programmes, engineering, and technical testing and analysis activities (NACE 59-63, and 71) account for 12%. In 2013, the R&D intensity in the business sector was 1.68%. Flanders therefore ranks higher than the EU-28 average, France and the Netherlands, but much lower than the Scandinavian countries, Germany, the USA and Japan.

## 4 Non-BERD

The share of R&D spending by the public sector within total R&D spending decreased between 2009 and 2012, but a slight recovery was noted for 2013 and 2014. R&D spending by the public sector (non-BERD = GOVERD + HERD + PNP) amounted to 1,817 million euros in 2014. About 36% of this amount was spent by public research institutes (GOV) and nearly 63% by higher education institutions (HES). There is still a slight increase in the R&D expenditure (in absolute terms) of the public sector in 2014, while the private sector noticed a small decrease. The R&D intensity for the public sector (non-BERD as a % of GDP) in Flanders amounted to 0.78% in 2014, a stagnation compared to 2013 after a steady increase since 2009. When the total R&D intensity of the non-BERD is broken down by source of funds, 0.20% is funded privately and 0.59% by public funds (2013).

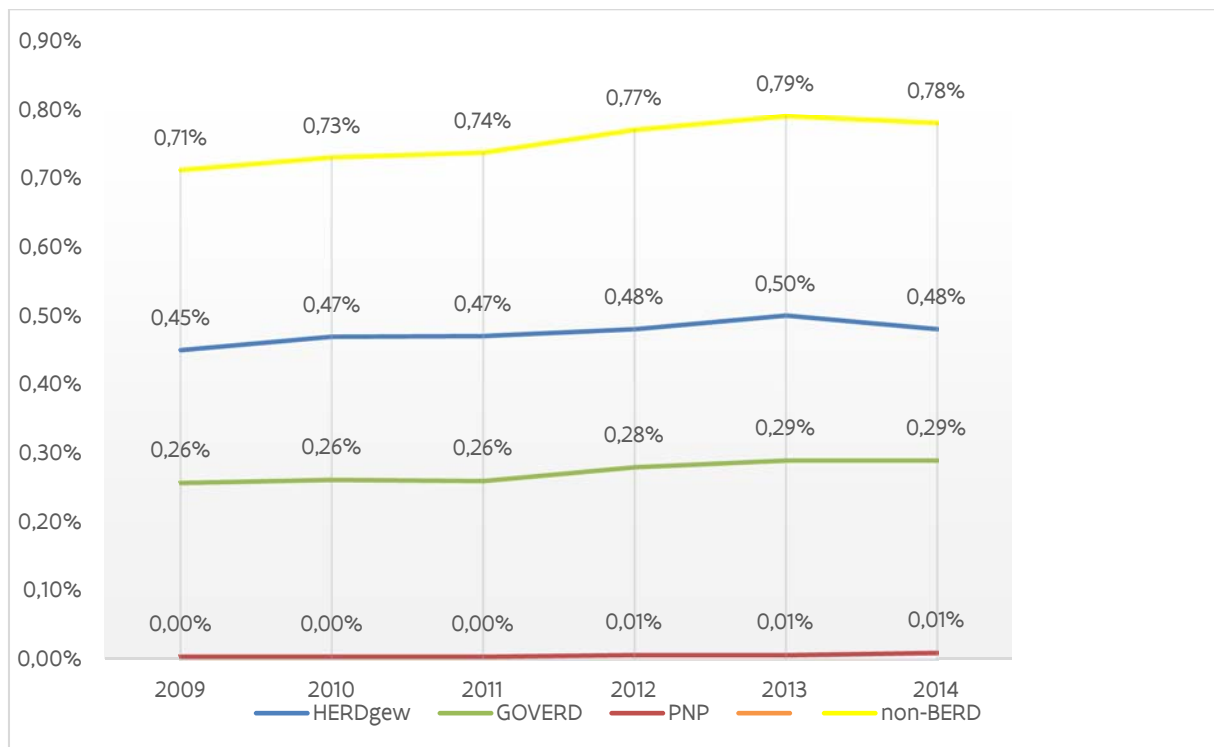
Figure 13: Evolution of the R&D spending by GOV, HES and PNP (non-BERD=GOVERD+HERD+PNP), from 2009 to 2014, in million euros (current prices)



The GOVERD and HERD (2013) can be broken down by different fields of science. For the GOV sector, this indicates the dominant position of engineering and technology (67.9%). For the HES sector, the most important fields of science are the medical sciences (31.5%), the natural sciences (18.5%), the social sciences (15.9%) and engineering & technology (14.8%).

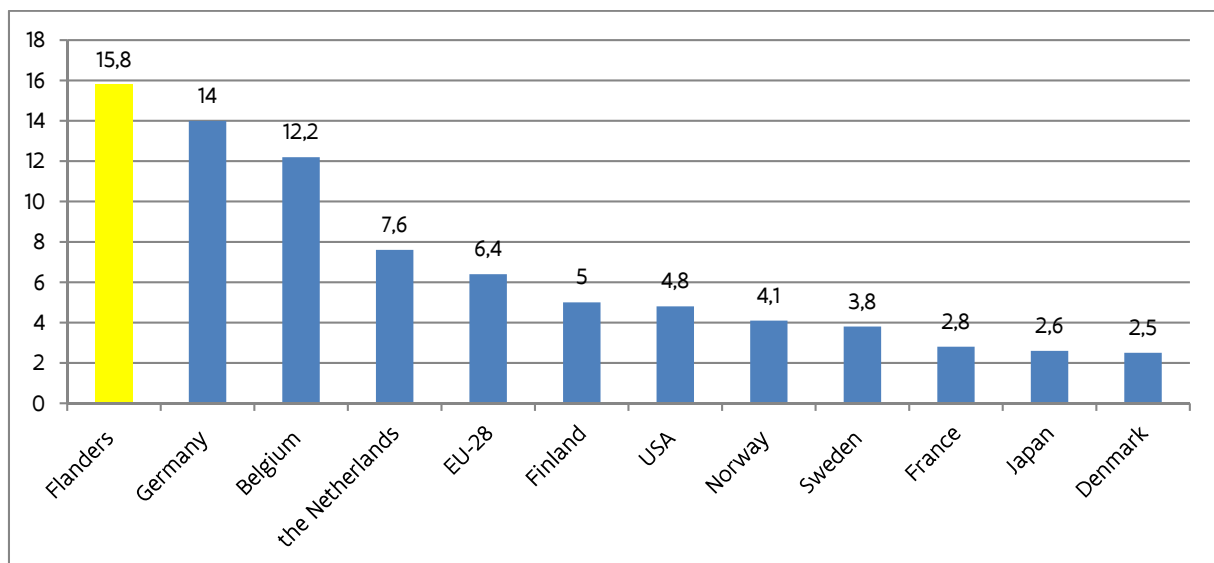


Figure 14: Evolution of the R&D intensity for the non-BERD (GOVERD, HERD and PNP) from 2009 to 2014



For the GOVERD, the most important source of funds in 2013 was *abroad* (48.4%), followed by *government funding* (44.7%) and thirdly the *companies* (6.2%). For the HERD, *government funding* was again the most important source of funds (71.5%), followed by the *companies* (15.8%) and *abroad* (8%). The proportion of the HERD that is supported by (domestic) companies for 2013 ranks higher internationally than any of the EU-28 countries and is more than twice the figure for the EU-28 as a whole. Only Germany has a similar proportion. In other words, companies are both an important client and an important source of funds for the research carried out at the Flemish higher education institutions.

Figure 15: International comparison of the funding of the HERD by companies, for 2013 in %.

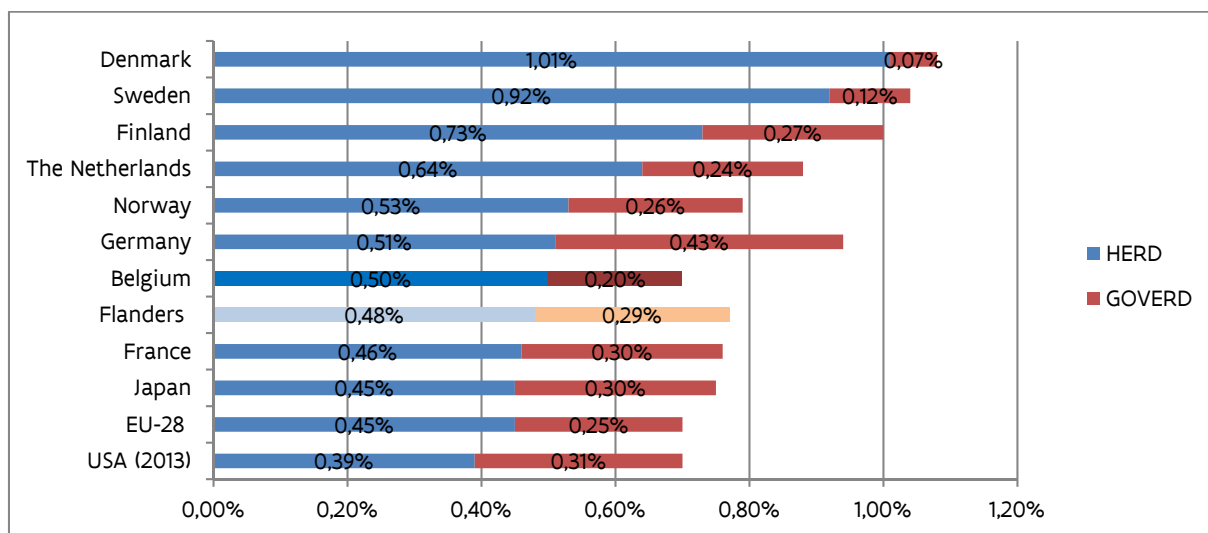


Source: OECD database, Main Science and Technology Indicators

EU-28: secretariat estimate or projection; Flanders: figure for domestic companies, for domestic and foreign companies (figure= 16%); USA: projection and most or all capital expenditure is excluded; Japan: break in time series.

For the R&D intensity of the HES, Flanders scores roughly similar to France and above the EU-28 average. Finland (0.73%), the Netherlands (0.64%), Denmark (1.01%) and Sweden (0.92%) have a much higher R&D intensity for the HES. The R&D intensity of the GOV is higher in Flanders than in Sweden, the Netherlands, Norway, Denmark and the EU-28 average. Flanders' results are roughly similar to France but lower than Germany. In summary, for both figures, Flanders is maintaining its international position.

Figure 16: International comparison of the R&D intensity of HERD and GOVERD for 2014



Source: OECD database, Main Science and Technology Indicators

The Netherlands and Germany: includes other classes (GOVERD); EU-28: secretariat estimate or projection based on national sources;; USA: most or all capital expenditure excluded (HERD); Belgium and Denmark: national estimate; France and Sweden: provisional; Japan: figure based on National Accounts.

## 5 GBARD

This section examines in detail the R&D support received from Flanders, in particular that of the Flemish government, and compares it with that of other countries. GBARD (Government Budget Appropriations for R&D) is an indicator used by the OECD and EUROSTAT. The table below shows an international comparison of the GBARD as a percentage of GDP. The calculation method of the Flemish figure is explained further in this chapter.

It is clear that the trends for GBARD, expressed as a percentage of GDP, differ between countries. In some countries there is stagnation; in others there is even a drop over a period of several years. Figure 16 compares Flanders with selected countries. Because of the worldwide financial and economic crisis, followed by measures taken for the benefit of the economy, it is necessary to proceed with caution when comparing budgets. Comparison is therefore made for the year 2013, the most recent year with data for all the compared countries.

Table 2: International comparison of Government Budget Appropriations or Outlays for R&D (GBARD), expressed as a percentage of GDP(R)

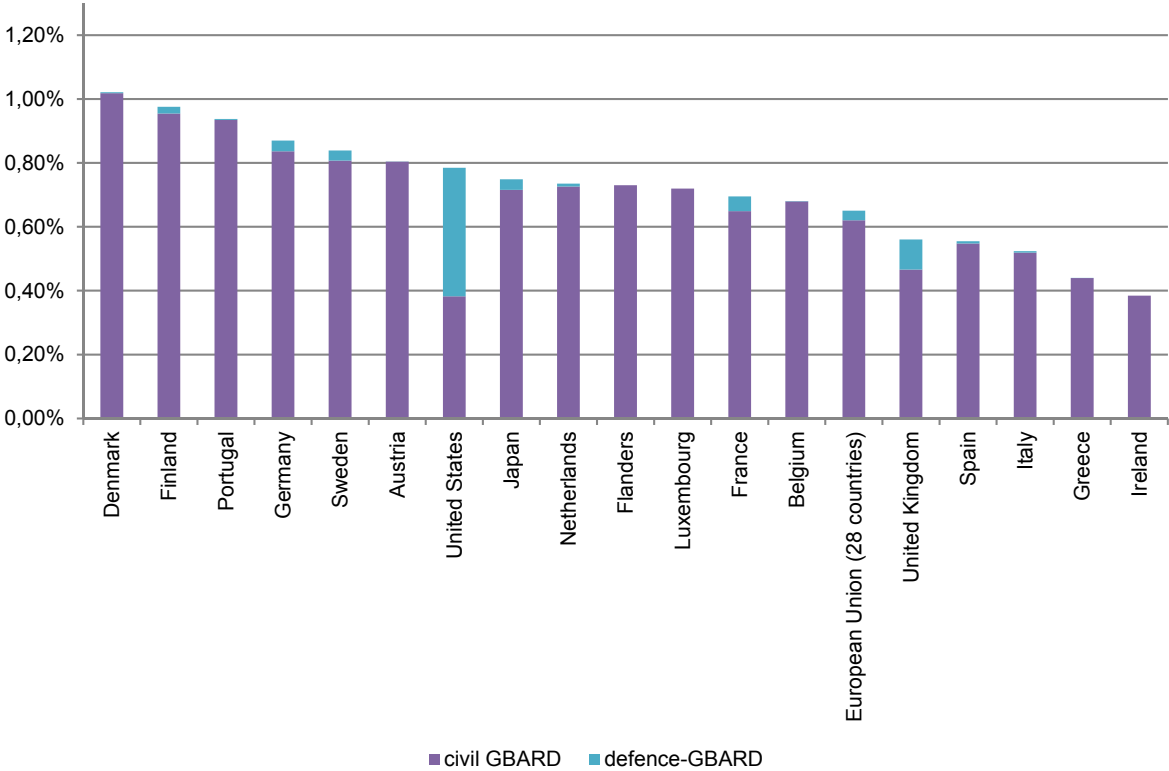
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016i
Denmark	0,72%	0,72%	0,79%	0,86%	0,99%	0,99%	1,01%	1,01%	1,03%	1,02%	1,00%	
Finland	0,98%	0,98%	0,93%	0,94%	1,07%	1,11%	1,05%	1,03%	1,00%	0,98%	0,98%	
Portugal	0,68%	0,67%	0,72%	0,88%	1,00%	0,98%	1,00%	0,92%	0,93%	0,94%	0,98%	
Germany	0,75%	0,74%	0,74%	0,77%	0,88%	0,89%	0,88%	0,87%	0,90%	0,87%	0,86%	
Sweden	0,82%	0,80%	0,75%	0,76%	0,86%	0,84%	0,79%	0,85%	0,84%	0,84%	0,80%	
Austria	0,64%	0,64%	0,63%	0,68%	0,75%	0,77%	0,79%	0,77%	0,80%	0,80%	0,82%	
United States	1,00%	0,98%	0,98%	0,98%	1,14%	1,00%	0,93%	0,89%	0,80%	0,78%	0,76%	
Japan	0,71%	0,71%	0,68%	0,71%	0,76%	0,74%	0,78%	0,78%	0,75%	0,75%	0,69%	
The Netherlands	0,74%	0,75%	0,73%	0,72%	0,79%	0,77%	0,77%	0,72%	0,74%	0,74%	0,74%	
Flanders	0,63%	0,65%	0,61%	0,68%	0,69%	0,72%	0,69%	0,68%	0,68%	0,73%	0,68%	0,69%
France	0,94%	0,79%	0,73%	0,85%	0,90%	0,82%	0,82%	0,73%	0,71%	0,69%	0,65%	
Belgium	0,57%	0,60%	0,59%	0,66%	0,66%	0,65%	0,63%	0,64%	0,64%	0,68%	*	
EU-28	0,67%	0,65%	0,65%	0,67%	0,73%	0,70%	0,68%	0,66%	0,66%	0,65%	*	
United Kingdom	0,64%	0,64%	0,63%	0,61%	0,63%	0,60%	0,56%	0,55%	0,58%	0,56%	*	
Spain	0,53%	0,67%	0,74%	0,75%	0,81%	0,77%	0,68%	0,59%	0,55%	0,55%	*	
Italy	0,64%	0,59%	0,62%	0,61%	0,62%	0,59%	0,56%	0,55%	0,53%	0,52%	*	
Greece	0,32%	0,31%	0,28%	0,42%	0,36%	0,30%	0,31%	0,38%	0,48%	0,44%	0,45%	
Ireland	0,42%	0,41%	0,45%	0,50%	0,53%	0,50%	0,45%	0,43%	0,40%	0,38%	0,36%	

Source: OECD database, Main Science and Technology Indicators

Flemish Government R&D funding + Flemish share of the federal funding (35.5% ESA, 56% for the rest),

Belgium 2013 figure: Commissie Federale Samenwerking, CFS/STAT: final budget Flanders + provisional budget other authorities).

Figure 17: International comparison of Government Budget Appropriations or Outlays for R&D (GBARD) 2014, expressed as a percentage of GDP(IR)



Source: OECD database, Main Science and Technology Indicators

## 6 Estimate calculation method for publicly financed R&D intensity (1% objective)

For the period after 2011, no R&D survey data by sector is yet available. A cautious estimate is being made of the growth path necessary to reach the 1% objective (the publicly financed share of the above mentioned 3% objective) by 2020. Consequently, for the present purpose, as in previous EWI Budget Browsers, a calculation is included to approximate the results of the most recent years.

The combined efforts of the government are calculated by elaborating different variants.

### 1. The own efforts of the Flemish Government

This is the Flemish GBARD in the strict sense, funded by the Flemish Government only.

### 2. The efforts of the Flemish Government + the Flemish share of federal government R&D funding

In Flanders, R&D activities are also funded by federal government R&D funds. When this share received from the federal government is added to the Flemish GBARD in the strict sense (1), a GBARD is obtained for Flanders that is probably closer to reality. This variant is consequently the most suitable for an international comparison of the GBARD. When calculating Flanders' share of federal government funding, the following formula is used: 35.5% of the funding from the European Space Agency (source: Flemish Council for Science and Innovation – VRWI) and 56% for the remainder of the total federal R&D funding.

### 3. The efforts of the Flemish Government + the Flemish share of federal government R&D funding + the Flemish return from the funds of the EU Framework Programs for Research and Technological Development

In another variant, the Flemish return from the EU Framework Programs for Research and Technological Development can also be added, since this too represents R&D activities funded publicly. However, the result of this calculation can no longer be considered as GBARD, but is actually a third variant that can be used for calculating the publicly financed share of the R&D intensity.

The results of this calculation are given in the table below. The figure for 2016, initial budget (i), is estimated at 0.76% of GDP(R).

Table 3: Evolution of the R&D budget and R&D intensity

R&D budget	2008	2009	2010	2011	2012	2013	2014	2015	2016i
Flemish Government (1)	1 121,43	1 130,07	1 224,02	1 227,58	1 236,01	1 243,50	1 397,77	1 298,43	1 398,24
Flemish Gov. + Flemish share of federal gov. (2)	1 403,28	1 390,34	1 506,83	1 511,54	1 533,79	1 544,56	1 693,07	1 595,62	1 701,38
Flemish Gov. + federal share + EU-FP (3)	1 563,28	1 550,34	1 666,83	1 671,54	1 693,79	1 704,56	1 853,07	1 755,62	1 861,38
<b>GDP(R) (million euro) (4)</b>	204546,5	201215,6	210001,3	218480	224672	228576,6	233432,4	239 158,50	245 624,70
<b>Public R&amp;D intensity as % of GDP(R) (1% objective)</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016i</b>
Flemish Government (1)	0,55%	0,56%	0,58%	0,56%	0,55%	0,54%	0,60%	0,54%	0,57%
Flemish Gov. + Flemish share of federal gov. (2)	0,68%	0,69%	0,72%	0,69%	0,68%	0,68%	0,73%	0,68%	0,69%
Flemish Gov. + federal share + EU-FP (3)	0,76%	0,77%	0,79%	0,77%	0,75%	0,74%	0,79%	0,73%	0,76%

(1) Flemish Government budget for R&D: final budgets 2009-2015; initial budget 2016.

- (2) • Flemish share in the federal government R&D funds: ESA distribution key at 35.5% for Flanders (source: VRWI) and the remainder of federal government R&D funds estimated at 56% for Flanders.
- federal government R&D funds: source: CFS/STAT; for 2015 and 2016i the initial budget of 2015 was used.
- (3) estimated return based on final results of the Flemish return for the Seventh Framework Programme (publication in preparation). Sources: eCorda data, reworked by EWI.
- (4) GDP(R): Gross Domestic Product by Region. Source: 2009-2013 NBB; 2014-2015 Hermreg - Research Centre of the Flemish Government (Studiedienst van de Vlaamse Regering), June 2016.

## 7 The EU Framework Programme for Research and Innovation - Horizon 2020

### 7.1 Introduction

Horizon 2020, the current framework programme for research and innovation, is the EU programme with the largest budget for supporting research and innovation activities for the 2014-2020 period. Horizon 2020, further H2020, has a budget of €74.8 billion.

H2020 is organised around three main pillars

1. Excellent Science: Activities under this pillar aim to reinforce and extend the excellence of the Union's science base and to consolidate the European Research Area in order to make the Union's research and innovation system more competitive on a global scale.
2. Industrial Leadership: This pillar aims to speed up development of the technologies and innovations that will underpin tomorrow's businesses and help innovative European SMEs to grow into world-leading companies.
3. Societal challenges: This pillar aims to encourage an integral, multidisciplinary approach to finding solutions for grand societal challenges.

In addition, there are two specific objectives:

1. Spreading excellence and widening participation
2. Science with and for society

and three smaller blocks:

1. European Institute of Innovation and Technology (EIT)
2. Joint Research Centre (JRC)
3. Euratom

The table below shows the structure of the Horizon 2020 programme:

Table 4: H2020 Programme Structure

	EUR million in current prices
<b>I. Excellent Science, of which:</b>	<b>24,232.1</b>
1. European Research Council (ERC)	13,094.8
2. Future and Emerging Technologies (FET)	2,585.4
3. Marie Skłodowska-Curie actions	6,162.3
4. Research infrastructures	2,389.6
<b>II. Industrial Leadership, of which:</b>	<b>16,466.5</b>
1. Leadership in enabling and industrial technologies (*), (****)	13,035

2. Access to risk finance (**)	2,842.3
3. Innovation in SMEs (***)	589.2
<b>III. Societal challenges, of which: (****)</b>	<b>28,629.6</b>
1. Health, demographic change and well-being	7,256.7
2. Food security, sustainable agriculture and forestry, marine, maritime and inland water research, and the bioeconomy	3,707.7
3. Secure, clean and efficient energy	5,688.1
4. Smart, green and integrated transport	6,149.4
5. Climate action, environment, resource efficiency and raw materials	2,956.5
6. Europe in a changing world – Inclusive, innovative and reflective societies	1,258.5
7. Secure societies – Protecting freedom and security of Europe and its citizens	1,612.7
<b>IV. Spreading excellence and widening participation</b>	<b>816.5</b>
<b>V. Science with and for society</b>	<b>444.9</b>
<b>VI. Non-nuclear direct actions of the Joint Research Centre (JRC)</b>	<b>1,855.7</b>
<b>VII. The European Institute of Innovation and Technology (EIT)</b>	<b>2,383</b>
<b>TOTAL</b>	<b>74,828.3</b>

(\*) Including EUR 7,423 million for Information and Communication Technologies (ICT) of which EUR 1,549 million for photonics and micro- and nanoelectronics, EUR 3,741 million for nanotechnologies, advanced materials and advanced manufacturing and processing, EUR 501 million for biotechnology and EUR 1,403 million for space. As a result, EUR 5,792 million will be available to support Key Enabling Technologies.

(\*\*) Around EUR 994 million of this amount may go towards the implementation of Strategic Energy Technology Plan (SET Plan) projects. Around one third of this may go to SMEs.

(\*\*\*) Within the target of allocating a minimum of 20% of the total combined budgets for the specific objective “Leadership in enabling and industrial technologies” and the priority “Societal challenges” for SMEs, a minimum of 5% of those combined budgets will be initially allocated to the dedicated SME instrument. A minimum of 7% of the total budgets of the specific objective “Leadership in enabling and industrial technologies” and the priority “Societal challenges” will be allocated to the dedicated SME instrument averaged over the duration of Horizon 2020.

(\*\*\*\*) The Fast Track to Innovation (FTI) pilot actions will be funded from the specific objective “Leadership in enabling and industrial technologies” and from the relevant specific objectives of the priority “Societal challenges”. A sufficient number of projects will be launched in order to allow a full evaluation of the FTI pilot.

The data used in the present section were taken from the database that the European Commission makes available via the electronic platform e-CORDA. The release date of the data is 01 June 2016, when about 22% of the available budget over the total period has been allocated.

## 7.2 Participation by Flanders

Flanders participates 854 times in 662 projects in H2020. This equates to a total participation funding for Flanders of 416.26 million euros. Flanders is responsible for the major part of the total Belgian number of participations, projects and coordinators, as well as the largest share of the participation grants.

The total Flemish participation funding represents 2.51% of the total funding received from the European Commission for participating in H2020.

Marie Curie (MSCA), ICT and FOOD are at present the three thematic priorities with the highest number of participations from knowledge actors in Flanders.

As shown in table 5, the Flemish participation was most successful (in terms of financial return) in the thematic priorities ICT, SWAFS, ADVMAT, FOOD and MSCA.



Table 5: Flemish participation in H2020 by priority

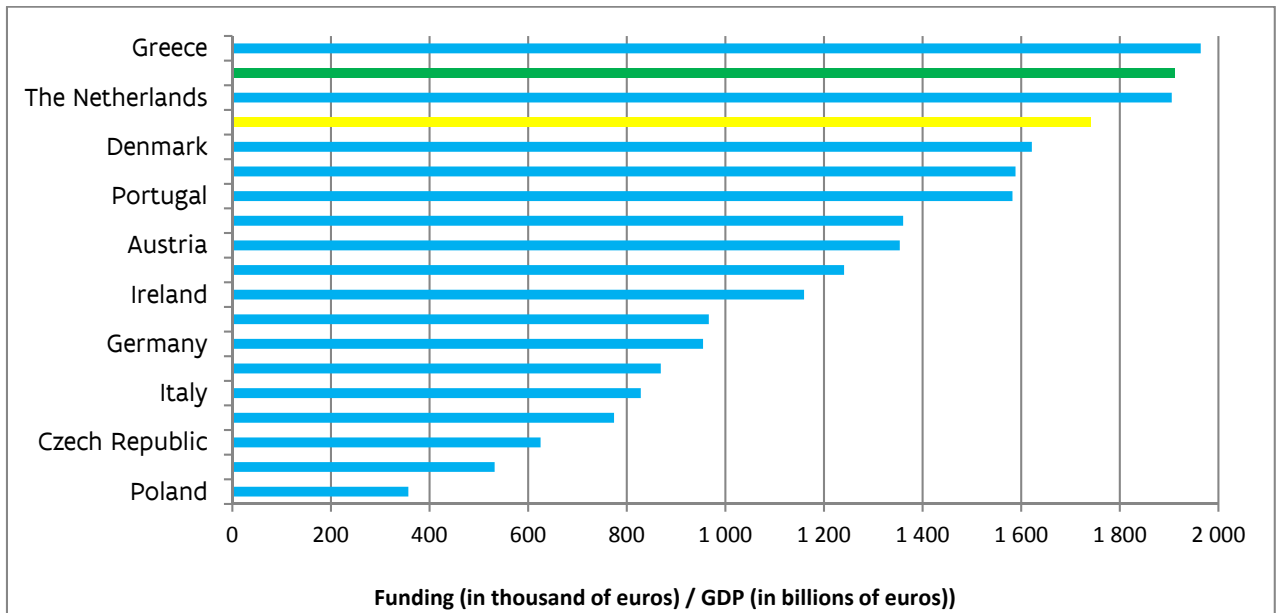
Pillar	Priority	Programme	Code	Number of projects	Number of participations	Funding (in millions of euros)	Return
Crosstheme	Crosstheme	CROSST	EU.0.	5	5	1.22	0.57%
	<b>Total</b>			<b>5</b>	<b>5</b>	<b>1.22</b>	<b>0.57%</b>
Excellent Science	European Research Council	ERC	EU.1.1	44	45	58.45	2.04%
	Future and Emerging Technologies	FET	EU.1.2	11	13	6.17	1.27%
	Marie Skłodowska-Curie Actions	MSCA	EU.1.3	157	190	66.98	3.31%
	Research Infrastructures	INFRA	EU.1.4	14	15	3.46	0.59%
	<b>Total</b>			<b>226</b>	<b>263</b>	<b>135.06</b>	<b>2.27%</b>
Industrial Leadership	Industrial Leadership - Cross-theme	INDLEAD-CROSST	EU.2.0.	4	4	0.74	0.55%
	Information and communication technologies	ICT	EU.2.1.1.	82	120	88.96	4.74%
	Nanotechnologies, Advanced Materials and production	NMP	EU.2.1.2	10	11	3.39	1.26%
	Advanced Materials	ADVMAT	EU.2.1.3.	9	15	9.91	4.22%
	Biotechnology	BIOTECH	EU.2.1.4.	2	2	0.35	0.33%
	Advanced Manufacturing and processing	ADVMANU	EU.2.1.5.	24	31	18.33	2.91%
	Space	SPACE	EU.2.1.6.	14	15	4.88	1.86%
	Access to risk finance	RISKFINANCE	EU.2.2.	0	0	0.00	0.00%
	Innovation in SMEs	SME	EU.2.3.	8	10	2.11	1.72%
<b>Total</b>			<b>153</b>	<b>208</b>	<b>128.68</b>	<b>3.53%</b>	
Societal Challenges	Societal Challenges - Cross-theme	SOCCHAL-CROSST	EU.3.0.	0	0	0.00	0.00%
	Health, demographic change and wellbeing	HEALTH	EU.3.1.	55	61	26.43	2.04%
	Food security, sustainable agriculture and forestry, marine and maritime and inland water research	FOOD	EU.3.2.	44	74	24.90	3.41%
	Secure, clean and efficient energy	ENERGY	EU.3.3.	49	65	35.33	2.51%
	Smart, green and integrated transport	TPT	EU.3.4.	46	65	26.44	2.38%
	Climate action, environment, resource efficiency and raw materials	ENV	EU.3.5.	27	44	16.43	2.45%
	Europe in a changing world - inclusive, innovative and reflective Societies	SOCIETY	EU.3.6.	15	20	5.32	1.64%
	Secure societies - Protecting freedom and security of Europe and its citizens	SECURITY	EU.3.7.	17	18	5.25	1.16%
<b>Total</b>			<b>253</b>	<b>347</b>	<b>140.09</b>	<b>2.32%</b>	
Spreading excellence and widening participation	Spreading excellence and widening participation - Cross-theme	SEAWP-CROSST	EU.4.0.	0	0	0.00	0.00%
	Teaming of excellent research institutions and low performing RDI regions	WIDESPREAD	EU.4.a	1	1	0.07	0.49%
	Twinning of research institutions	TWINING	EU.4.b	9	9	1.79	2.66%
	ERA chairs	ERA	EU.4.c	0	0	0.00	0.00%
	Transnational networks of National Contact Points	NCPNET	EU.4.f	0	0	0.00	0.00%
	<b>Total</b>			<b>10</b>	<b>10</b>	<b>1.86</b>	<b>1.55%</b>
Science with and for society	Science with and for Society - Cross-theme	SWAFS	EU.5.0.	1	1	0.28	4.53%
	Make scientific and technological careers attractive for young people	CAREER	EU.5.a.	1	1	0.24	0.81%
	Promote gender equality in research and innovation	GENDEREQ	EU.5.b	0	0	0.00	0.00%

	Integrate society in science and innovation	INEGSOC	EU.5.c	1	1	0.17	0.50%
	Develop the governance for the advancement of responsible research and innovation	GOV	EU.5.f	1	1	0.47	2.38%
	Improve knowledge on science communication	KNOWLEDGE	EU.5.h	0	0	0.00	0.00%
	<b>Total</b>			<b>4</b>	<b>4</b>	<b>1.16</b>	<b>1.07%</b>
<b>EURATOM</b>		<b>EURATOM</b>		<b>11</b>	<b>17</b>	<b>8.19</b>	<b>1.59%</b>
<b>TOTAL</b>				<b>662</b>	<b>854</b>	<b>416.26</b>	<b>2.51%</b>

### 7.3 Benchmark for Flanders

The performance of Flanders in Horizon 2020 is examined by dividing its funding by the Gross Domestic Product and ranking the result with those of other participating countries. Figure 17 shows that Flanders performs well with a ranking in fourth place, behind Greece, Belgium and the Netherlands, but performing better than the Scandinavian countries, Finland, Denmark and Sweden.

Figure 18a: Benchmark for the Flemish participation in H2020: funding / GDP

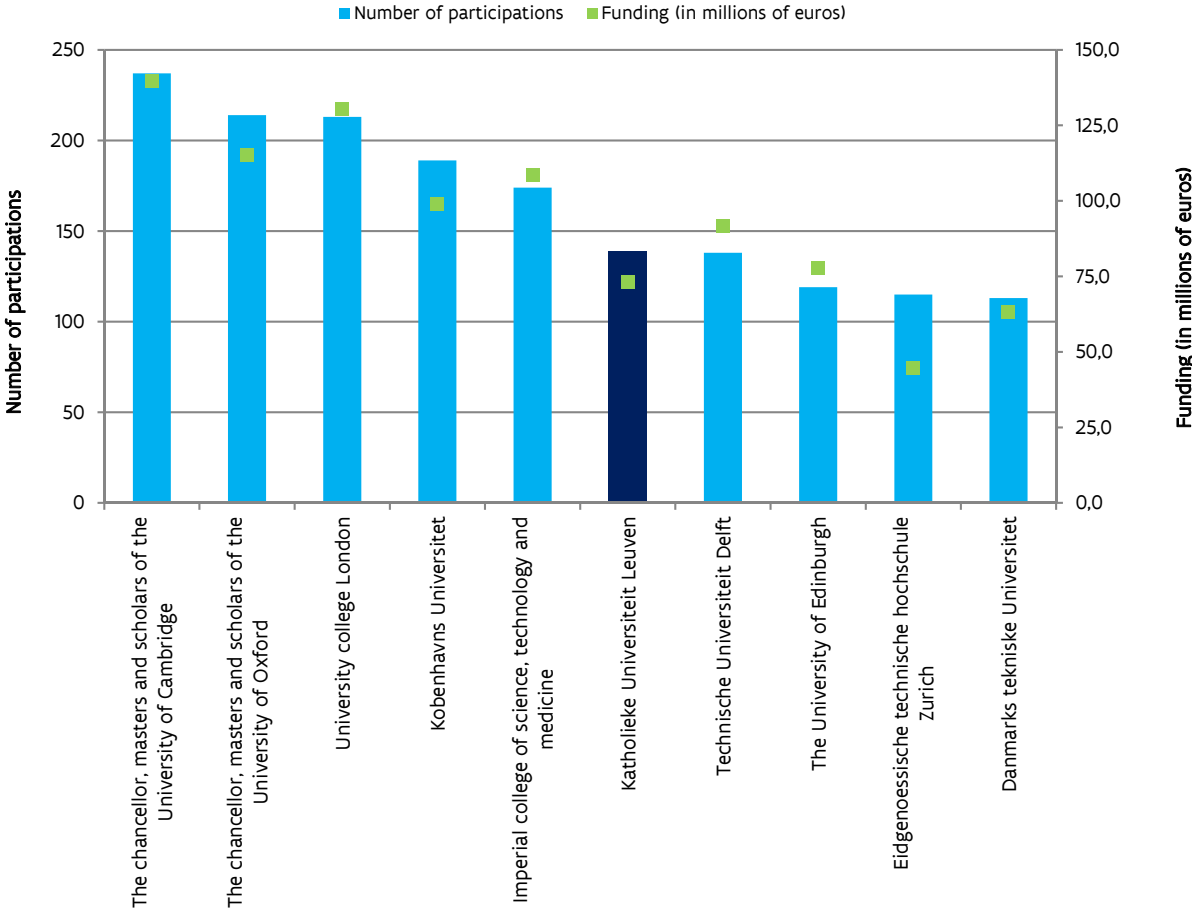


### 7.4 Top participating organizations

The higher education sector (HES) is provisionally the main Flemish beneficiary of H2020, accounting for about 39% of the return received by Flanders. The research centres receive almost 32% of the Flemish return, and the companies about 22%.

The top-3 participating institutions in Flanders in H2020 are as yet KU Leuven, UGent and IMEC, which jointly represented almost a third of the total EU FP contributions to Flemish grant holders.

Figure 18b: Top-10 universities (HES) in an international ranking, sorted by number of participations and funding (in millions of euros)



## 8 EU Regional Policy Fund (ESIF) and R&D&I support

For the past period 2007-2013, the Flemish Region was entitled to receive support from the EU regional funds within the framework of the Objective 2 and Objective 3 programmes. These (cohesion) budgets are considerably lower than the (competition-based) support that is directed to research actors and origins from the Framework Programme for Research and Technological Development / Horizon2020 programme. In 2015, the last projects of this period 2007-2013 came to an end.

Under the Objective 2 programme (ERDF-Flanders), a total budget of 200 million euros was available between 2007 and 2013, divided equally among four main priorities. The first of these was “Knowledge and Innovation”. Subtracting the budget for coordination costs, the total available R&D&I budget for Flanders reached 48.5 million euros (of which about 30 million euro for “strictly” R&D), which is an average of about 8 million euros per year. This amount was complemented by almost 95 million euros from Flemish partners (Flemish Government, provinces, municipalities, private partners, non-profit organisations).

Under the Objective 3 programme (ERDF-Interreg) for European Territorial Cooperation, Flanders was entitled to receive 118.6 million euros, yet it did receive in total 190.3 million euros for 440 international projects in total on knowledge economy and innovation, environment and energy, connectivity and transport, sustainable cities and communities. About 23% of the total amount was oriented at innovation (43.8 million euros). Complemented with the Flemish co-funding, total amount of all projects reached 415 million euros (95.5 million euros for research and innovation).

The programmes in which R&D and innovation was involved were Interreg IV A (Euregio Meuse-Rhine, Grensregio Vlaanderen – Nederland (Border region Flanders – The Netherlands, Two Seas), Interreg IV B (Northsea Region, Northwest-Europe), Interreg IV C, and the supporting programmes (such as ESPON). In the STI-domain, (knowledge) institutes from Flanders participated into various Interreg-projects such as Food2Market, InnoFun (Funding of Innovation), TANDEM, ECO-LASERFACT, GCS, SCINNOPOLI (“Scanning Innovation Policy Impact”), and SPIDER (“Supporting Public Service Innovation using Design in European Regions”). The EWI Department took part in a supporting interregional project, AMCER (“Advanced Monitoring and Coordination of R&D policies at European level”, within ESPON).

A number of major Interreg-projects are worth mentioning:

- **BioBase Europe** (allocation of 21.8 million euros): a project for the construction of a pilot plant (for research) and training facilities for bio-based activities, which aim to speed up the development of a sustainable bio-based economy in Europe. It is the first facility of its kind in Europe that will use renewable resources for industrial biotechnology on such a scale. The actors involved are the Ghent Bio-energy Valley, UGent, Stad Gent, Biopark Terneuzen (Zeeuws-Vlaanderen, the Netherlands), and various other stakeholders;
- **NanoSenseEU** (allocation of € 1.6 million): a project that intends to develop a universal measure surface for the detection of biomolecules; to develop and use biosensors; and also to set up a knowledge cluster on biosensors (various specialities). The Flemish partners involved are UHasselt, IMOMEC (IMEC vzw) and KU Leuven;
- **Hydrogen Region Flanders - South Netherlands** (allocation of 14.1 million euros): a project that focuses on the sustainable generation of hydrogen in the fields of education, production, infrastructure and “early markets” (demonstration projects). The Flemish participants are IMEC, UGent, several university colleges and various other stakeholders.

- **Organext:** a project that brings together twelve partners from business, policy and knowledge centres from the Euregio Maas-Rhine, Eindhoven and Leuven, with expertise in the domain of nanotechnology, new materials, organic solar cells and economic valorisation. The Flemish partners are UHasselt and IMOMEK.

Summarized, during the period 2007-2013, the total ERDF budget allocated to research and innovation potential in Flanders was almost 93 million euros (of which 49 million euros from ERDF Flanders and 43.8 million euros from ERDF Interreg). Considering a working period of 6 years, the ERDF support for R&D&I reached 15.5 million euros annually. Hence in 2007-2013 the average EU budget for R&D&I that originates from the FP7 on RTD was over 10 times higher per annum than that from the ERDF.

Total EU support in 2007-2013 for R&D and innovation was about 175 million euros annually (160 million euros from FP for RTD + 15 million euros from ERDF), which was complemented by the CIP with a budget / a set of guarantees for projects on innovation.

December 2014, the European Commission approved the Flanders' ERDF Operational Programme 2014-2020. Total available budget for Flanders from the ESIF (the new EU Regional Fund in 2014-2020) reaches 345.5 million euros. Within the objective "Investing in growth and jobs" (ERDF Flanders), there is 173.5 million euros available, and for territorial collaboration (Interreg Flanders) another 172 million euros. The total budget Flanders is entitled to, is lower than in the previous period of 2007-2013.

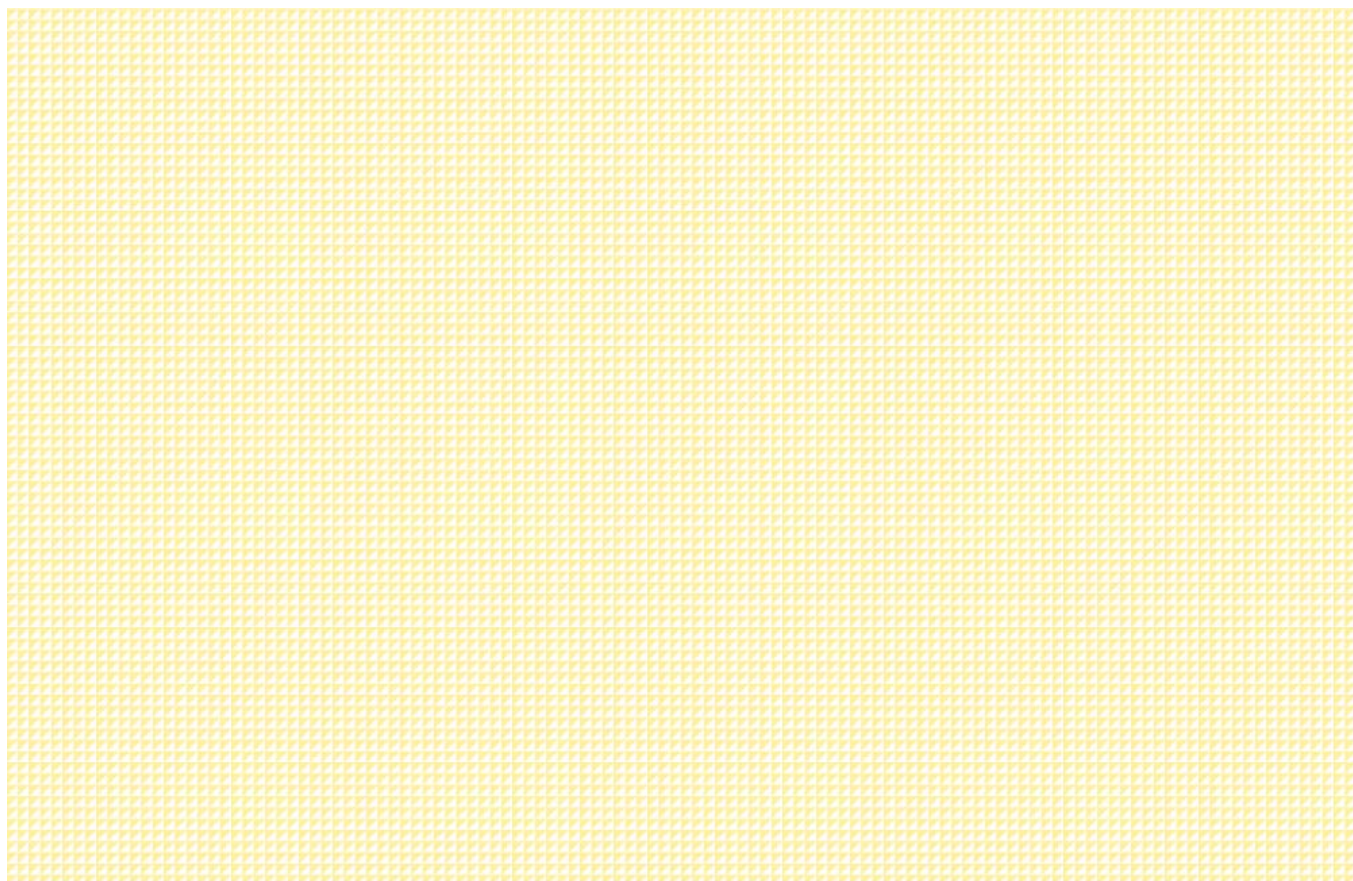
Nevertheless, the budget that Flanders has earmarked for research, development and innovation has risen to 138.2 million euros (based on the assumption that 40% of total ERDF budget in Objective 2 and 3 is earmarked for the innovation theme). Over a total period of 6 years, this is 23 million euros per annum, about 50% more than in the previous period 2007-2013. This increase demonstrates that Flanders attaches great importance and commits itself to the change towards a knowledge-based economy and society.

An ex-ante condition that the Commission imposed, is the elaboration of a smart specialisation strategy (S3). Hence, Flanders has submitted in its ERDF Operational Plan 2014-2020, 8 specialisation domains or strategic cluster domains, based on the experience of the RIS3 Platform and responding to current policy developments. Details are listed under Chapter 1, part 8.2.

The Interreg programmes that Flanders takes part in during the 2014-2020 period, are identical to those in the previous planning period (e.g. Euregio Meuse-Rhine, Flanders – The Netherlands, North West Europe, North Sea, etc.). In 2015, the first calls have been launched. An example of (new) Interreg cooperation in 2014-2020 is the WaterstofNet 2.0 (Hydrogen Network 2.0) project within the Interreg V A border region "Flanders - the Netherlands" programme. The investment is worth 14 million euro, of which 6 million euro from ERDF-Interreg, and 0.375 million euro cofunding from Flanders. This is a continuation of the project "Hydrogen Region Flanders - South Netherlands" of the 2007-2013 Interreg IV A programme. The Hydrogen Network 2.0 will focus on further adaptations of the technology specifically for logistics and mobility and the sustainable generation of hydrogen via renewable energy sources. Another project of the Flanders – the Netherlands ERDF-Interreg cooperation is CrossRoads2 that focuses on cross-sectoral and cross-technological innovations in domains such as chemistry and materials, agro-food, life sciences & health, clean technology and bio-based economy. It will offer financial support to 50 sustainable and cross-border innovation projects. Total budget is 19 million euro, of which 8 million euro from ERDF-Interreg and 0.491 million euro cofunding from Flanders. Finally, Link2Innovate and Crosscare both stimulate innovation among SME's and represent in total 12.3 million euro (of which 5.9 million euro from ERDF-Interreg). In Link2Innovate, technological start-up companies are supported that are active in key enabling technologies such as micro and nano electronics, photonics, and advanced manufacturing, while Crosscare is a matchmaker in care.

# Chapter 3

## Human resources in science and technology



# 1 Introduction

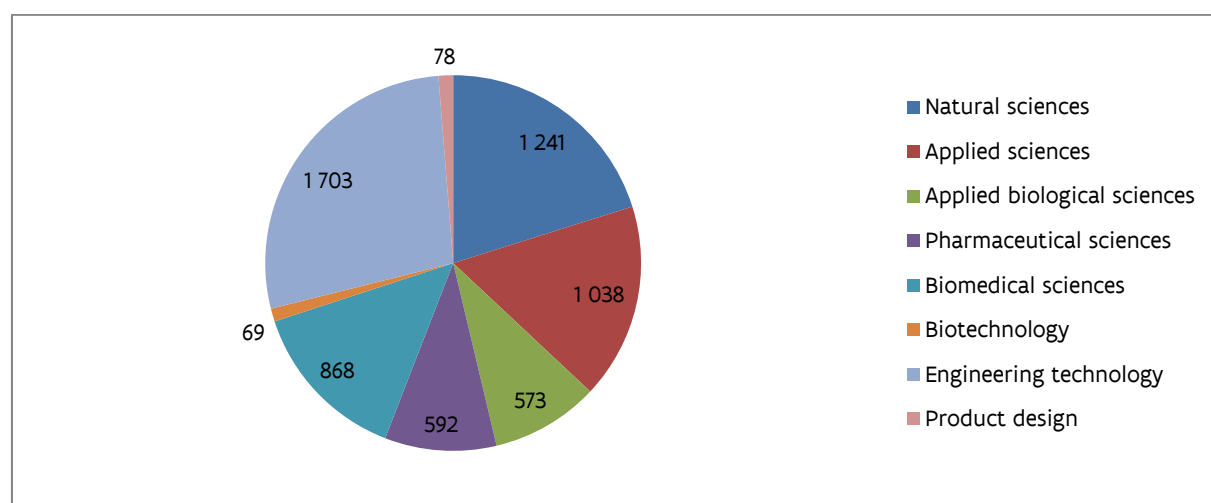
Highly educated and skilled personnel are a key resource for science and technology. Consequently, indicators for Human Resources in Science and Technology (HRST) are very important. HRST statistics always focus on two main aspects. Firstly, the stock of HRST that focuses on the characteristics of the current labour force involved in science and technology. Secondly, the flows showing the job-to-job mobility and the inflow from education to the science and technology labour force. In this case, particular attention is paid to scientists and engineers, who are often the innovators at the centre of technology-led development.

## 2 S&T students

More than six out of every ten students start in higher education after their secondary education. In the 2014-2015 academic year, 46,550 students enrolled for the first time at a Flemish university or a university college. Of this group, known as first entry students, more than half started a professional Bachelor training at a university college.

About 6,160 first entry students (about 32% of the total) at the universities start in the S&T domains (grouping together the natural sciences, applied sciences, applied biological sciences, pharmaceutical sciences, biomedical sciences, biotechnology, engineering technology, product design).

Figure 19: The number of first entry students at Flemish universities in the S&T domain for the academic year 2014-2015, in absolute terms



Source : Education department – DHO database

In the professional and academic Bachelor at the university colleges, nearly 17% of first entry students opt for a study within the following science and technological domains: biotechnology, industrial sciences and technology, nautical sciences and product development.



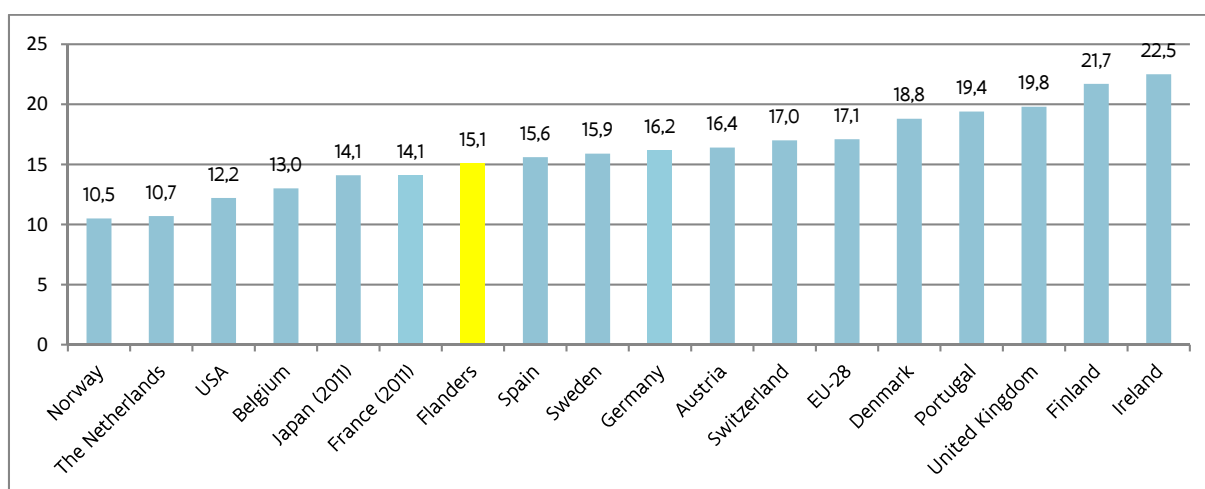
### 3 S&T graduates

There has been a steady increase since 2003 (12.3%) in the 20-29-year-old population of Flanders with a higher degree in mathematics, science and technology. In 2012, the figure was 15.1%. In this respect, Flanders ranks below the EU-28 average (17.1%) and the gap with the leaders - Ireland (22.5%), Finland (21.7%), the United Kingdom (19.8%) and Portugal (19.4%) - remains very high. On the other hand, Flanders scores better than the Netherlands, Norway and the United States.

Table 5: Evolution of the proportion of graduates in mathematics, science and technology (higher education) in Flanders for the age group 20 to 29 years (2003-2012)

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Flanders	12.3%	11.8%	12%	11.9%	15.6%	14.0%	14.2%	13.9%	14.3%	15.1%

Figure 20: International comparison of the proportion of graduates in mathematics, science and technology (higher education) for the age group 20 to 29 years (2012)



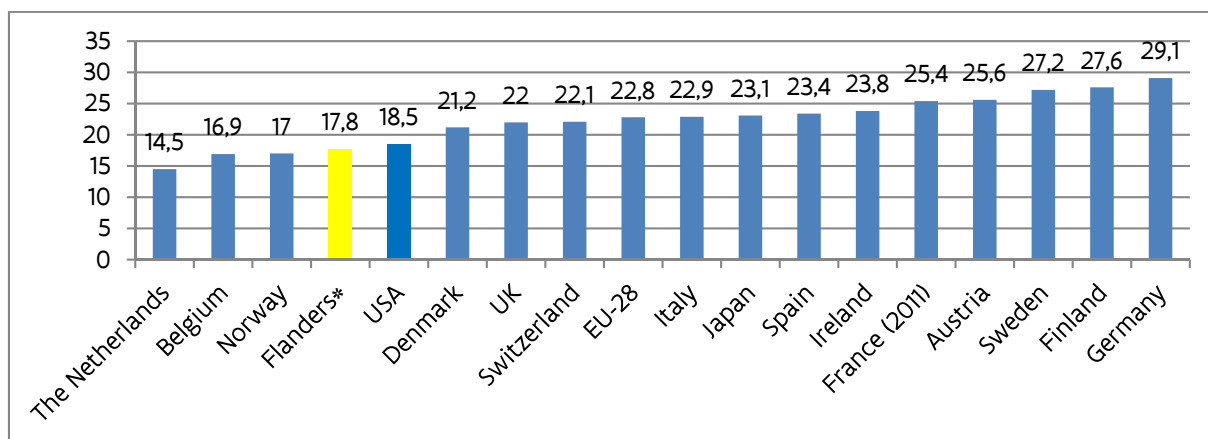
Source : Education department – DHO database

Despite the numerous initiatives to promote S&T, the proportion of S&T graduates in the total number of graduates in Flanders has not increased during the past ten years. In fact, the proportion has even declined marginally. Viewed from an international perspective, in 2012 Flanders was ranked below the EU-28 average and well below the leaders (Germany, Finland, Sweden, Austria and France), where more than 25% of all degrees are awarded in science, mathematics and technology. The Netherlands, Norway and the United States also score poorly with regard to their proportional number of ST&M graduates.

Table 6: Evolution of the percentage of degrees in mathematics, science and technology in higher education as a proportion of all degrees in higher education for Flanders (2003-2012)

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Flanders	20.5%	20.1%	20.3%	19.0%	19.8%	18.5%	19.0%	17.7%	17.8%	17.8%

Figure 21: International comparison of the percentage of degrees in mathematics, science and technology in higher education as a proportion of all degrees in higher education (2012)



Source : Education department – DHO database; \*Flanders: figures for Flemish Community

## 4 R&D personnel

In 2014, the total number of R&D personnel for Flanders reached 44,077 full-time equivalents (FTE), which is an increase of 17.5% since 2009. Over the past five years, the number of research staff has increased both in companies and in the public sector. The public sector groups together all research institutes from the higher education sector (HES), the government sector (GOV) and the private not-for-profit sector (PNP). The majority of the R&D personnel (58.1%) work in the private sector (BES). The overall share of the public component (PNP, HES and GOV) rather stays stable since 2010. The HES component is the most important element of the public component (with 14,449 FTE or 78.2%) in 2013, followed by the GOV component (3,905 FTE or 21.1%).

Figure 22: Evolution of the R&D personnel from 2008 to 2014

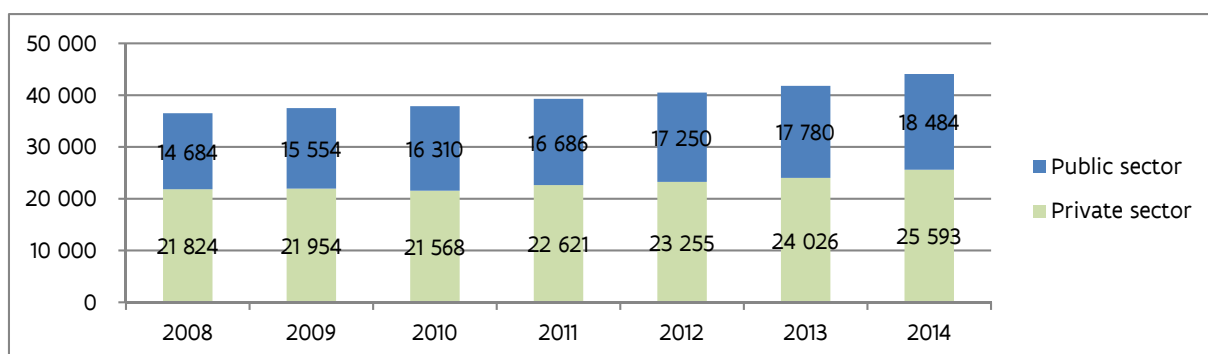
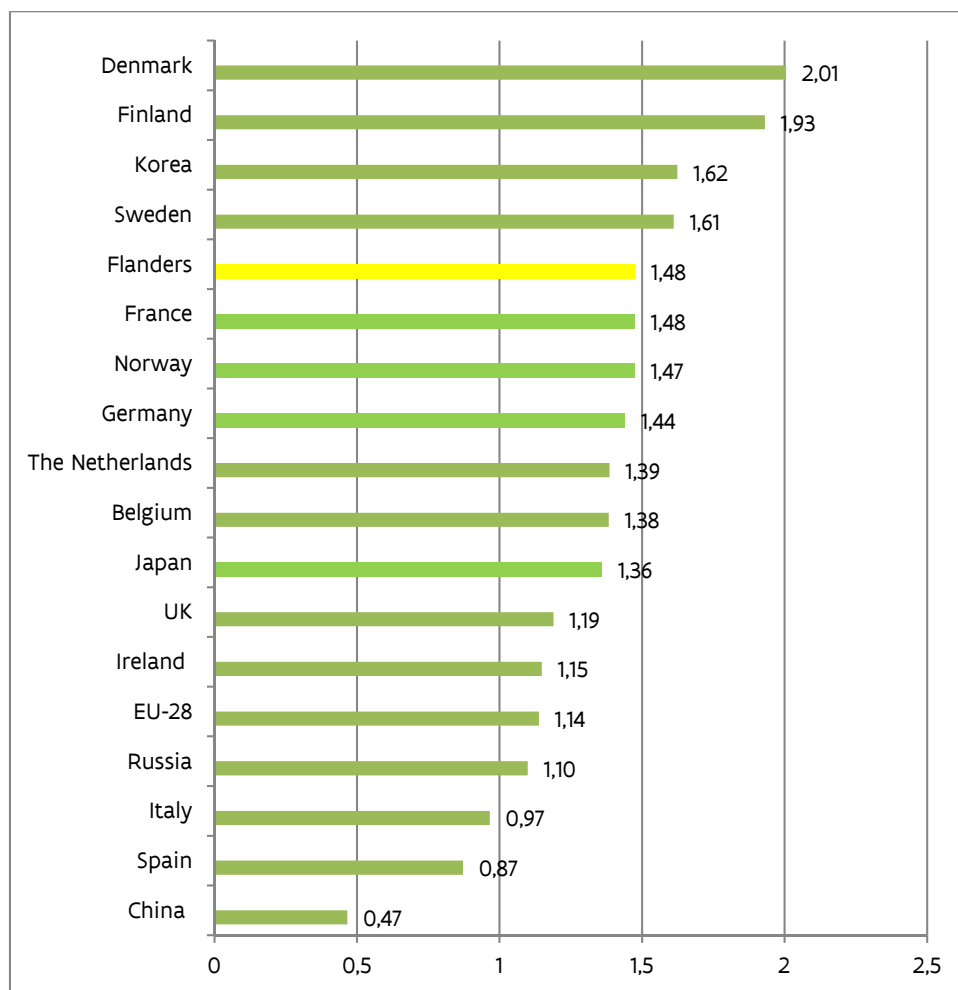


Figure 23: International position of Flanders for total R&D personnel (% of the labour force) (2014)



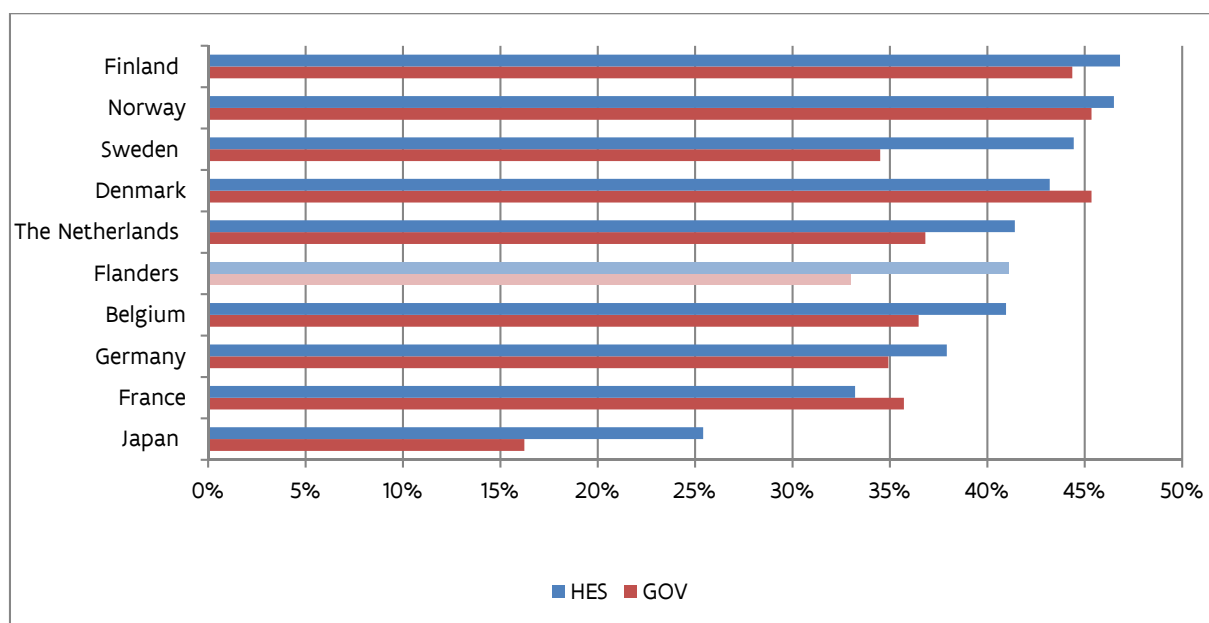
Source: OECD database, Main Science and Technology Indicators

The level of R&D personnel corresponds to 0.69% of the total population and 1.48% (2014) of the labour force. Flanders therefore belongs to the sub-top with regard to R&D personnel numbers as a proportion of the total population. The Flemish figure is higher than the EU-28 average and compares favourably with the French, the German and the Norwegian figures. However, the other Scandinavian countries still have a significant lead.

81.6% of the R&D personnel working in the HES in Flanders are researchers (2013). This figure is high compared to the other European countries and much higher than the EU-28 average. Approximately 62% of the R&D personnel (2013) in the GOV in Flanders are also researchers. Once again, this figure is higher than for France, Germany and the EU-28 average, but this time lower than most of the Scandinavian countries.

With a figure of 41% for female researchers working in the higher education (HES), Flanders again compares favourably with neighbouring countries (the Netherlands and France), but lays behind the Scandinavian lands. For female staff working in public research centres (GOV), Flanders has a score quite similar to Germany and France, but once again cannot match the performance of the north European countries. Flanders needs to work harder to follow the international trend of an increasing proportion of female researchers in both HES and GOV.

Figure 24: International comparison - % share of women researchers in GOV and HES (headcount) (2013)



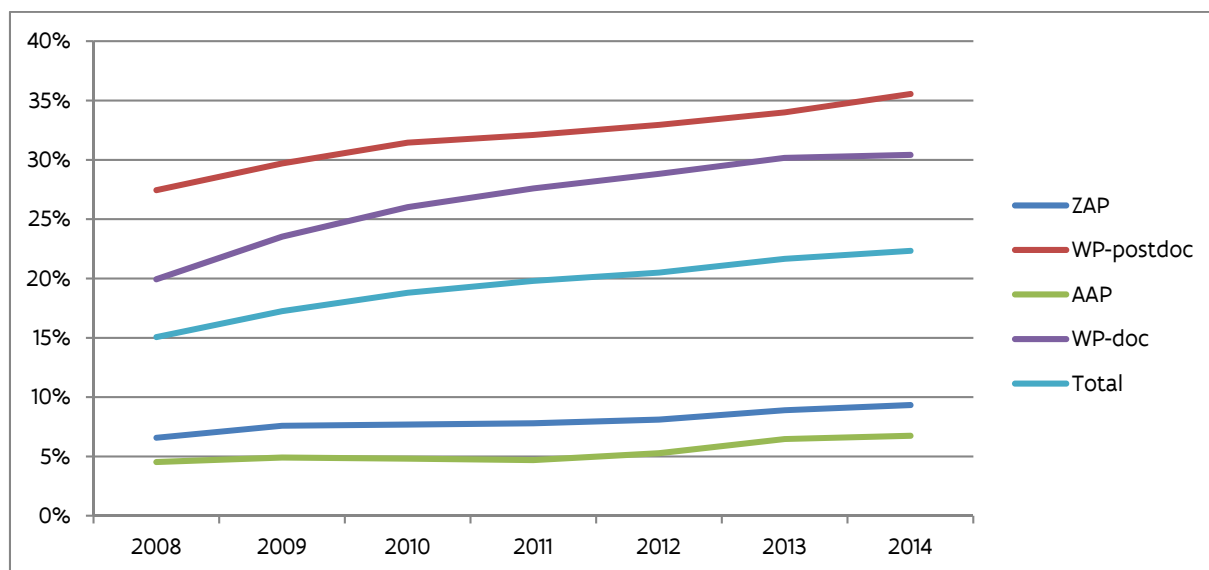
Source: OECD database, Main Science and Technology Indicators

EU-28, USA: no recent data available; France: underestimated data; The Netherlands: includes other classes (GOVERD); Sweden: break-in-time series.

## 5 Mobility of researchers

Between 2004 and 2015, the existing pattern of nationality for all statutes and levels of academic careers in Belgium gradually changed. These changes were least pronounced for Assisting Academic Staff or AAP (in 2004, 95.6% were Belgians and 92.8% in 2015) and for Senior Academic Staff or ZAP (95.0% in 2004 and still 90.2% in 2015). However, the changes were particularly strong for Scientific Staff or WP, above all in the sub-category “post-doctorates”, where the number of Belgian researchers declined from 77.2% in 2004 to 60.8% in 2015. The same trend is also noticeable for doctoral researchers: from 88.3% in 2004 to 69.9% in 2015.

Figure 25: Evolution of the non-Belgian nationality of researchers for the different statutes and levels of the academic career (2008-2015)



For Belgian PhD holders, the United States is the most popular destination to continue their career. The availability of positions at renowned research institutes obviously attracts more researchers. Belgian researchers also frequently choose neighbouring countries with strong research tradition, such as France, the United Kingdom, the Netherlands and Germany. This mobility pattern is similar to other Western European countries. Researchers in medical sciences often remain at an academic institution (or hospital) in North America. For the natural, applied and human sciences, researchers more often prefer to work in other countries within the EU.

Dutch, Italian and German researchers are strongly represented among the group of foreign researchers in Belgium, but also researchers from China and India are quite good represented. Foreign researchers are mainly found in the doctoral and postdoctoral sub-categories. The share of non-EU researchers for ZAP (Senior Academic Staff) or AAP (Assisting Academic Staff) personnel is rather limited to 1.5% of the total.

In the international survey “Careers of Doctorate Holders”, the market situation of doctorate holders was analysed in detail. A third of all doctorate holders are employed at the university where they obtained their doctorate, and a fifth afterwards move into industry. Less than 10% is employed in government institutes (8,7%), research institutes (7.7%) or the service sector (7.5%). Compared to other countries, the position in Flanders is similar to that of the United States, Denmark and the Netherlands, in terms of the ratio of doctorate holders employed in the business sector (including industry and services) compared with doctorate holders who have a university or college career. In Belgium, 33.4% of doctorate holders are employed in the enterprise sector and 41.7% in higher education sector; for Flanders these figures are respectively 35.6% and 40.5%.

## 6 PhD

Figure 26: Evolution of the number of PhDs in Flanders by gender from 2004-2005 to 2014-2015

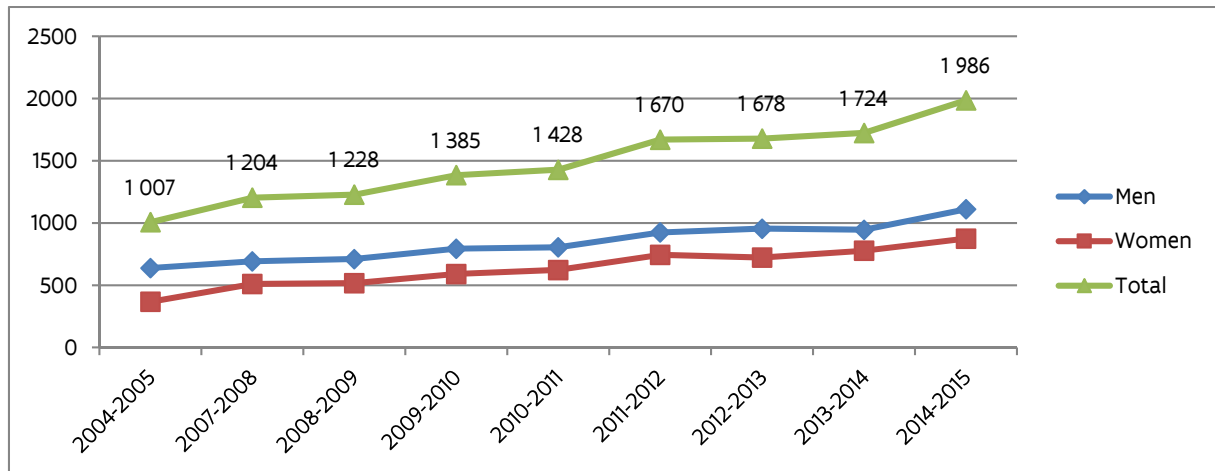
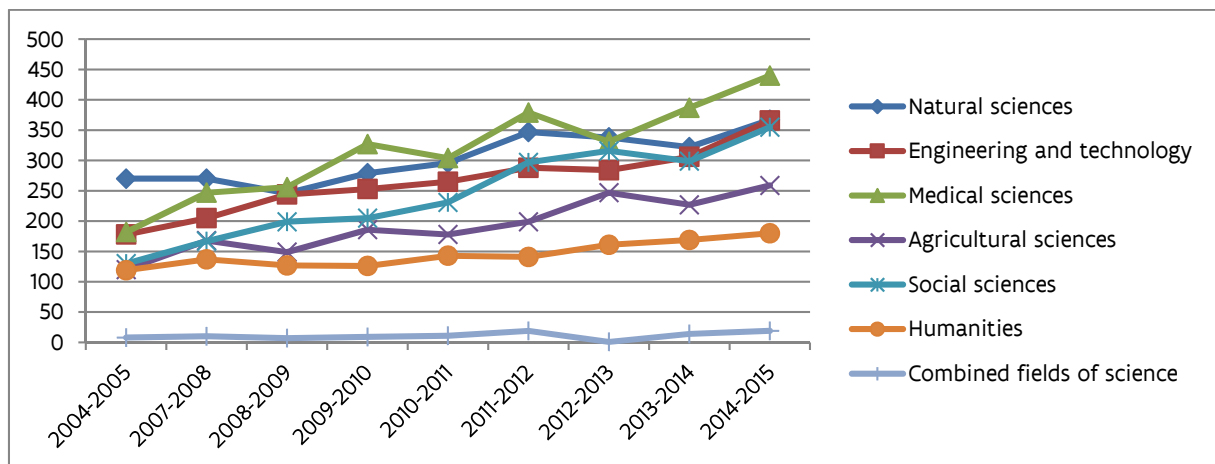


Figure 27: Evolution of the number of PhDs in Flanders by field of science from 2004-2005 to 2014-2015



During the past five years, the total number of PhDs in Flanders has increased by more than 43%, reaching a level of 1,986 new doctorate holders in 2014-2015. The number of female PhDs has also grown significantly (roughly doubled in the past ten years). Even so, the proportion of women holders is still limited to 44%. An analysis of the number of PhDs per field of science shows a substantial increase for the medical sciences, social sciences and engineering and technology in recent years. For the other fields of science, a slighter increase can be seen.





# Chapter 4

## Innovation efforts by enterprises in Flanders (CIS results)

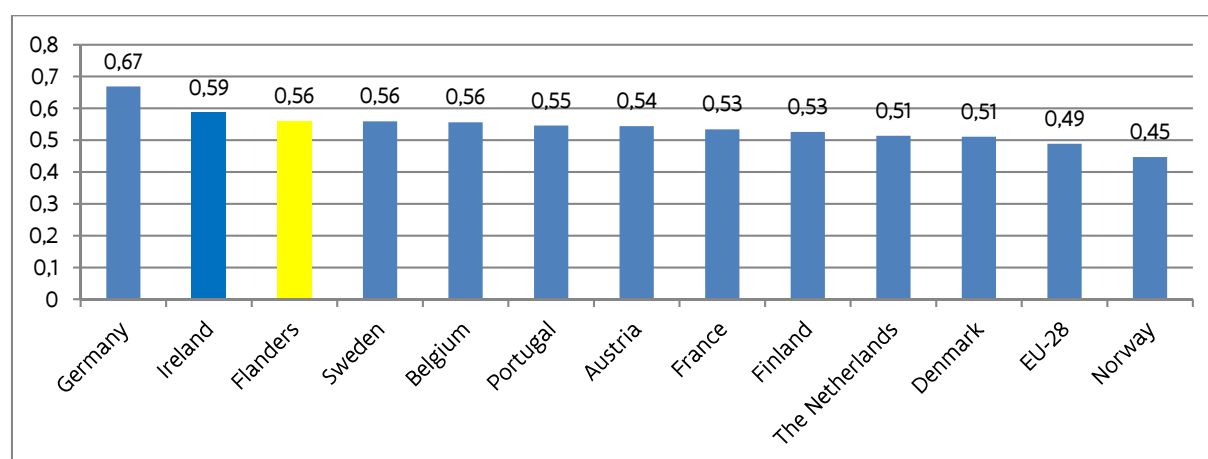


# 1 CIS: global results

Based on the principles described in the so-called Oslo Manual, the innovation efforts made by businesses in the European Union are systematically measured by the Community Innovation Survey (CIS). These harmonized surveys are carried out by the national statistical offices and are designed to give information about the degree of innovativeness in different sectors and regions. Different surveys were conducted over the years. The CIS-4 (2005) survey included for instance more sectors than other surveys but by disregarding the additional sectors, a historical comparison can be made for product and process innovation.

The overall innovation rate (process innovations, product innovations, organizational and marketing) of Flanders rose from 56% in 2012 to 68% in 2014. For 2014, no international comparison can be made. In 2012 Flanders (56%) scored above the EU-28 average of 49% and therefore kept its ranking among the top countries.

Figure 28: International comparison of the percentage of companies with ongoing or discontinued product and/or process innovation activities, and/or marketing and organizational innovation activities (2010-2012)



## 2 Process and product innovation

The results for Flanders for the CIS2015 show that in the period 2012-2014 57% of companies were innovative in terms of their products and/or processes. This is an increase compared to the results of CIS2013 (49%). Nevertheless, the time series show that the proportion of innovative firms remains relatively stable.

Table 7: Evolution of the percentage of companies in Flanders with ongoing or abandoned product and/or process innovation activities

	CIS-3 (2000)	CIS-4 (2005)	CIS2007	CIS2009	CIS2011	CIS2013	CIS 2015
All companies	58%	59%	56%	52%	53%	49%	57%
SMEs	58%	57%	54%	51%	52%	48%	56%
Large companies	83%	88%	82%	80%	79%	73%	76%
Low technology	55%	55%	53%	49%	49%	45%	54%
High technology	71%	78%	71%	70%	73%	66%	71%
Industry	69%	64%	64%	56%	60%	56%	65%
Services	49%	54%	49%	49%	47%	44%	51%

Source: ECOOM

A historical comparison can be made when the additional sectors from CIS-4 are disregarded.

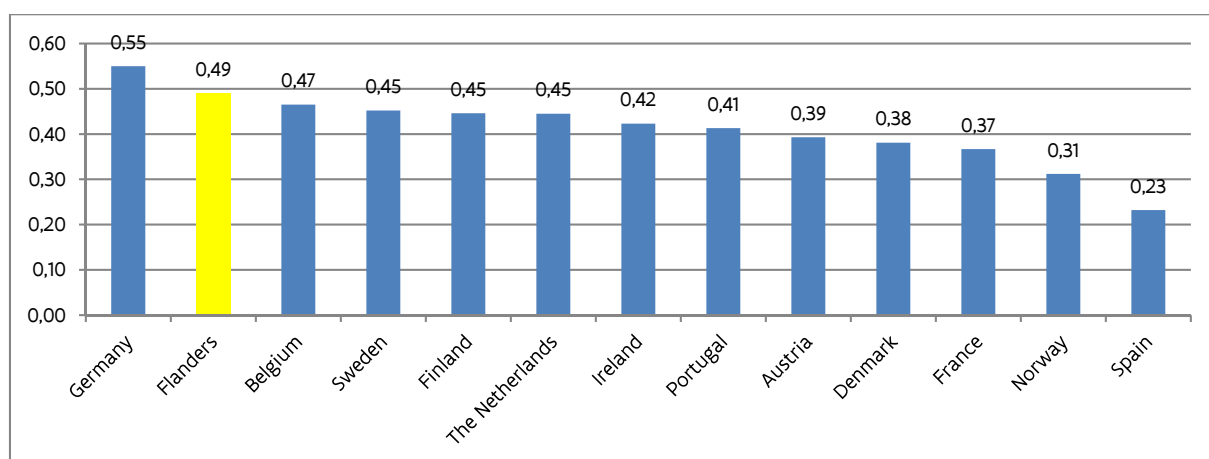
Process innovation is most common form of innovation in Flemish companies. Approximately 34% of all enterprises carried out process innovation in the period 2012-2014, corresponding to 75% (=43%/57%) of Flemish innovative companies. Approximately 34% of all enterprises carried out product innovation and this corresponds to 60% (=34%/57%) of Flemish innovative companies. Approximately 26% of all enterprises report ongoing or abandoned innovation activities (or 46% of the Flemish innovative companies).

Large companies and medium-sized companies are more innovative: they have consistently introduced more product and process innovations than smaller firms in recent years. The most innovative sector is the chemical/pharmaceutical industry, where 76% of companies indicated that they had started (but possibly not finished) product and/or process innovation activities in 2014.

With regard to the main reasons for undertaking innovation in earlier surveys, 48% of the innovative companies said that their aim was to improve the quality of their goods or services (main target). Other objectives included the expansion of the current range of goods or services (45%), an increase in market share (44%), and the replacement of obsolete products or processes (43%).

With an innovation rate for process and product innovation of 49% in 2012, Flanders scored well in comparison with the rest of Europe. However, for most European countries a decrease in the innovation rate has occurred in comparison with 2010.

Figure 29: International comparison of the percentage of companies with ongoing or discontinued product and/or process innovation activities (2012)



### 3 Organizational and marketing innovation

In addition to product and/or process innovations, organizational and/or marketing innovations can also have a significant impact on the performance of a company. During the period 2012-2014, organizational innovations were introduced by 37% of the companies. This was particularly the case with large companies (66%), compared to 46% for medium-sized firms and 32% for small enterprises. High-tech companies also initiated more organizational innovations (43%) than low-tech companies (36%). The main reasons for undertaking organizational innovations mentioned in previous surveys were the ability to respond faster to the needs of customers or suppliers (54%), the provision of better quality goods or services (51%), and better communication and information sharing within the company and with other companies and/or public institutions (37%).

According to the CIS-2015 definition, 31% of the surveyed companies said that they had carried out marketing innovation during the period 2012-2014. The differences between low-tech and high-tech companies (30% vs 33%) and between the industrial and service sectors (33% vs 29%) are much less pronounced than is the case for organizational innovations. Once again, however, it can be noted that large companies are more active in this type of innovation (42%) than medium (34%) or small (29%) companies. Reported main reasons for undertaking marketing innovations in previous surveys were to increase or maintain market share (70%), followed by the introduction of products to new customer groups (50%) and the introduction of products to new geographic markets was seen by one third of the companies as a goal.



# Chapter 5

STI productivity or STI output?



# 1 Introduction

Patent statistics and publication statistics provide important indicators for measuring R&D output. Long time series are available and the data allow cross-country comparison. This section looks more closely at the role of publications and patents (applications and grants) as an output of R&D expenditure.

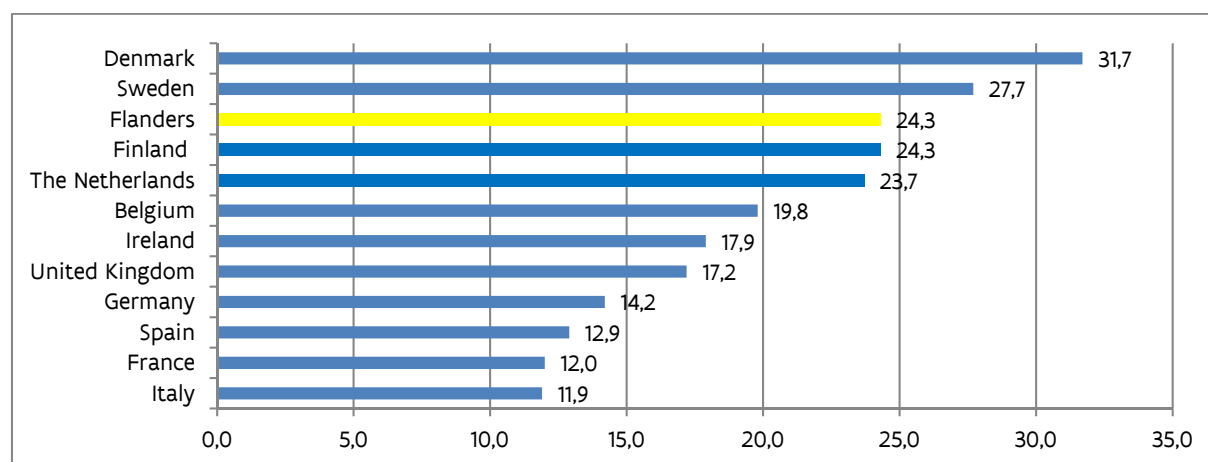
## 2 Scientific publications

Scientific publications are an important instrument for measuring the visibility of research output. This analysis is based on the major bibliographic information of ISI-Thomson Scientific; namely, the Science Citation Index (scientific journals) and the Proceeding Database (conference proceedings). The Flemish output of scientific publications has increased significantly in recent years. In 2014, there were 24.3 publications per 10,000 inhabitants, whereas there were only 14.2 publications per 10,000 inhabitants in 2003. Flanders now ranks in thirteenth position in Europe together with Finland after Denmark and Sweden.

Table 8: Evolution of the publication output per 10,000 inhabitants for Flanders (2006-2014)

	2006	2007	2008	2009	2010	2011	2012	2013	2014
only scientific journals	14,7	15,2	17,1	17,3	17,8	19,3	20,0	20,3	22,5
scientific journals and proceedings	16,4	17,4	19,9	19,1	19,7	20,9	22,3	22,3	24,3

Figure 30: International comparison of the publication output per 10,000 inhabitants (2014)



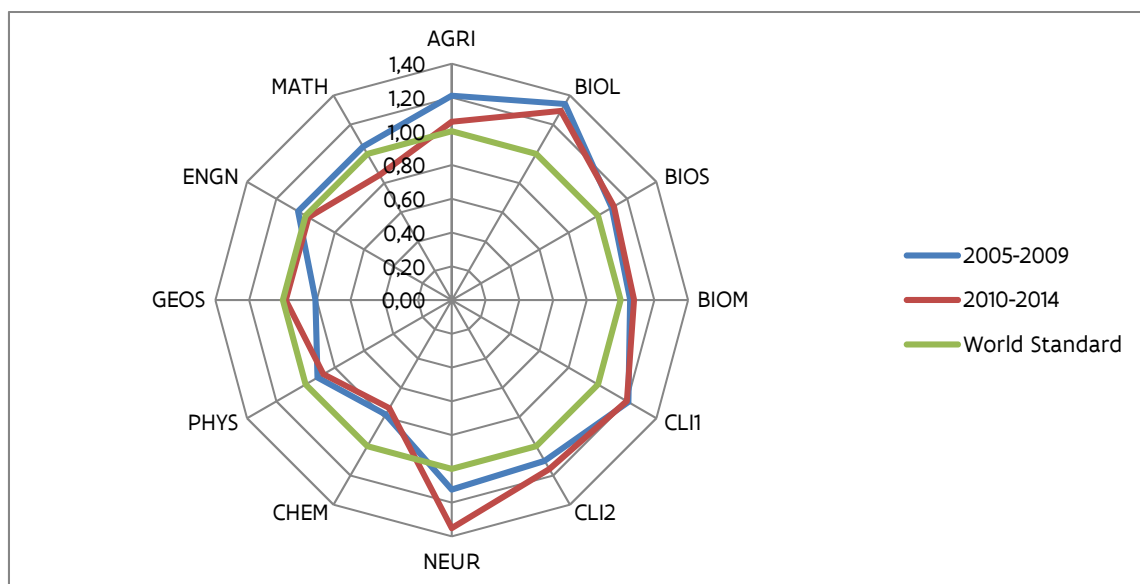
The share of Flemish publications in the total figure for Belgium shows an upward trend from 66% in 2002 to approximately 73% in 2014. The Flemish share (journal articles only, all S&T fields) of the world total of scientific publications increased from 0.86% in 2002 to 0.99% in 2013 (an increase of almost 18%). In the past ten years, the share of most European countries in the global total started to decline for France, Germany, Sweden, the UK, and Finland. Belgium, the Netherlands, Ireland, Denmark, Italy and Spain increased their share. However, the most important new player is China. In 2002, China's share of world publication output was roughly equivalent to that of Italy (about 4.89%). China passed France in 2004 and Germany and Great Britain in 2006. By 2013, the Chinese share had already risen to 15.87%.

All publication output for the period 2008 to 2013 can be broken down into publications by different types of organizations. The share of higher education (universities and university colleges) in the total number of Flemish scientific publications amounted to more than 87%. Over 11% of all Flemish SCIE documents were

published by employees from public research institutes or civil servants. Private institutions and hospitals (apart from university hospitals) were responsible respectively for around 7% and about 4% of the total. The share of the research institutes has continued to increase slightly in recent years.

The scientific specialization profile for Flanders for the period 2005 to 2014 is a typical example of the classic “Western” pattern, with life sciences and medical sciences as the dominant publications areas. Nevertheless, some other evolutions within this overall pattern are worth noting. For example, there was a sharp growth in Flanders between 2010 and 2014 in the fields of neuroscience (NEUR) and earth and space sciences (GEOS). The Flemish publication profile also shows that Flemish output is significantly above the world standard in terms of biology (BIOL), clinical and experimental medicine I (CLI1), experimental medicine ii (non-internal) (CLI2) and neurosciences (NEUR); and below the world standard in chemistry (CHEM), physics (PHYS) and mathematics (MATH) for the second period (2010-2014).

Figure 31: The scientific publication profile of Flanders in 2005-2009 and 2010-2014 based on the Activity Index (AI)



- AGRI = Agronomy and Environmental Sciences
- BIOL = Biology (at the organism and the supra-organism level)
- BIOS = Life Sciences (general, cellular and subcellular biology, genetics)
- BIOM = Biomedical Research
- CLI1 = Clinical and Experimental Medicine (general and internal medicine)
- CLI2 = Experimental Medicine II (non-internal)
- NEURO = Neurosciences
- CHEM = Chemistry
- PHYS = Physics
- GEOS = Earth and Space Sciences
- ENGN = Engineering
- MATH = Mathematics

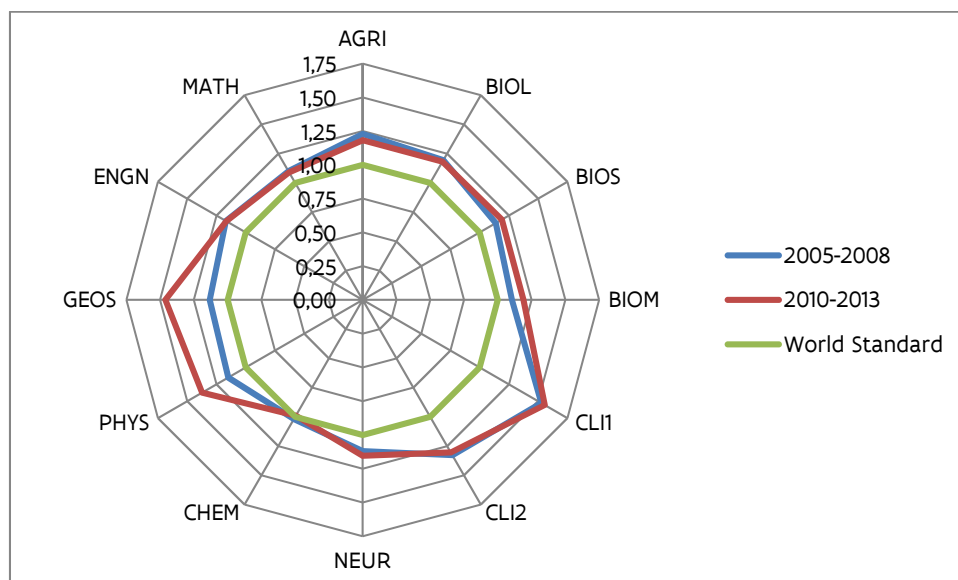


### 3 Citations

Citations analysis reflects the impact made by the research output of the scientific community and can also be used for measuring the quality of that output. Compared to other European countries and based on the results for the different periods covered in the citation map (2005-2008 and 2010-2013), Flanders is part of the leading group with Sweden, Denmark, the United Kingdom and the Netherlands.

The results of the two periods show that, in terms of relative citation frequency, Flanders is above or at least equal to the world standard in all fields of science. In particular, a very high score can be noted for the life sciences. The indicator value for chemistry (CHEM) is the lowest, but still represents the neutral value of 1.0 in comparison with the world standard. The relative citation scores for clinical research (CLI1 and CLI2) are higher than for the natural sciences. Also noteworthy is the increased impact in physics (PHYS) and earth and space sciences (GEOS) and the decreased impact in agriculture (AGRI).

Figure 32: The scientific citation profile of Flanders from 2005-2008 and 2010-2013 based on the Activity Index (AI)



### 4 Co-publications

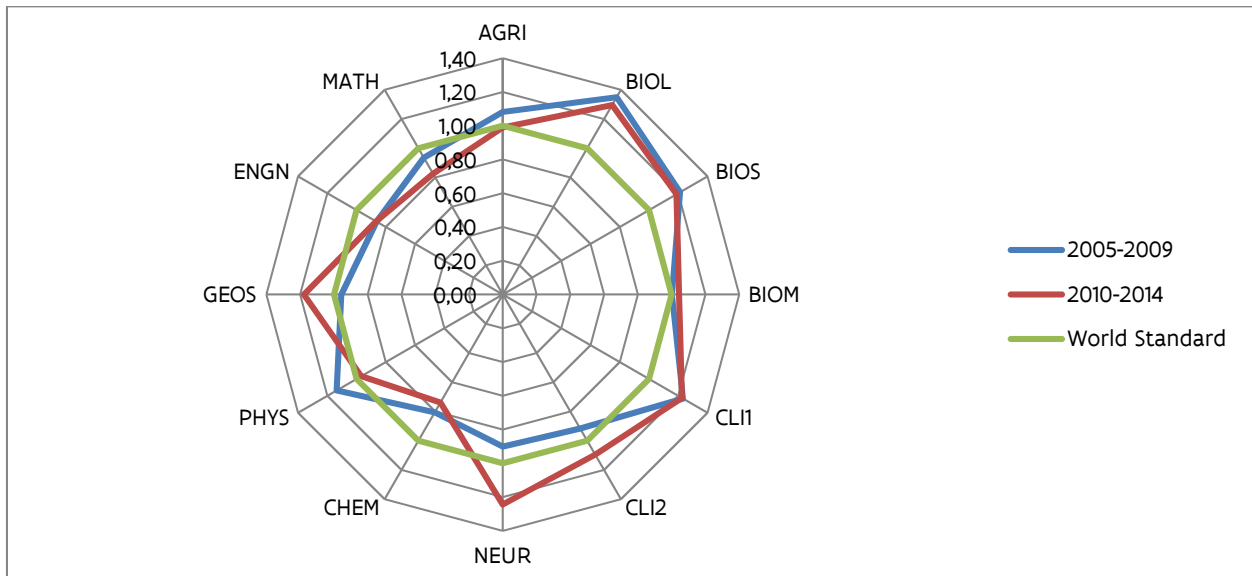
Flemish scientific publications are increasingly the result of close international cooperation. In 2014, almost 66.8% of the publications were written with at least one foreign co-author. Flanders occupies a leading position with Denmark (62.7%) and Sweden (62.4%) in the ranking of countries involved in co-authorship (2013). An analysis of the major co-publication links for Flanders for the period 2008-2013 reveal strong cooperation links with the Netherlands and medium co-publication links with Germany, UK, France, Switzerland, Hungary, Sweden, Spain, Austria and the United States. Other (but weaker co-publication links) can be found for most of the other EU-28 countries, with some African countries and other countries like Canada, Australia, New Zealand, Vietnam, Armenia, Georgia,...).

The relatively important link with some African countries (for example, the Democratic Republic of Congo) can partly be explained on historical grounds, although in general cooperation with Africa is still rather limited.

A comparison between the profile of the international co-publications of Flanders with the profile of all publications shows a clear polarization in favour of the biosciences (BIOL and BIOS) and CL11. In the second

period (2005-2009), the profile for Flanders for co-publications moved slightly over the world standard in the neuro- and behavioural sciences (NEUR), non-internal medicine (CLI2) and the earth and space sciences (GEOS). On the other hand, the co-publication activity in chemistry, technical sciences and mathematics decreased.

Figure 33: The scientific co-publication profile of Flanders from 2005-2009 and 2010-2014 based on the Activity Index (AI)



## 5 Social sciences & humanities

The growing importance of publications in the innovation chain and in the distribution of research funds to universities has become evident in recent years. Studies also show that the Web of Science (WoS) does not fully represent the research efforts being made in the social sciences and the humanities. The Flemish Government also wants to map the publications that are not included in the WoS. Consequently, a group of experts was charged to collect both groups in a database, called the “Vlaams Academisch Bibliografisch bestand” (VABB) for the socio-economic sciences and humanities (SSH).

At the present time, VABB-SSH lists 49,833 publications published between 2000 and 2012, of which just 20,034 were found in the WoS (under the categorizations SCIE, SSCI, AHCI and the proceedings for CPCI-S & CPCI-SSH). The other 29,799 contained 19,966 articles in magazines, 760 books (author), 1,312 books (editor), 6,956 chapters in books and 805 proceedings. Analysed by discipline (period 2000-2011), economics has the greatest share (14.0%), followed by law (13.8%), social health sciences (10.3%) and psychology (9.8%).

## 6 Patents

Patents are intended to grant innovators a temporary monopoly to exploit their innovative efforts. Patent information also helps to map technological progress and assess the degree of innovation within a particular organization or region. The total number of patents for Flanders, as well as those for the other reference countries, has increased in recent years.

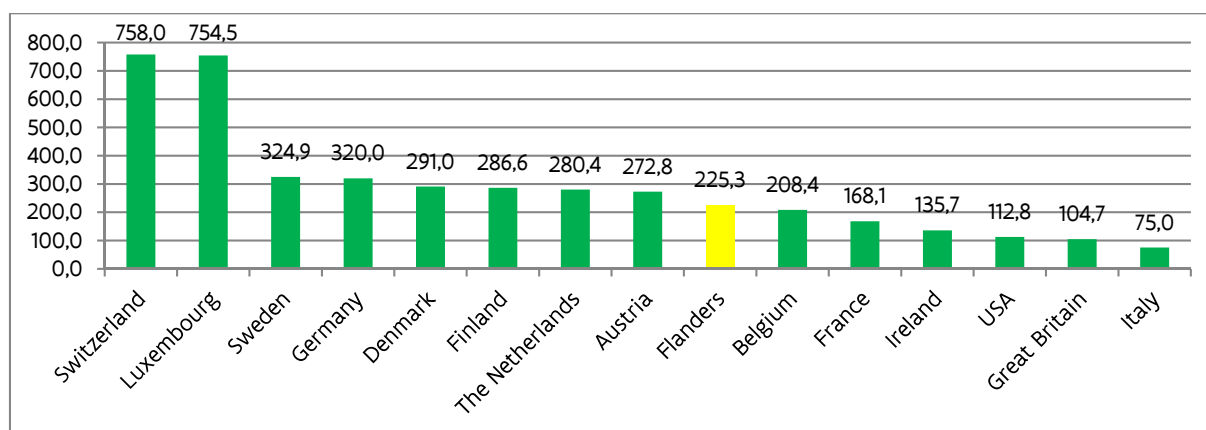
Between 1980 and 2012, 41,765 EPO patent applications with a Belgian inventor and/or applicant were made and, at the moment when the analysis was made, 19,129 or 46% had been effectively assigned. For Flanders, 28,319 patents applications were made during the same period and 13,257 (51%) were assigned 47%. These proportions are roughly equal to those for the following reference countries: Germany, UK, USA, the Netherlands, France, Sweden and Finland.

An international comparison (2012) of the number of patents by origin (EPO patents) indicates that Flanders is located in the group of followers (ninth position), with 225.3 patents per million of population, by origin, inventor and/or applicant. This ranking is led by Switzerland, Luxembourg, Sweden and Germany. Flanders is after Austria (eighth) and before Belgium (tenth). Viewed in international terms, this is quite a good result for Flanders and Belgium, bearing in mind that all the reference countries together represent about 95% of total patent activities.

Table 9: Evolution of EPO patent applications for Flanders per million of population by origin, inventor and/or applicant (2004-2012)

	2004	2005	2006	2007	2008	2009	2010	2011	2012
Flanders	231,4	272,5	274,7	280,3	270,7	232,4	227,4	233,8	225,3

Figure 34: International comparison of EPO patent applications per million of population by origin, inventor and/or applicant (2012)

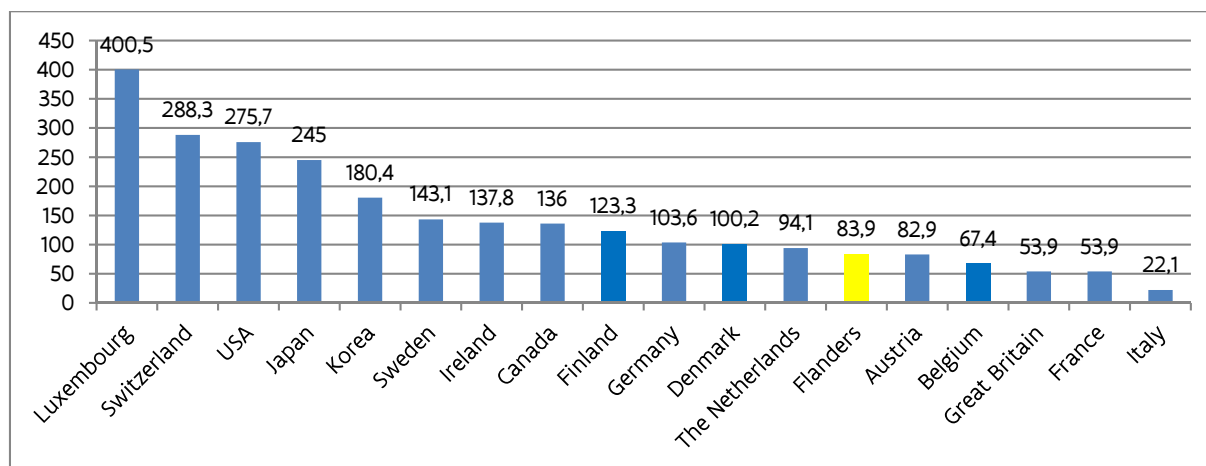


Based on patents granted under the USPTO system, Belgium and Flanders occupy respectively fifteenth and thirteenth place. The leaders here are Luxembourg, Switzerland, the USA, and Japan.

Table 10: Evolution of USPTO patent grants for Flanders per million of population by origin, inventor and/or applicant (2004-2011)

	2004	2005	2006	2007	2008	2009	2010	2011
Flanders	150,3	182,5	172,4	152,2	144,6	126,3	110,8	83,9

Figure 35: International comparison of USPTO patent grants per million of population by origin, inventor and/or applicant (2011)

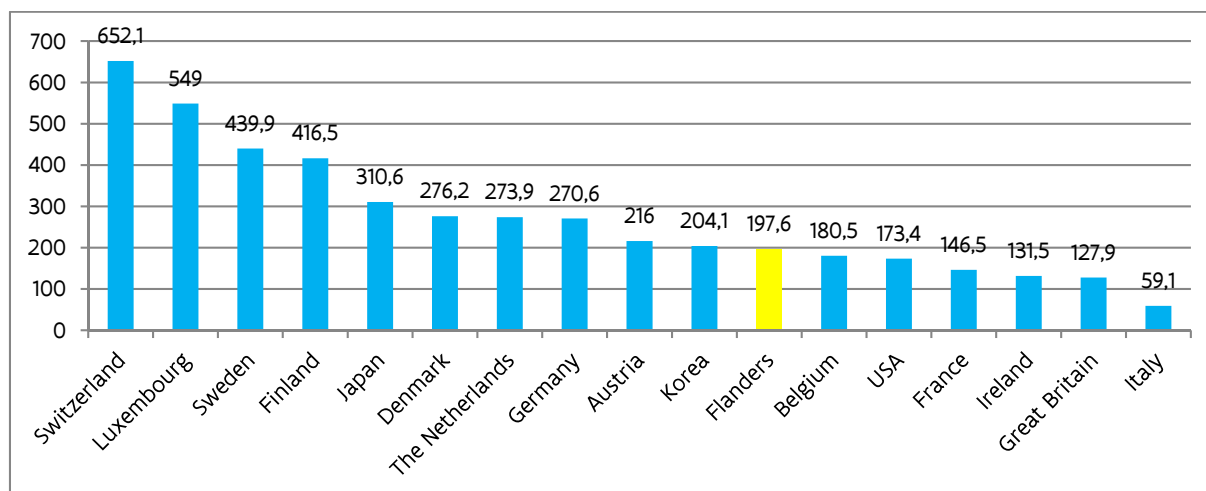


Flanders occupies the eleventh place in the ranking of PCT applications, with Belgium in twelfth position. This list is headed by Switzerland, Luxembourg, Sweden, Finland and the Netherlands.

Table 11: Evolution of PCT patent applications for Flanders per million of population by origin, inventor and/or applicant (2004-2011)

	2004	2005	2006	2007	2008	2009	2010	2011
Flanders	145,1	179,9	192,5	205,8	214,9	189,1	192,9	197,6

Figure 36: International comparison of PCT patent applications per million of population by origin, inventor and/or applicant (2011)



Companies are particularly active in applying for patents (78%). In addition, both the public research centres (IMEC, VIB,...) and the universities are increasingly active as patent applicants (10%). Viewed in international terms, this rate for Flanders is very high. The five most important applicants for Flanders are Agfa-Gevaert (inclusive Agfa Healthcare and Agfa Graphics), Electrolux Home Products Corporation, Janssen Pharmaceutica, IMEC and KU Leuven.

In 34% of all EPO-patent applications with a Flemish inventor - in the last ten years - foreign applicants are involved. These patent applications with Flemish inventor(s) are mainly applicants from the United States (26%), Germany (16%) and France (15%). International collaboration can be illustrated by patents with at least one Flemish inventor and one foreign inventor (co-invention). This is the case in 45% of the Flemish patents, which is quite higher than for other reference countries (34%).

A regional European patent map (version 2016) divided 276 European regions at the NUTS2 level. The European top-five on the basis of information from the *applicants* are: *Nordwestschweiz* (CH), *Oberbayern* (DE), *Stuttgart* (DE), *Helsinki-Uusimaa* (FI) and *Zentralschweiz* (CH). For Flanders: *Vlaams-Brabant* occupies position 44 in this ranking, with *West-Vlaanderen* at 52, *Oost-Vlaanderen* at 74, *Antwerpen* at 82 and *Limburg* at 103. On the basis of information from the *inventors* of the patents, the top-five are Nordwestschweiz (CH), Vorarlberg (AT), Karlsruhe (DE), Stuttgart (DE), and Mittelfranken (DE) The Flemish provinces are ranked at 24 (*Vlaams-Brabant*), at 57 (*Oost-Vlaanderen*), at 64 (*Antwerpen*), at 78 (*Limburg*) and at 79 (*West-Vlaanderen*).

The regional patent map for Flanders (version 2016) divided the patents at the departmental level. On the basis of information provided by the inventors the top-five are *Leuven*, *Gent*, *Halle-Vilvoorde*, *Kortrijk en Roeselare*. The top-five based on information from the applicants are *Leuven*, *Brugge*, *Kortrijk*, *Gent* and *Tielt*.

# Acronyms and abbreviations

AAL	Ambient Assisted Living
AAVR	Office of the General Representative of the Government of Flanders to the EU within the permanent representation of Belgium to the EU
AHA	Active and Healthy Aging
AIO	Flanders Innovation and Entrepreneurship
ARTEMIS	Advanced Research & Technology for EMbedded Intelligence and Systems
BAN Vlaanderen	Business Angels Network in Flanders
BBB	Better Governing
BBI	BioBased Industries
BBRI	Belgian Building Research Institute
BERD	Business Expenditure on Research and Development
BES	Business Enterprise Sector
BIOL	Biology
BOF	Special Research Fund
BRRC	Belgian Road Research Centre
BWI	Belgian Welding Institute
CECAM	European Centre for Atomistic and Molecular Computations
Centexbel	Scientific and Technical Service Centre for the Belgian Textile Industry
CERN	European Organization for Nuclear Research
CIP	Competitiveness and Innovation Framework Programme
CIS	Community Innovation Survey
COST	(European) Cooperation in Science and Technology
CRC	Centre for Research and Conservation
CRIC	Centre for the Cement Industry
CSTP	Committee on Science and Technological Innovation Policy
EEN	Enterprise Europe Network
ECOOM	Centre for Research & Development Monitoring
EIS	European Innovation Scoreboard
EIT	European Institute for Technology
EMB	European Marine Board
EMBO/L	European Molecular Biotechnology Organisation/Laboratory
ENGN	Engineering
EMODnet	European Marine Observation and Data Network
EPO	European Patent Office
ERA	European Research Area
ERDF	European Regional Development Fund
ERRIN	European Regions Research and Innovation Network
ESA	European Space Agency
ESF	European Science Foundation or European Social Fund
ESFRI	European Strategy Forum on Research Infrastructures
ESO	European Southern Observatory
ESRF	European Synchrotron Radiation Facility
EU	European Union
EUREKA	An intergovernmental initiative to promote international cooperation for projects for applied and market-oriented industrial R&D
EWI	Economy, Science and Innovation (Economie, Wetenschap en Innovatie)
FISCH	Flanders Innovation Hub for Sustainable Chemistry
FIT	Flanders Investment and Trade
FLAMAC	Flanders Materials Centre
Flanders DRIVE	Automotive Industry
Flanders Food	Innovative Food Industry
Flanders InShape	Product Development and Industrial Design
Flanders Synergy	Innovative Labour Organization
Flanders PlasticVision	Plastic Processing Industry

FMTC	Flanders Mechatronics Technology Centre
FP	Framework Programme
FRIS	Flanders Research Information Space
FTE	Full-time equivalent
FUST	Flanders UNESCO Science Trust
FWO	Research Foundation Flanders
GBARD	Government Budget Appropriations for R&D
GDP	Gross Domestic Product
GDP(R)	Gross Domestic Product per Region
GERD	Gross Expenditure on Research and Development
GII	Global Innovation Index
GIMV	Flanders Investment Company
GOV	Government sector
HEI	Universities and university colleges
HES	Higher education sector
HRST	Human Resources in Science and Technology
HUB	Hogeschool-Universiteit Brussel (University College-University Brussels)
IBN	Innovative Business Networks (innovatieve bedrijfsnetwerken)
IIC	Incubation and Innovation Centre
ILVO	Institute for Agricultural and Fisheries Research
IMEC	Interuniversity Micro-Electronic Centre
IMI	Innovative Medicines Initiative
iMinds	Interdisciplinary Institute for Broadband Technology
INBO	Research Institute for Nature and Forest
IOC	Inter-governmental Oceanographic Commission
IODE	International Oceanographic Data and Information Exchange
IOF	Industrial Research Fund
IPR	Intellectual property rights
IRG	Innovation Steering Groups
IRMM	Institute for Reference Materials and Measurements
ITM	Institute for Tropical Medicine
IUS	Innovation Union Scoreboard
IV	Internationaal Vlaanderen, Flanders International (policy field)
JP	Joint Programming
JPI	Joint Programming Initiative
JRC	Joint Research Centre
JTI	Joint Technology Initiative
JU	Joint Undertakings
KANTL	Royal Academy for Dutch Language and Literature
KET	Key Enabling Technologies
KGAB	Royal Academy for Medicine of Belgium
KI	Knowledge institution
KMSKA	Royal Museum of Fine Arts Antwerp
KVAB	Royal Flemish Academy of Belgium for Sciences and Arts
LERU	League of European Research Universities
MATH	Mathematics
MIC	Microsoft Innovation Centre Flanders
MIP	Environmental and Energy Technology Innovation Platform
MIX	Media Innovation Centre
MoU	Memorandum of Understanding
NACE	General industrial classification of economic activities within the European Communities
NCP	National Contact Point
NERF	Neuro-electronics Research Flanders
NESTI	National Experts on Science and Technology Indicators
NEUR	Neurosciences
Non-BERD	GOVERD + HERD + PNP
NUTS	Nomenclature of Territorial Units for Statistics



OECD	Organization for Economic Cooperation and Development
OMC	Open Method of Coordination
QS	Quacquarelli Symonds (ranking)
PIC	Provincial Innovation Centres
PCT	Patent Cooperation Treaty
PMV	Flanders Holding Company
PNP	Private non- Profit Sector
PPP	Purchasing Power Parities
PPS	Programmatory Public Service
PROs	Public Research Organizations
R&D	Research and Development
R&D&I	Research, Development and Innovation
REC	Research institutes
RIS	Regional Innovation Scoreboard
RTD	Research and Technological Development
RZSA	Royal Zoological Society of Antwerp
SCK CEN	Nuclear Energy Centre
S&T	Science & Technology
SERV	Flanders Social and Economic Council
SIA's	Strategic Innovation Agendas
SIM	Strategic Initiative on Materials
SIRRIIS	Collective Centre of the Belgian Technology Industry
SME Programme	Small and Medium-sized Enterprises
SOC's / SRC	Strategische Onderzoekscentra / Strategic Research Centres
SSH	Socio-economic Sciences and Humanities
STEM-action	Science, Technology, Engineering, Mathematics
STI	Science, Technology and Innovation
STV	Foundation for Technology Assessment Flanders
SWOT	Strengths, Weaknesses, Opportunities and Threats (analysis)
TGO	Transformational Medical Research
TINA fund	Transformation, Innovation and Acceleration Fund
TIP	Technology and Innovation Policy
TTO	Technology Transfer Office
UGent	Ghent University
UN	United Nations
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNU-CRIS	United Nations University – Centre for Regional Integration Studies
USPTO	United States Patent and Trademark Office
VABB	Flemish Academic Bibliografic Database
VIB	Flanders Institute for Biotechnology
VIL	Flanders Institute for Logistics
VIM	Flemish Institute for Mobility
VIN	Flemish Innovation Network
Vinnof	Flemish Innovation Fund
VIS	Flemish Innovation Partnerships
VITO	Flemish Institute for Technological Research
VKI	Von Karman Institute for fluid dynamics
VLEVA	Liaison Agency Flanders-Europe
VLHORA	Flemish Council of University Colleges
VLIZ	Flanders Marine Institute
VRWI	Flemish Council for Science and Innovation
VUB	Vrije Universiteit Brussel
WIPO	World Intellectual Property Organisation





# Websites (non-comprehensive list)

**Pact 2020**  
(monitoring reports) [www.vlaandereninactie.be/over/pact-2020](http://www.vlaandereninactie.be/over/pact-2020)

**VRWI** [www.vrwi.be](http://www.vrwi.be)

## Policy actors (EWI)

*EWI Department* [www.ewi-vlaanderen.be](http://www.ewi-vlaanderen.be)

*FWO* [www.fwo.be](http://www.fwo.be)

*AIO* [www.vlaio.be](http://www.vlaio.be)

*PMV* [www.pmv.eu](http://www.pmv.eu)

## policy-related, other

*Policy research centres* [www2.vlaanderen.be/weten/steunpunten](http://www2.vlaanderen.be/weten/steunpunten)  
*ECOOM R&D Monitoring* [www.ecoom.be](http://www.ecoom.be)  
*Special Research Fund (BOF)* [www.ewi-vlaanderen.be/ewi/wat-doen-we/programmas-subsidies/financiering-van-onderzoek/bijzondere-onderzoeksfondsen](http://www.ewi-vlaanderen.be/ewi/wat-doen-we/programmas-subsidies/financiering-van-onderzoek/bijzondere-onderzoeksfondsen)

*KVAB* [www.kvab.be](http://www.kvab.be)

*KAGB* [www.zorg-en-gezondheid.be/KAGB](http://www.zorg-en-gezondheid.be/KAGB)

*KANTL* [www.kantl.be](http://www.kantl.be)

*VCP → Horizon 2020, other:* [www.europrogs.be](http://www.europrogs.be)

*Europrogs*

*Vlaams Innovatienetwerk (VIN)* [www.innovatienetwerk.be](http://www.innovatienetwerk.be)

*E.E.N. Vlaanderen* [www.enterpriseeuropenvlaanderen.be](http://www.enterpriseeuropenvlaanderen.be)

*Policy documents* [www.ewi-vlaanderen.be/ewi/beleid/beleidsdocumentatie](http://www.ewi-vlaanderen.be/ewi/beleid/beleidsdocumentatie)

*VRWI Foresight 2025* [www.vrwiforflanders2025.be](http://www.vrwiforflanders2025.be)

*GIMV* [www.gimv.com](http://www.gimv.com)

*BAN Vlaanderen* [www.ban.be](http://www.ban.be)

*Qbic* [www.qbic.be](http://www.qbic.be)

*Technology Transfer Offices (TTO)* [www.ttoflanders.be](http://www.ttoflanders.be)

*Flanders*

*FlandersBio* [Flandersbio.be](http://Flandersbio.be)

## Science, Research and Innovation institutes and related organizations

*5 (university) associations (Brussel, Antwerpen, KU Leuven, Limburg, Gent)* [www.ond.vlaanderen.be/hogeronderwijs/nuttigeAdressen/#associatie](http://www.ond.vlaanderen.be/hogeronderwijs/nuttigeAdressen/#associatie)

*Universities (VUB, UA, KU Leuven, UGent, UHasselt, HUB-KU Brussel, tUL)* [www.ond.vlaanderen.be/hogeronderwijs/nuttigeAdressen/#Universiteiten](http://www.ond.vlaanderen.be/hogeronderwijs/nuttigeAdressen/#Universiteiten)

*University colleges* [www.ond.vlaanderen.be/hogeronderwijs/nuttigeAdressen/#Hogescholen](http://www.ond.vlaanderen.be/hogeronderwijs/nuttigeAdressen/#Hogescholen)

<i>FRIS database (research projects from Flemish Community institutes)</i>	<a href="http://www.researchportal.be">www.researchportal.be</a>
<i>VLIR</i>	<a href="http://www.vlir.be">www.vlir.be</a>
<i>VLHORA</i>	<a href="http://www.vlaamsehogescholenraad.be">www.vlaamsehogescholenraad.be</a>
<i>VLUHR</i>	<a href="http://www.vluhr.be">www.vluhr.be</a>
<i>VLOR</i>	<a href="http://www.vlor.be">www.vlor.be</a>
<i>IMEC</i>	<a href="http://www.imec.be">www.imec.be</a>
<i>VIB</i>	<a href="http://www.vib.be">www.vib.be</a>
<i>VITO</i>	<a href="http://www.vito.be">www.vito.be</a>
<i>IMINDS</i>	<a href="http://www.iminds.be">www.iminds.be</a>
<i>Flanders Make</i>	<a href="http://www.flandersmake.be/">http://www.flandersmake.be/</a>
<i>Innovation platforms (list of institutes acknowledged by AIO, previously the IWT)</i>	<a href="http://www.iwt.be/subsidies/innovatieplatformen">www.iwt.be/subsidies/innovatieplatformen</a>
<i>Federal collective research centres</i>	<a href="http://economie.fgov.be/en/entreprises/Market_Regulation/Standardization/Prenormative_research/">economie.fgov.be/en/entreprises/Market_Regulation/Standardization/Prenormative_research/</a>
<i>ILVO</i>	<a href="http://www.ilvo.vlaanderen.be">www.ilvo.vlaanderen.be</a>
<i>INBO</i>	<a href="http://www.inbo.be">www.inbo.be</a>
<i>KMSKA</i>	<a href="http://www.kmska.be">www.kmska.be</a>
<i>Flanders Heritage Agency</i>	<a href="http://www.onroerenderfgoed.be">www.onroerenderfgoed.be</a>
<i>ITM</i>	<a href="http://www.itg.be">www.itg.be</a>
<i>VLIZ</i>	<a href="http://www.vliz.be">www.vliz.be</a>
<i>KMDA - CRC</i>	<a href="http://www.kmda.org">www.kmda.org</a> and <a href="http://www.zooresearch.be">www.zooresearch.be</a>
<i>MIP3</i>	<a href="http://www.mipvlaanderen.be">www.mipvlaanderen.be</a>
<i>ICleantech</i>	<a href="http://www.i-cleantechvlaanderen.be">www.i-cleantechvlaanderen.be</a>
<i>NERF</i>	<a href="http://www.nerf.be">www.nerf.be</a>
<i>Energyville</i>	<a href="http://www.energyville.be">www.energyville.be</a>
<i>CMi</i>	<a href="http://www.cmi-vzw.be">www.cmi-vzw.be</a>
<i>SIM</i>	<a href="http://www.sim-flanders.be">www.sim-flanders.be</a>
<i>Microsoft Innovation Centre Vlaanderen</i>	<a href="http://www.micvlaanderen.be">www.micvlaanderen.be</a>
<i>Plan C</i>	<a href="http://www.plan-c.eu">www.plan-c.eu</a>
<i>Smart Grids Flanders</i>	<a href="http://www.smartgridsflanders.be">www.smartgridsflanders.be</a>
<i>Flanders District of Creativity</i>	<a href="http://www.flandersdc.be">www.flandersdc.be</a>
<i>College of Europe</i>	<a href="http://www.coleurope.eu">www.coleurope.eu</a>
<i>Vlerick Business School</i>	<a href="http://www.vlerick.com">www.vlerick.com</a>
<i>Antwerp Management School</i>	<a href="http://www.antwerpmanagementschool.be">www.antwerpmanagementschool.be</a>
<i>Federal scientific institutes</i>	<a href="http://www.belspo.be/belspo/fsi/index_en.stm">www.belspo.be/belspo/fsi/index_en.stm</a>
<i>National Institute for Radioelements</i>	<a href="http://www.ire.eu">www.ire.eu</a>
<i>Nuclear Energy Centre - SCK</i>	<a href="http://www.sckcen.be">www.sckcen.be</a>
<i>Agency Botanic Garden of Meise</i>	<a href="http://www.plantentuinmeise.be">www.plantentuinmeise.be</a>
<i>College of Europe</i>	<a href="http://www.coleurope.eu">www.coleurope.eu</a>
<i>Vlerick Business School</i>	<a href="http://www.vlerick.com">www.vlerick.com</a>
<i>Antwerp Management School</i>	<a href="http://www.antwerpmanagementschool.be">www.antwerpmanagementschool.be</a>
<i>Technology Attachés FIT</i>	<a href="http://www.flanderstrade.be/site/wwwnl.nsf/BuitenlandsnetwerkTA?readform">www.flanderstrade.be/site/wwwnl.nsf/BuitenlandsnetwerkTA?readform</a>
<i>Von Karman Institute for fluid dynamics</i>	<a href="http://www.vki.ac.be">www.vki.ac.be</a>
<i>JRC - IRMM</i>	<a href="http://irmm.jrc.ec.europa.eu">irmm.jrc.ec.europa.eu</a>
<i>Project Office for IODE</i>	<a href="http://www.iode.org">www.iode.org</a>



# Colophon

STI in Flanders is a publication of

The Flemish Government,  
Department Economy, Science and Innovation

Flemish Government  
Department of Economy, Science and Innovation  
Koning Albert II-laan 35, bus 10  
1030 BRUSSELS, Belgium

Tel.: +32 (0)2 553 59 80  
info@ewi.vlaanderen.be  
www.ewi-vlaanderen.be

Authors:

Niko Geerts, Stefanie Maris, Monica Van Langenhove,  
Pierre Verdoodt, Peter Viaene

Coordination: Emmelie Tindemans en Ils De Bal

Publisher:

Johan Hanssens, Secretary-General,  
Department Economy, Science and Innovation  
Flemish Government

Content revised and enlarged version finalised on 1<sup>st</sup> of September 2016

The reproduction of content of the “STI in Flanders”  
publication is only allowed with a reference to the source. The  
Department Economy, Science and Innovation is not liable for  
any use of information in this edition.

D/2016/3241/231

DEPARTMENT OF  
**ECONOMY**  
**SCIENCE &**  
**INNOVATION**



DEPARTMENT OF  
**ECONOMY, SCIENCE & INNOVATION**

KONING ALBERT II-laan 35 bus 10  
1030 Brussels  
[www.ewi-vlaanderen.be](http://www.ewi-vlaanderen.be)