mKETs-Pilot lines project
The goal of the mKETs-PL project is to prepare and foster a common understanding and consensus for future actions in Europe focusing on multi-KETs pilot lines

mKETs-PL working document

Country report Belgium

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- Netherlands organisation for Applied Scientific Research TNO
- Fraunhofer-Gesellschaft
- Commissariat à l'énergie atomique et aux énergies alternatives (CEA)
- Cambridge University-Cambridge enterprise
- VTT
- Tecnalia
- Technology Partners Foundation
- Joanneum Research Austria
- D'Appolonia S.p.A
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Content

1. Policy perspective

This report describes multi-KETs pilot lines and the way they are supported in Belgium. Belgium is a federal state, with the major part of the responsibility for science, research, education and innovation delegated to the regions and communities. This report will discuss the policy perspective on KETS taking into account the various entities in Belgium.

1.1. Country specific innovation system with emphasis on KET[1]

Belgium is a federal state, consisting of seven autonomous entities: the Federal Government, three regions and three communities[2]. Each entity has exclusive responsibilities. The Federal Government is responsible for policy areas of national interest, including defense, justice, monetary and fiscal policy, social security and the main part of health policy and research. The communities correspond to population groups and are responsible for person-related issues such as language, culture and educations. The regions correspond to a territorial concept and are responsible for issues such as innovation, economic development, spatial planning, technological development, environment and agriculture (the latter since 2001). Each of the seven entities has its own government and parliament. In Flanders, the Flemish Region and the Flemish Community are integrated into one government.

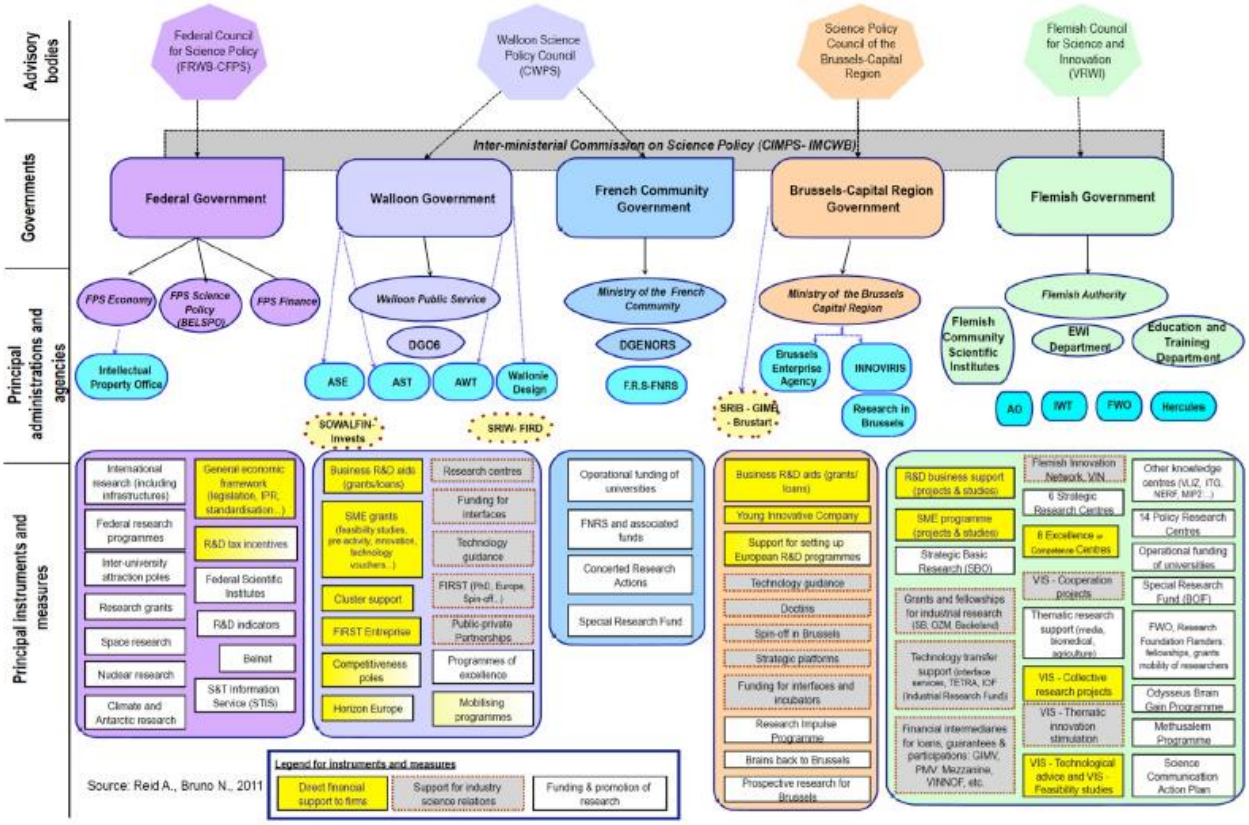
The responsibilities in the science, technology and innovation system are also spread over the different levels. The Federal Government is responsible for supporting scientific research related to the overall responsibilities (health related research for example), international or supranational agreements, data exchange, federal scientific institutes and international research organisations. The communities are responsible for education and fundamental research at universities, and applied research at higher education institutes. The regions are responsible for applied and industrial research, technology development and the promotion of innovation.

The federalised structure of Belgium results in a large number of public authorities and agencies at both federal and regional levels (see figure 1). Therefore, when discussing the Belgian science, technology and innovation system, attention should be paid to authorities and policies at both federal and regional levels. This report will discuss the issues according to these different levels, i.e. the Federal Government, Flanders, Wallonia (including the French-speaking Community) and the Brussels Capital Region. Furthermore, this report will not include information about the German-speaking Community, as it has not developed a science and technology policy because it does not host institutions involved in research activities. Innovation support targeting the industry based in the German-speaking Community is implemented by the Walloon Region.

[1] Information about the Belgian research and innovation system is primarily based on Belspo (2010) Belgian Report on Science, Technology and Innovation 2010 (BRISTI); ERAC-OMC 2011 Policy Mix Review Belgium; ERAWATCH Country Report Belgium 2011.

[2] The official names for the various communities and regions in their official languages are: Vlaanderen (Flanders), Vlaams Gemeenschap (Flemish Community), Vlaams Gewest (Flemish Region); Wallonie (Wallonia), Région wallonne (Walloon Region), Communauté française (French-speaking Community); Région de Bruxelles-Capital or Brussels Hoofdstedelijk Gewest (Brussels Capital Region); Deutschsprachigen Gemeinschaft (German-speaking Community). For practical reasons, in this report the English translations will be used.

Figure 1 Overview of the Belgian research and innovation system governance



Source: Erawatch Country Reports: Belgium 2011

Federal Government

In the Federal Government three departments are involved in the policy for science, technology and innovation. The Federal Minister for the Economy, Energy, Foreign Trade and Scientific Policy is responsible for developing and coordinating the general orientation of the federal science policy. Other ministers of the Federal Government are responsible for research and development in their own policy domains.

At the administrative level, the Belgian Federal Science Policy Office (BELSPO)[3] is responsible for coordinating science policy at a federal level, for the design and implementation of research programmes and networks, for the management of Belgium's participation in European and international organisations and the supervision of the federal scientific institutions. It also prepares and implements a number of research programmes and measures and is responsible for scientific collections and cultural and scientific promotional activities via the federal scientific institutes. The Federal Public Service Finances coordinates the fiscal instruments for supporting research & development, mainly for tax deductions on labour costs for researchers. The Federal Public Service Economy supports the development of demand-driven innovation policy by organizing actions in standardization, reform of intellectual property rights , reform of the regulatory environment, administrative procedures etc.

The Inter-Ministerial Conference for Science Policy (IMCPS) was created in order to coordinate policy matters among various ministries. It coordinates the preparation and execution of government decisions regarding federal science policy matters. Action can only be taken following mutual agreement by two or more

[3] http://www.belspo.be/

ministerial departments. The Federal Council for Science Policy (CFPS-FRWB) is an advisory body of the federal government for preparing science policy. Its members are representatives of academic, scientific and socio-economic circles and reflect the federal structure.

One of the elements of the Belgian innovation system introduced at the federal level concerns the collective research centres. The collective research centres were founded by Belgian enterprise federations and aimed to conduct applied research and technology development relevant for companies in specific sectors: each centre is dedicated to a specific sector. Since the 1990s, the federal support has slowly been taken over by regional funding. One of these centres is SIRRIS[4], the collective centre of the Belgian technological industry. SIRRIS supports companies in the implementation of technological innovations. It also offers shared testing facilities. The technology domains include materials engineering, production technology, mechatronics, additive manufacturing, software engineering and ICT.

Given the concentration of the Federal Government on more basic scientific research priorities, there are no relevant policy measures specifically supporting KETs innovation systems.

Flemish Government

The Flemish Government has developed an active and broad policy mix for supporting and stimulating science, technology and innovation. Approximately half of the Belgian GBAORD is now provided by Flanders[5]. The Flemish Department for Economy, Science and Innovation (EWI) coordinates the Flemish science, technology and innovation policy and integrates both the support for economy and entrepreneurship and the support for scientific research and innovation[6].

The current policy programme is Flanders in Action (ViA)[7]. With this programme Flanders aims to reach the top-5 of European regions in 2020 in terms of economic performance and living conditions. The 3% objective is part of this programme. The core of this programme is the agreement between social partners to boost the Flemish society: Pact 2020, including 20 objectives related to economic growth, innovativeness, living conditions, sustainability etc. To achieve these objectives transition of the Flemish ecosystem needs to take place. Transition means that all the social partners think together about the actions that are required in the long term (2050). The idea is to conceive new systems to replace the current ones. The transition approach is applied to 13 themes: smart care; talent development; smart mobility; poverty; acceleration of investment projects; development of Gazelles (fast-growing companies); renewable energy and smart grids; streamlining of targeted innovation policy; sustainable materials management; sustainable and smart cities; sustainable building and living; new industrial policy; and environment.

Within the theme 'new industrial policy', several activities have been initiated to develop the future industry in Flanders. The white book 'a new industrial policy for Flanders'[8] describes a cross-sector industrial policy combining four pillars: production and competition policy; industrial innovation policy; infrastructure policy; and competence development and labour market policy. A key concept is the Factory of the Future, which will be applied in several priority sectors, such as the chemical industry and the manufacturing industry. The new industrial policy targets specific industrial clusters, based on a smart specialisation strategy.

One of the first actions in the new industrial policy was the establishment of the TINA fund, in which the Flemish Government invested EUR 200 million[9]. TINA (Transformation and Innovation Acceleration Fund) is managed by Investment fund Flanders (PMV) and aims to provide public risk capital for transformation

[4] http://www.sirris.be/
[5] OECD Research and Development Statistics: http://stats.oecd.org/Index.aspx?DataSetCode=GERD_FUNDS and EWI Speurgids 2012 Ondernemen & Innoveren
[6] http://www.ewi-vlaanderen.be/
[7] http://www.vlaandereninactie.be/
[8] Witboek; Een nieuw industrieel beleid voor Vlaanderen, May 2011
[9] http://www.pmv.eu/nl/diensten/tina

trajectories carried out by open innovation consortia, aimed at breakthrough projects with high economic risk and high societal gain. PMV manages several funds for supporting innovation in companies.

Within the theme 'streamlining of targeted innovation policy', the Flemish government developed the concept policy document 'Innovation centre Flanders'[10] with a horizontal, but challenge-driven innovation policy for six innovation junctions, equivalent to the Flemish version of the European Innovation Partnerships. These six innovation junctions concern eco-innovation; green energy; sustainable mobility and logistics; innovation in health care; social innovation; and transformation by innovation.

A key element in both the new industrial policy and the innovation centre Flanders is the selection and development of key clusters, following a smart specialisation strategy[11]. The smart specialisation strategy for Flanders is based on the development of industry-driven platforms, the use of strategic intelligence, alignment with international (European) roadmaps and initiatives, and the development of roadmaps for Flanders. An example of this alignment with European roadmaps is the establishment of the KET Platform Flanders in November 2012. This platform aims to support the alignment of Flemish roadmaps for KETs with European roadmaps and PPPs in KETs[12].

All new actions following from the roadmapping exercises will mainly be implemented by the new Flemish government (Elections will take place in Summer 2014).

The Agency for Innovation by Science and Technology (IWT)[13] implements the Flemish policy measures for supporting R&D and innovation. Target groups include companies, both large and small, individual researchers and research centres, and innovation collaborations. IWT offers support for R&D projects in companies, including feasibility studies. Specific support is available for SMEs. IWT has a large, specific programme for collective research and innovation trajectories (VIS). This programme includes several types of projects and programmes, including support for competence poles (or centres of excellence), living labs and feasibility studies. In competence poles, industrial partners collaborate with public research organisations, universities and other stakeholders. Competence poles offer a platform for networking and a sector specific research programme. There are currently nine competence poles, including one for mechatronics (FMTC – Flanders' Mechatronics Technology Centre) and FISCH (Flanders Innovation Hub for Sustainable Chemistry). FISCH is also selected as the first transformation and innovation platform (TIP) as part of the targeted cluster policy for the chemical industry in Flanders[14].

Collective research projects are supported through the VIS programme aiming at the development, dissemination and valorisation of expertise in a specific domain for a large group of companies, including large companies and SMEs. The collective research projects are carried out by a research organisation, but for a group of companies and other stakeholders. The VIS programme supports all kinds of activities, including the development of prototypes, validating test results, and pilot trajectories[15].

The IWT has also acknowledge and accredited collective research centres, including the Flemish location of SIRRIS, the collective centre for the Belgian Technological Industry. SIRRIS supports companies in the implementation of technological innovations. It also offers shared testing facilities. The technology domains

[10] Concept note 'Innovation Centre Flanders' http://www.agentschapondernemen.be/sites/default/files/documenten/oo_fvt_conceptnota_innovatiecentrum_vlaanderen.pdf
[11] Concept note 'A smart specialization strategy for focused cluster policy', 2013 http://www.ewi-vlaanderen.be/ewi/nieuws/conceptnota-slimme-specialisatiestrategie-voor-gericht-clusterbeleid
[12] http://www.ewi-vlaanderen.be/ewi/wat-doen-we/de-samenleving/workshops-ewi-focus/ewi-focus-10-key-enabling-technologies-horizon-20
[13] http://www.iwt.be
[14] http://www.iwt.be/overzicht-van-competentiepolen
[15] http://www.iwt.be/subsidies/vis-trajecten

include materials engineering, production technology, mechatronics, additive manufacturing, software engineering and ICT.

The Hercules Foundation[16], established in 2007, provides funding for medium sized (150 to 600 thousand euros and 600 to 1,500 thousand euros) and large research infrastructures (more than 1,500 thousand euros), used for foundational and strategic basic research in all scientific disciplines. Large research infrastructures are mainly operated by the large strategic research centres.

Basic scientific research in Flemish universities and research institutes is supported by the Research Foundation – Flanders (FWO)[17]. Flanders has six universities and five strategic research centres that are active in specific domains. IMEC – Interuniversity Micro-Eletronics Centre is the Flemish strategic research centre in the field of nano-eletronics and nanotechnology. VIB – the Flemish Institute for Biotechnology, focuses on research and technology transfer in life sciences and biotechnology. VITO – Flemish Institute for Technological Research addresses research in energy, materials, remote sensing and the environment. IBBT – Interdisciplinary Institute for Broadband Technology focuses on research in broadband technologies and ICT. Recently, a fifth strategic research organisation has been developed: SIM – Strategic Initiative Materials. In addition, start-up funding is provided to CMI – Centre for Medical Innovation, a virtual research centre for joint translational research based on biobanks.

In summary, the Flemish system for STI policy can be characterized by a continuous focus on stimulating the innovation power for the economy, strengthening the alignment between science and economy, and by targeting specific clusters and grand societal challenges. Specific key enabling technologies are the focus of these actions targeting specific cluster initiatives and strategic research centres.

Governments of the Walloon Region and the French-speaking Community

Although the Walloon Region and the French-speaking Community have separate governments, they collaborate intensively. Since 2009, both governments share one prime minister and several ministers, including the one for scientific research, have a joint responsibility for both region and community related issues. The key strategy for Wallonia is embedded in the Plan Marshall_2.Vert, the second edition of the Plan Marshall that was initiated in 2005[18]. Plan Marshall_2.Vert invests EUR 1.6 billion for five years (2009-2014) and focuses on sustainability (vert is the French word for green) in six priorities:

- Development of human capital
- Continuation of the policies targeting competition poles (Poles de Competitive) and company networks
- Strengthening scientific research as driving force for the future
- Creating a favourable framework for creating business and high quality jobs
- Employment – Environment Alliances
- Mixing-up employment and social welfare

The Directorate General for Higher Education and Scientific Research from the French-speaking Community is responsible for basic research at universities and higher education institutes. This mainly concerns bottom-up support for basic, non-directed research. This type of research is also supported through the Fund for Scientific Research (FRS-FNRS) and associated funds.

The Directorate General for Economy, Labour and Research of the Walloon Government[19] takes measures and initiatives for promoting industrial research and experimental development of innovative products, processes and services, as well as the development of industry networks and the connection with European policy

[16] http://www.herculesstichting.be/
[17] http://www.fwo.be/
[18] http://www.wallonie.be/fr/actualites/plan-marshall-2vert-mise-en-oeuvre-2010-2012
[19] http://recherche-technologie.wallonie.be/

objectives. The Walloon Government provides support for industrial research projects at universities and higher education institutes, research centres for applied research, technological innovation partnerships, and innovative companies. The Walloon government has several programmes supporting industrial research and experimental development projects. Some programmes provide grants, others offer loans. There are also specific programmes for spin-offs and SMEs, especially for hiring a research project manager, feasibility studies, and patenting.

One of the main pillars of the Walloon science, technology and innovation policy is the establishment of clusters and competitiveness poles[20]. The cluster policy was launched in 2001 and since then approximately 10 clusters have been developed, including one for photonics (Cluster Photonique). These are business clusters, very much oriented on SMEs. The clusters form partnerships for industrial and commercial developments and developing an ecosystem for innovation in specific sectors.

Since 2005, competitiveness poles are concerned as the main instrument to organize and support regional networks and partnerships for innovation. Competitiveness poles follow a triple helix approach and combine companies, education institutes, public and private research organisations in developing collective innovation projects. The partnerships are market driven and aim to create critical mass for reaching competitive advantages and a strong international position. Six of these competitiveness poles have been selected: Biowin – life sciences, Wagralim – agro-food; Mecatech – machine engineering; Logistics in Wallonia – logistics and transport; Skywin – aerospace; and GreenWin- focusing on environmental technologies. The Walloon Government supports competitiveness poles by investments in infrastructure, buildings and installations; financial support for research and development; investment grants; training support; and acquiring foreign investments. The support is organized through internal calls for projects.

The investments in the competitiveness poles are provided by SOFIPOLE. SOFIPOLE will finance large collective research infrastructures, also in coordination with ESFRI. The total amount the Walloon Government invests in the competitiveness poles in the period 2010 to 2014 amounts to EUR 288 million.

The Walloon Government also supports networking and science-industry linkages through the programme Public-Private Partnerships (PPP) for breakthrough innovation. This programme aims to support projects that acquire new scientific and technological knowledge for the development of product, processes or services for the industry involved. Other programmes supporting science-industry linkages and knowledge exchange through mobility of researchers include the Mobilising Programmes and the FIRST programme. All these programmes are mainly oriented on the research side of the research-innovation spectrum.

The Walloon Government also launched in 2010 the plan Creative Wallonia to support creativity and innovation in Walloon society by providing support to new ways of working, encouraging the provision of education focused on creativity and innovation, supporting new innovative practices and innovative production, including the promotion of newly developed products / services and processes (after the first prototype) and financial support for innovative production. Creative Wallonia addresses mainly the non-technological aspects of innovation[21].

The Agency for Technological Stimulation (AST) aims to support knowledge and technology transfer, especially to non-innovative firms, by organising networking activities, providing support and access to expertise and partners for innovation trajectories, and by offering technology vouchers to SMEs for using research services. Unsecured loans, risk capital and warrants to commercial loans for SMEs and more specifically innovative projects in SMEs are provided by Sowalfin, the Agency for Financing of Walloon SMEs.

The French-speaking Community supports basic research in seven universities, concentrated in three University Academies (University Academy Louvain; University Academy Wallonia-Brussels; University Academy Wallonia-

[20] http://clusters.wallonie.be/federateur-fr/
[21] http://www.creativewallonia.be/

Europe). In addition there are 19 higher education instituted, which have established 12 research centres for industrial research. The Walloon Region has also acknowledged 22 collective research centres, including SIRRIS.

The Walloon Government increasingly collaborates with the government of the Brussels Capital Region. The Walloon - Wallonia-Brussels Federation governments (Walloon Region and French-speaking Community) developed in 2011 an integrated research strategy (Research Strategy 2011-2015 "Towards an Integrated Research Policy") and this also includes the objective to develop a joint action plan with the Brussels Captial Region. The integrated research strategy focuses on five key areas, linked to societal challenges and the competitiveness poles: sustainable development, renewable energies, quality and length of life, health, and research in technological fields[22].

Main challenges for the Walloon government is to organize better leveraging of complementary research and innovation assets, moving from collaborative research projects to real commercial exploitation of research results, and to strengthen the position of Walloon SMEs in global value chains[23].

Government of the Brussels Capital Region

Since 2006, the Government of the Brussels Capital Region has focused its support for science, technology and innovation on three innovative sectors: ICT, health and environment.

The Ministry of Bussels Captial Region has delegated the coordination and implementation of the regional science, technology and innovation policy to regional agencies. In addition, the Ministry provides support for hiring unemployed people, also for research and for SMEs investing in knowhow in the region.

The Brussels Institute for Scientific Research and Innovation (Innoviris)[24] is the main agency in the region for support to research and innovation. Since 2008, Innoviris has had full control of the regional budget for research and innovation. It provides support for industrial research and precompetitive development at universities and companies. The Regional Innovation Plan 2007-2013 initiated two new initiatives to support innovation: Impulse programme and Strategic platforms. The Impulse programmes support collaborative industrial research projects aimed at valorisation through the creation of spin-offs, transfer of intellectual property or technology. To support the exchange between academic research and industrial applications, Innoviris has initiated the development of strategic platforms. Strategic projects target essentially projects in which special emphasis is placed on industrial application opportunities for Brussels' enterprises. One strategic platform concerns toxicology of nanomaterials. NanoIRIS will become an expertise centre for toxicology of nanomaterials, bringing together the expertise of scientific research, industry working with nanomaterials and public authorities regulating. The programma Spin-off in Brussels provides financial support for researchers that want to start a spin-off company. The financial support concerns support for patenting, prototyping, prevalidating, demonstration etc.

Similar to the approach in Wallonia has the government of Brussels Capital Region developed clusters of innovative companies in the three priority sectors. These clusters support exchange and networking between companies in a specific sector. Several clusters have been developed, including a biofarma cluster, a telemedicine cluster, a software publishing cluster and an eco-innovation cluster.

The Brussels Agency for the Enterprise (BAO) acts a s a one-stop shop for companies that want to innovate by providing networking activities and support for starting and expanding innovation projects. Risk capital and investments in innovation projects is provided by the regional investment fund (GIMB).

[22] http://www.recherchescientifique.cfwb.be/
[23] ERAWATCH Country Reports 2011: Belgium; OECD Reviews of Regional Innovation: Wallonia, Belgium
[24] http://www.innoviris.be/site/

Similar to the Flemish and Walloon governments has the government of the Brussels Capital Region selected three collective research centres, including SIRRIS.

One of the new objectives of the recent update (2014-2020) of the Regional Innovation Plan is to support the development of innovations through the creation of living labs. In 2013 the government of Brussels Capital Region will assess the opportunities and possibilities for organizing living labs and demonstrators in the priority domains of the regions[25].

1.2. Organisation of mKETs policy

There are no specific policy measures available fostering innovation structures that involve two or more of the KETs. However, there are several initiative that target single KETs. These initiatives do not exist at the Federal level, but the three Regions do have some initiatives.

Flanders

The KETS Platform Flanders was established in November 2012 and aims to develop roadmaps for KETs in Flanders, in alignment with the European roadmaps, PPPs, platforms and programmes targeting KETs. The KETS Platform Flanders focuses on five KETs. It is unclear if the platform will also target nanotechnology as a separate KET, because nanotechnology is considered as heavily interlinked with the other KETs. For each KET a roadmap will be developed by a platform of industry, research organisations and policy makers. Each roadmap starts with the identification and assessment of key actors, European roadmaps, existing initiatives, programmes, facilities and infrastructures in Belgium and internationally (Europe). Although the roadmaps will be developed for each KET individually, a multi-KETs approach will be enabled in a matrix with on the horizontal axis the individual KETs initiatives and on the vertical axis the value chains and application areas. The junctions offer opportunities for multi-KETs. An example is the newly developed Nano for Health programme, which aims to combine nanoelectronics with biopharmaceutics.

KETS are also addressed in the support and stimulation of specific cluster initiatives and strategic research centres. Some competence poles focus on specific KETs or represent important application domains of KETS. Flanders' Mechatronics Technology Centre – FMTC[26] is established by Agoria, the Belgian association for technology industry and mechatronic companies and conducts industry-driven joint projects and contract research assignments in smart sensors, self-optimization of mechatronic systems, energy efficient electro-mechanical drive-lines, and model-based design of mechatronic systems. The most recently established cluster initiative is FISCH[27], the Flanders Innovation Hub for Sustainable Chemistry. FISCH was established by Essenscia Flanders, the industry association for the chemical and life sciences industries and VITO (Flemish Institute for Technological Research), in cooperation with various companies in the sector and all Flemish university associations. FISCH aims to support open innovation by organizing cross-company collaborations for research and innovation and by clustering existing knowledge and innovation platforms at companies, knowledge centres and universities. FISCH will specifically focus on opening up infrastructures by taking inventory of available infrastructures and developing viable and market-respecting business models for sharing these infrastructures.

The Flemish Government has established several strategic research centres, which aim to develop and perform strategic research and technology transfer in a specific domains, bringing together various knowledge centres and also including industry. The Flemish Institute for Biotechnology (VIB) was established in 1995 and focuses on strategic basic research in life sciences, but pursues an active technology transfer policy as well[28]. The

[25] http://www.innovativebrussels.irisnet.be/nl/onthaal/het-beleid-inzake-onderzoek-en-innovatie/actualisering-van-het-gewestelijk-innovatieplan
[26] http://www.fmtc.be/
[27] http://www.fi-sch.be/
[28] http://www.vib.be

Interuniversity Micro-Electronics Centre (IMEC) was established in 1984 and focuses on nanotechnology and nanoelectronics. IMEC is more applied-research oriented and bridges the gap between basic research at universities and industrial research[29]. IMEC and VIB, together with KU Leuven also established NERF - Neuro Electronics Research Flanders, a research lab for collaborative, interdisciplinary research combining nanoelectronics with neurobiology. NERF is funded by the Flemish government[30].

Recently, another strategic research centre was established, Strategic Initiative Materials – SIM[31]. SIM concentrates on strategic research for advanced materials and includes Flemish universities, 10 materials companies, Sirris, the collective centre for Belgian technological industry, and Agoria Flanders, the technological industry association. SIM integrates FLAMAC, one of the existing competence poles in high-throughput methodologies for materials research.

Within the policy programme Flanders in Action and its theme 'new industrial policy', one of the projects initiated is Made Different[32]. Made Different aims to support the manufacturing industry in transforming into true factories of the future and was initiated by Sirris, Agoria, FMTC and Flanders' Drive. Made Different distinguishes seven 'transformation' areas, from the development and application of world-class production means to simultaneous product and production development, smart production systems, eco-production, networked factories, human-centred production, and digitalized processes. Made Different supports manufacturing companies in developing vision and roadmaps for transformation and performing transformation projects, but it also aims to develop general methods and tools for transformation trajectories, to support knowledge exchange between companies, to create awareness, and to develop demonstration projects. Made Different is also initiator of another strategic research centre, Smart Manufacturing Industry, which should integrate strategic research efforts in the domains of advanced manufacturing, design methods, and mechatronics. This centre should start beginning of 2014.

KETs are also addressed in several projects and initiative funded by general subsidies and grants from IWT.

Wallonia

KETS as such are not explicitly targeted by Walloon STI policy and programmes. Many of the available programmes and schemes for support of science, technology and innovation are open to all technology domains, although there are specific programmes for STI in ICT and green ICT. Life sciences is also a priority domain for the region. There have been some programmes supporting strategic basic research and science-industry collaborative projects in biotechnology. In addition, funding is provided to collaborative research centres, clusters and competitiveness poles in life sciences. Examples are GIGA - the Interdisciplinary Cluster for Applied Geoproteomics, BioWin, and Wagralim, BioLiege, Biovallee/ImmuneHealth. The focus of these initiatives is mainly on life sciences for health and agro-food and less on industrial biotechnology.

GIGA, located at the University of Liege and partly funded by the Structural Funds, is a cluster of academic research, technology transfer office, an incubator, a training center, and it offers seven technology platforms as a R&D service to researchers and industry[33]. GIGA focuses on the interlinkage between genomics and proteomics. BioWin and Wagralim are both Competitiveness Poles. BioWin focuses on health biotechnology and medical technologies[34]. BioWin brings together industry and researchers and organises applied and industrial research collaborations, training programmes, the emergence of innovation and technology platforms as well as internationalisation strategies. Wagralim acts in a similar way and concentrates on agro-food technologies[35]. BioLiège is an association of academic organisations and biotechnology companies aiming

[29] http://www.imec.be; More explanation on IMEC is provided in section 2.
[30] http://www.nerf.be
[31] http://www.sim-flanders.be/
[32] http://www.madedifferent.be/
[33] http://www.giga.ulg.ac.be/
[34] http://www.biowin.org/
[35] http://www.wagralim.be/

at creating linkages between sciences and industry through promotion, networking, events etc[36]. ImmuneHealth (formely BioVallee), based in the Biopole ULB-Charleroi, is a collective research centre between university of Charleroi, university hospitals and GSK Biological, dedicated to R&D activities in the domain of immunology and health biotechnology[37]. The centre includes a clinical research unit and an immunomonitoring lab, for designing and testing of new products, as well as identifying and validating immunological biomarkers. In 2009/2009, the Walloon government supported the establishment of a new virtual inter-university research centre in life sciences, WELBIO[38]. WELBIO aims at promoting scientific excellence in fundamental life sciences research and at translating scientific results in medical, pharmaceutical and veterinary biotechnology applications. WELBIO is the Walloon equivalent of the Flemish VIB.

One of the business clusters concentrates on photonics, Cluster Photonique[39]. The cluster was created in 2008 and includes 40 enterprises, 12 research centres and 2 training institutions. Mecatech is the Competitiveness Pole in Mechanical Engineering[40]. Mecatech focuses on four strategic lines of development: materials and surfaces of the future, comprehensive forming technologies, microtechnologies and mechatronics, and intelligent maintenance.

KETs are on the agenda of the Competitiveness Poles. The Walloon government has asked the poles to indicate which KETS are relevant for them, what their expectations are and how they position themselves towards KETS. Every pole has interest in advanced materials and Mecatech is interested in every KET. For example, Mecatech organises a tripartite approach that can be regarded as a multi-KETS approach. The focus on KETS is really new for the region. The region always focused on the critical mass and clusters, more than on technology. Fifteen years ago the region identified key technologies, but the list was too long and not suitable for policy making. That is why the region preferred the sector approach and this is now slowly merging with the KETs approach. All the KETS can be embedded, further developed, and exploited in the poles.

Figure 2 Overview of Competitiveness Poles and KETs

	Biowin	Wagralim	skywin	Liw	Mecatech	Greenwin	TOTAL
ICT	X	X	X	X	X		5
Micro/nano electronics			X	X	X		3
Advanced materials	X	(X)	X	X	X	X	5 (6)
Industrial biotechnology	(X)				X	X	2 (3)
Nano-technology					X	X	2
Photonics	X				X		2
Advanced manufacturing		X			X	X	3

Source: DGENORS

[36] http://www.bioliege.ulg.ac.be/bioliege.php
[37] http://www.biopark.be/biopark/immunehealth-en.html
[38] http://welbio.org/cms/j_5094/accueil
[39] http://clusters.wallonie.be/photonique-fr/
[40] http://clusters.wallonie.be/mecatech-fr/

Government of the Brussels Capital Region

There are no specific programmes available targeting single or multi KETs in Brussels Capital Region. The STI policy efforts of the Regions are focused on three priority areas: ICT, life sciences and environment, of which the life sciences projects have some relation to KET.

Within the Impulse programme several projects focus on life sciences related research themes, but this mainly concerns health-related research questions. One strategic platform, NanoIRIS concerns the toxicology of nanomaterials. NanoIRIS will become an expertise centre for toxicology of nanomaterials, bringing together the expertise of scientific research, industry working with nanomaterials and public authorities regulating.

Similar to the approach in Wallonia has the government of Brussels Capital Region developed a cluster policy to support clusters of innovative companies in the three priority sectors. Among these clusters is a life sciences cluster, Brussels Life Tech, with a focus on medical technologies and biopharmaceutics.

1.3. Main policies for Pilot lines

Federal government

The Federal government does not provide support for pilot lines.

Flanders

There is no *specific* policy measure for supporting pilot lines. Only feasibility studies, some prototype development is supported through very generic policy measures for supporting innovative companies. Investments in large infrastructures for scientific research are funded by a dedicated fund. The support by IWT is mainly related to the lower TRLs, 1 to 7, although there are some ad-hoc initiatives for demonstration projects, but not really pilot lines. With the new government (there will be elections Summer 2014) in Flanders, IWT will have some more means for supporting actions coming from the development of roadmaps, as part of the KETs Platform Flanders. The strategic research centres mainly focus on TRL levels 1 to 5, with the exception of IMEC. IMEC develops a pilot line for 450mm as part of an application for Horizon 2020 funding. This pilot line will offer a test bed for the industry to enable testing of installations and machines developed by the industry. Another pilot line in development relates to photonics and will offer new processes for the production of newly developed products. The activities of IMEC will be described in more detail in section 2.

In addition, there are some living lab initiatives (proeftuinen) in which technological and non-technological aspects of innovation are developed and tested.

In some of the clustering initiatives, including FISCH, the new strategic research centre for materials research – SIM, and the initiative Made Different, efforts are made to open up infrastructures and facilities and developing demonstration projects. The Open Manufacturing Campus – OMC is another project under the heading of 'new industrial policy'[41]. OMC is based on the Philips production site in Turnhout and aims to offer access to facilities and square meters, technical staff, engineers and industrialization and automation competences for the full value chain, from product idea, development, process design, production ramp-up, automation and quality set-up to lean production optimization. It acts as an open innovation campus for the manufacturing industry.

In the new industrial policy, one of the pillars concerns infrastructure policy, including three action domains: 1) critical infrastructures for system innovation, such as smart grids; 2) long term planning of R&D infrastructures that need to follow roadmaps 3) identifying existing infrastructures that can be opened to stimulate open innovation. It may be possible that the newly developed roadmaps indicate the need to establish new infrastructures.

[41] http://www.openmanufacturingcampus.com/

So far, investments in large infrastructures, including pilot lines, are rather ad hoc and some with substantial funding from INTERREG. The BioBase Europe Pilot Plant is funded with support from Interreg Flanders-Netherlands, part of INTERREG IV 2007-2013 programme funded by the European Union from the European Regional Development Fund (ERDF)[42]. This pilot plant will be described in more detail in section 2. B-phot, the Brussels Photonics group based at the VUB is developing a new facility outside Brussels to bring together separate infrastructures and instruments together in one pilot line[43]. The infrastructure is purchased using funding from the Flemish government (Hercules Fund). The activities of B-phot are described in more detail in section 2.

As said, many of these initiatives are rather ad hoc and there is only limited coordination. Moreover, these are not very well embedded in European roadmaps. The KETs Platform Flanders aims to change this and provides coordination on the development of roadmaps for KETs, in relation to European initiatives. Within the framework of the KETs Platform Flanders, policy attention will mainly go to opening up existing pilot lines and infrastructures. 'Closed' pilot lines can hardly be supported by the government, because of state aid rules.

Wallonia

There is a general support scheme for innovation in any sector or technology domain, and this also includes support for prototyping, but this is not specifically targeted. In theory, pilot lines could be supported, but this is not happening. Main reason put forward is that classical investment schemes do not match the specificities of a pilot line. R&D programmes are open for multi-actor projects, but the investment and exploitation programmes are often focused on one actor only. There are also problems with intellectual property in multi-actor investments and exploitation trajectories.

There are no publicly funded KETS pilot lines in Wallonia. There must be some industry-led pilot lines, but unclear if these can be considered as a KET or MultiKET pilot line.

Brussels Capital Region

No specific policy measures for pilot lines, only generic support for spin-offs including prototyping. One of the new objectives of the recent update (2014-2020) of the Regional Innovation Plan is to support the development of innovations through the creation of living labs. In 2013 the government of Brussels Capital Region will assess the opportunities and possibilities for organizing living labs and demonstrators in the priority domains of the regions.

[42] http://www.bbeu.org/
[43] http://www.b-phot.org/

2. Business perspective

This chapter discusses the business perspective on pilot lines in Belgium. The majority of pilot line activities are found in the Flanders region in Belgium, followed by Brussels, few pilot line initiatives have been found in the Walloon region. The majority of pilot line projects takes place at multi-purpose facilities or pilot plants. Therefore, this paragraph will start by a description of these facilities, followed by the experiences concerning the implementation of pilot lines. The second paragraph evaluates the relevant KET policies.

Bio Base Europe Pilot Plant

The Bio Base Europe Pilot Plant (hereafter: BBEU) was established in June 2012 as the result of a partnership between Ghent Bio-Energy Valley, Biopark Terneuzen and their respective stakeholders. BBEU provides the facilities and equipment to develop and scale up biobased products and processes up to production scale. It positions itself as a one-stop-shop: BBEU can perform the complete bioprocesses, from biomass raw material to the pure and refined bioproduct [44]. In other words, the pilot plant is capable of performing the entire value chain in a single plant: from the green resources up to the final product. The Bio Base Europe Pilot Plant focuses mainly on second generation technologies to convert agricultural waste products and non-food crops such as wheat straw, corn cobs, wood chips, Jatropha and algae oils into bio-fuels, bio-plastics and other bioproducts. Next to the pilot plant, Bio Base Europe covers a training center in Terneuzen to address an industry-wide shortage of skilled process operators and technical maintenance specialists for biobased and sustainable energy processe.

BBEU is an independent facility to safeguard confidentiality and a sound company-customer relation. It services companies and research institutes worldwide. The pilot plant is financed through the INTERREG IV programme from the European Regional Development Fund [45]. This tri-partite approach included about equal contributions of the European Commission, the Dutch government and the Flemish Government. These funds were used to acquire equipment and the plant itself, operational costs are covered through the projects done for companies, research institutes and governments. There are no public funds available to cover these costs.

Bio Base Europe participates in several FP7 programs in which it supports the upscaling of industrial biotech based products:

1. Biosurfing: this projects aims on the scaling-up and optimization of fermentation processes to produce specific types of biosurfactants. One of the objectives is the demonstration production of these surfactants at ton scale. The project will run for four years and is coordinated by Ghent University - Centre for Industrial Biotechnology and Biocatalysis.
2. Novosides: the goal of this project is the development of biocatalytic processes for the glycosylation of small organic molecules such as flavonoids, alkaloids and steroids. The reactions will then be optimised and scaled-up at pilot plant facilities to allow the commercial exploitation of the glycosylated products. The project will run for four years and is again coordinated by Ghent University - Centre for Industrial Biotechnology and Biocatalysis.

B-PHOT

B-Phot originated as research and education group at the university of Brussels focusing on micro-miniaturized photonics. Nowadays it focuses on three different branches: education, fundamental research and industrial research, the latter being B-phot's most important activity. B-Phot's main objective is to shorten the time to market by developing photonics based components up to preproduction levels. B-phot is strongly focused on serving the industry with cost-effective, timely and cutting edge micro-photonic solutions. This is achieved through a team of about 40 experts in micro-photonic technologies, covering the complete value chain from modeling&design, metrology, component fabrication up to proof of concept demonstrations. B-Phot can

[44] GENERATIES. (2013). Project BioBase Europe Pilot Plant vzw. Retrieved from: http://www.generaties.net/Portals/2/GENERATIES_BioBaseEurope.pdf
[45] Bio Base Europe. (n.d.). General Info. Retrieved from: http://www.bbeu.org/general-info

support companies in developments either by offering consulting or customized trainings or by offering complete development services. It can offer the complete value chain from design to ultra-fast prototyping and pre-production. Next to industrial research, B-phot is active in various national and European projects focused on fundamental research and it offers various education related services.

Like Bio Base Europe, B-Phot is an independent facility which is open to companies and research institutes throughout the world. It has collaboration agreements in fundamental, strategic, applied and industrial research with research groups in Europe, in the United States, Australia, and Asia, and with companies in Flanders, Europe, Asia, Japan, and the US.

B-Phot is involved in several projects which aim at the upscaling of photonics based components. Among the most important ones is the FP7 project ACTMOST, where B-Phot coordinates a consortium of 14 high-tech research institutes in Europe who provide European companies with industrial access to photonics experts and micro-photonic technologies. ACTMOST is a one-stop-shop-solution-provider that supports companies with a technology platform that encompasses the entire food-chain of micro-photonics: from optical design, to measurement, prototyping, replication and packaging, all the way to proof-of-concept demonstration, prototyping, reliability testing, and pre-production level fabrication [46].

The ACTMOST consortium can provide companies with hands-on trainings or dedicated development projects and can finance these services under certain conditions for free. In this case, SMEs have to follow certain guidelines and complete a short evaluation procedure, by showing that they really need the innovation and that they are engaged in the innovation project. SMEs do not receive funding from ACTMOST, but the operational costs of the development are covered through the subsidy provided by ACTMOST, meaning that SMEs receive the innovation services at no cost and risk-free. About 30 projects have been executed in a 30 month period, thus contributing to making photonics innovations more accessible to SMEs [47]

The activities of B-Phot cover the technology readiness levels 2-6, industrial research in the higher technology readiness levels is possible, but such projects are funded on a bilateral basis. Subsidies from the ACTMOST are not available for such activities.

IMEC

IMEC is a leading R&D lab for micro- nanoelectronics and aims to bridge the gap between fundamental research at universities and technology development in the industry. IMEC is headquartered in Leuven, Belgium, but has additional R&D teams in The Netherlands (Holst Centre in Eindhoven), China, Taiwan, and India, and offices in Japan and the USA. IMEC's staff of close to 2,000 people include more than 600 industrial residents and guest researchers [48]. Like B-Phot and BBEU, IMEC is an independent R&D organization, yet it receives funding from the Flemish Government to cover operational costs. This amounts to 16% of total revenues or 46 million Euros in total [49].

IMEC is a program oriented organization which focus on assisting the realization of industry roadmaps on micro-nanoelectronics. IMEC research broadly divides into two different approaches [50]: 1) Programs related to scaled CMOS, the "Core CMOS Program". These programs are associated with efforts to continue the doubling

[46] ACTMOST (2010). Our Mission. Retrieved from: http://www.actmost.eu/About-us/Our-Mission

[47] ACTMOST (2012). European SMEs embrace complimentary photonics innovation support from ACTMOST. Retrieved from: http://www.actmost.eu/content/download/880/7550/file/Press%20kit%20ACTMOST%20successfully%20supports%20photonics-driven%20innovation%20(3).docx

[48] IMEC (2013). Company Profile. Retrieved from: http://www2.imec.be/be_en/about-imec/company-profile.html

[49] IMEC (2012a). Annual Accounts 2011. Retrieved from: http://annualreport.imec.be/Annual-Accounts-2011/page.aspx/1078

[50] IMEC (2012b). Scientific Report: Research Programs. Retrieved from: http://www.imec.be/ScientificReport/SR2011/1413969.html

of scale ("More Moore" programs); 2) Programs related to 'Heterogeneous Integration' Application Oriented Programs. These CMORE programs go beyond Moore scaling ("More than Moore") by adding functions other than logics and memory on the chips of CMOS micro- and nanodevices [51]. The CMORE solutions are implemented in IMECs 200 & 300mm pilot lines.

In terms of intellectual property, IMECs model is based on a joint ownership model in which IMEC takes its part in the costs associated with R&D. IMEC makes specific and detailed IP arrangements for each business case to maximize transferability of R&D in the market. The ownership of intellectual property rests with IMEC, but partners receive the rights to exploit the intellectual property in their own specific field of work based on a license and are allowed to sublicense the rights to other partners. The IP policy pays specific attention to the position of the agreement in the R&D life cycle and aims on a fair compensation of identified intellectual property in this respect [52].

2.1. Implementation of multi-KETs pilot lines

This paragraph discusses the experiences of business stakeholders concerning the implementation of pilot lines. The first paragraph of this section focuses on how industry stakeholders define and perceive the concept of pilot lines, followed a synthesis of relevant pilot line experiences across the various KETs in the second section.

Technological perspective on pilot lines

Industry stakeholders commonly defined pilot lines as an activity to initiate the first experiences with a new technology or component. All stakeholders agreed that pilot lines are a crucial element in the development of KETs based components and in bridging the 'valley of death' towards commercial manufacturing. The output of a pilot line should always satisfy a market need, yet pilot lines are associated with high risks and high capital expenditures, often leading to underinvestment by the industry. However, the difference between KET and multi-KET pilot lines and the added value of such a demarcation is much less clear to the industry. For example, KETs are referred to as having a multidisciplinary character, since they span multiple sectors and involve multiple stakeholders. Multi-KETs are however characterized as multi-disciplinary KETs, making it increasingly difficult to delineate between both, according to industry stakeholders. A focus on multi-KETs might be of added value in the future, but at the moment, the definition of multi-KETs is still a high-level theoretical discussion.

Furthermore, it seems that various KETs have natural synergies, such as nano-microelectronics and advanced manufacturing or advanced materials and advanced manufacturing, whereas various other KETs and industrial biotechnology specifically have much less synergies with other KETs. Therefore, it is much more difficult for stakeholders in the industrial biotech sphere to initiate multi-KET pilot lines, whereas for advanced manufacturing technologies this is a much more natural thing to do, since pilots seem to have a multi-KET character by definition. Delineating between KET and multi-KET pilot lines would suggest that pilot lines in industrial biotechnology are much less difficult to initiate than this is for other KETs, yet in practice this does not seem to be the case.

It seems to depend on the KETs involved if pilot lines can be characterized as competitive or pre-competitive. In particular for nano-microelectronics, KETs seem to be pre-competitive, which creates a motivation for companies to work together on shared pilot projects. Due to the pre-competitive nature, partners have enough possibilities to differentiate based on the output of the platform, creating a common ground for collaboration. With other KETs this is much less the case, pilot lines are characterized as highly competitive according to

[51] IMEC (2012c). Scientific Report : Strategy: CMORE, a European More-than-Moore development fab serving our worldwide partnerships. Retrieved from: http://www.imec.be/ScientificReport/SR2011/1414014.html
[52] IMEC. (2006). Case Study – Nanopatents. Retrieved from: ftp://ftp.cordis.europa.eu/pub/nanotechnology/docs/iprworkshop_vandenbroek_and_ryckaert_en.pdf

industry stakeholders, creating reticence among private enterprise to collaborate in pilot line projects. The reasons why pilot line projects for some KETs are more competitive than for others and what the exact consequences are is still point for discussion however.

Belgium has a considerable number of living labs, or "proeftuinen" as they are called. Such living labs involve real life experiments where companies initiate the first experiences between users and newly developed products. For example, there are living labs focusing on new developments in agriculture, in electrical vehicles and in healthcare. Yet the components tested in such living labs are not purely experimental; the actual development of the components takes place in an earlier stadium. These labs bridge the gap between pilot line projects and commercial manufacturing, but should not be considered pilot lines. Living labs are better characterized as KET deployment projects, since they address the higher technology readiness levels.

Organizational perspective on pilot lines

All industry stakeholders agree that pilot lines should be industry led and industry owned, to ensure that the output of a pilot line feeds into the commercialisation steps which follow on the pilot line and ultimately create market impact. Yet pilot lines do not have to be closed or open by definition. Belgium, and especially the Flanders region, have a long tradition with regard to multi-purpose facilities which assist companies in the upscaling of KET components towards commercial manufacturing. One of the main advantages of such plants is their one-stop shop solution: they offer a wide range of different equipment and facilities to assist companies in the upscaling process, reducing the need for transportation to a minimum. This saves costs and makes more complicated processes possible, since in most cases it is either impossible or very expensive to transport a semi-finished component from one facility to another.

The pilot plants examined in this country study are all independent facilities, that is, they are registered as enterprises and the shares of the plant are not in the hands of one or several companies. These pilot plants work on a customer basis with companies interested in using their facilities to upscale KET based components and it seems that the independence of these plants is a crucial basis for a successful collaboration. Customers collaborate with such plants precisely because they are independent. In some cases pilot plants are wholly owned subsidiaries of other companies in the sector, often large enterprises, yet in these cases the willingness of customers to collaborate with such plants is very much dependent on the relation with the company that owns the pilot plant. Industry stakeholders agree that their pilot plant would lose a considerable number of customers if it would be part of a larger conglomerate at one point in time.

Independent pilot plants serve a range of different companies, from SMEs to large enterprises, but they seem to be particularly well suited to support SMEs in their innovation processes. SMEs often lack the financial and human resources to build a pilot line themselves or lack sufficient knowledge and capabilities to do so. The fact that there are pilot plants available where SMEs can test the first prototypes of KETs based products also stimulates those SMEs to engage in innovation in the first place. Without these plants, there was no possibility to initiate the first experiences with prototypes, making it less attractive for those companies to engage in fundamental research.

Concerning intellectual property, the pilot plants have different approaches to arrange the appropriate returns for R&D efforts. With the majority of pilot line projects, the intellectual property rests with the customer. Companies only pay a certain access fee to be allowed to use the equipment and the facilities at the pilot plant, the intellectual property on the output of the pilot project rests with the company in question. In some cases, the access fees are covered through a project under the 7th Framework Programme and as a consequence SMEs can even receive the innovations for free. With other pilot line projects, the intellectual property rests with the pilot plant and customers are allowed to commercialize the output of a pilot line based on a licensing system. Although both approaches towards intellectual property work and lead to satisfactory results, it seems that a licensing system is in general less suitable for SMEs due to the high costs involved with such licenses. To conclude, there are limits regarding the willingness of companies to share knowledge in a consortium. In general, companies are not willing to share (technological) knowledge considered crucial to their core competences.

Market perspective on pilot lines

Next to the pilot facilities, this country study also examined the barriers that independent enterprises experience concerning the implementation of pilot lines. Here, it can be concluded that the barriers related to the up-scaling of products and components were not so much technological in nature, but were related to an insufficient articulation of the market. Especially with new technologies, such as additive manufacturing, customers lack the knowledge to understand the full possibilities of these technologies, especially in relation to serial production. The challenge lies in demonstrating and articulating the benefits of these technologies for mass manufacturing, rather than the established perspective that such manufacturing technologies are more suited for small scale pilot production. Furthermore, the market has sometimes doubts about the quality of the output of a pilot project. Companies have difficulties in articulating to the market that they have the capabilities to manufacture the components on a small scale with sufficient quality, even though the quality is demonstrated across all components. The absence of standards with regard to the required strength or composition of certain materials is seen as an inhibitor in this respect and creates ambiguity with regard to what is seen as good quality and what isn't.

2.2. Evaluation of KET polices/KET innovation eco-System

Public support, either on a national or European level, is crucial in the successful deployment of pilot lines. Throughout the interviews, several policy measures were identified which have an impact on the support of KET pilot lines. First, the role of public funding will be discussed as the most important policy instrument, followed by an overview of several other relevant policy measures. Specific attention will be paid to the role of state aid rules in the second section of this paragraph.

Public funding

Industry stakeholders agreed on funding being the most important policy measure to support pilot lines. Especially given the current economic times, industry have increasing difficulties in attracting sufficient funds to engage in high-risk pilot projects. The support of such pilot lines is not per definition a European or national cause. Although pilot plants are located in Belgium and have a positive influence on employment in the region, they are open to companies from all EU member states, making the support of such pilot plants of European interest as well.

Stakeholders agree that the distribution of these public funds should be focused and targeted on a number of priority areas. Funds should be allocated to those industries that already have a strong position in Belgium and Europe and which have world class potential. Focussing on too many industries or priority areas leads to a scattering of public funds. In this respect an industrial policy for those priority areas which are of local interest is clearly warranted, according to industry stakeholders.

In terms of the financial support of multi-purpose facilities, the stakeholders argued that the authorities should focus on creating a critical mass of such facilities throughout Europe. Policy should focus on supporting those facilities that are already operational and make them accessible to companies and research institutes in all EU member states. This way, one creates a critical mass of equipment and services at existing pilot plants, rather than building the same facilities in several EU member states. Industry stakeholders call for an expansion of existing pilot plants to a European scale: build on pilot plants that are already operational and create a critical mass at such facilities. Europe needs to make sure that they possess the equipment, tools and experience to support KET pilot lines on an European scale.

Concerning the selection criteria to select among pilot lines eligible for public funding, the industry argues that the allocation should be based on the output variables of pilot lines, instead of the input variables that feed into a pilot line. Several multi-purpose facilities, who receive public funds from national or European authorities, are already evaluated based on the end-result of their pilot line activities. Industry stakeholders argue that the European Commission should set several key performance indicators which consortia have to meet when they receive public funds for pilot activities, for example in terms of market impact or jobs created.

In the end, what counts are the results of a pilot line, not what feeds into a pilot project, according to industry stakeholders. By focusing on the end results of a pilot project, the European Commission would behave more as an investor, instead of a controller. Important in this respect is a continuing involvement of the European Commission as an investor. Their role does not end once the grants have been issued, stakeholders argue for a continuing involvement of the Commission throughout the project, by monitoring the progress and interfering when necessary.

Other relevant policy instruments

Several other relevant policy instruments were identified by industry stakeholders. These instruments go beyond the scope of public funding and were given considerable importance by the respondents. First, public entities can play an important role in bringing different parties together to initiate new discussions and improve the communication between parties across the value chain. For example, in case of 3D printing the requirements of this technology should be incorporated already in the design phase to be able to exploit the full possibilities of 3D printing, since it allows more complex shapes and objects than what is possible with conventional technologies. Yet at the moment designers are unaware of these possibilities, leading to inconsistencies and incongruences across the value chain. Public entities could play a role in training these designers, for example through branch organizations, and thus improving the communication between parties in the value chain the increase the speed of up-scaling.

Second, the issuing of standards would help in increasing the credibility and usability of new technologies. In the absence of these standards, the market has doubts whether to perceive a component as having a sufficient quality or not. Standards might help in removing such ambiguity and increase the speed of adoption of new technologies. Partly publicly funded projects which demonstrate the existing technological capabilities to the market, rather than projects which aim on improving the technological knowledge base, could help in this respect.

Third, although FP7 projects are seen as a useful medium to support private R&D, there is generally too much bureaucracy involved. The criteria which a consortia has to fulfil in order to be eligible for public funding is very exhaustive, as is the time it takes before grants are issued. Three months is seen as an acceptable period of time, given the funds that are involved and the precaution that needs to be taken here, but at the moment the bureaucracy involved in framework programmes is too high.

Fourth, industry stakeholders argue that a fundamental change of the state aid rules is necessary if Europe wants to support pilot line projects. This is necessary because of three reasons. First, the state aid rules focus on internal competition within the European Union, whereas KET pilot lines are pan European by definition and address competition between the European Union as a whole vs. the USA or Asia. Therefore, current state aid rules are not applicable to the support of pilot lines. Second, the state aid rules are too simplified in the sense that they do not distinguish between the financial support of an independent multi-purpose facility and the support of private enterprises. If public authorities financially support pilot lines of private companies which are developing products for a specific company then it will disturb the market. However, if a pilot line enables the production via a platform of R&D or a multi-purpose facility, which offers new opportunities to the markets, this will not disturb the market. This difference should be acknowledged by the state aid rules. Third, the percentage of eligible costs of pilot lines that is funded through public grants is generally too low, especially for multi-purpose facilities. At the moment, state aid rules allow a maximum of 45% for small enterprises and 35% for medium sized enterprises. Yet in other countries, especially in Asia and the USA, such facilities are funded with up to 70-80% in public funds, making it possible to acquire more advanced equipment and support enterprises in their upscaling processes on an more serious basis.

In sum, changing the state aid rules is a prerequisite for the public support of pilot lines. Europe will probably not succeed in changing the behaviour of other continents, changing the way Europe approaches the support of industrial research, development and innovation seems to be necessary.

3. Conclusions

Based on desk research and the interviews conducted, this report provided insights in the KETs policy in Belgium, as well as in the initiatives that the Belgian industry takes to initiate pilot lines. Several conclusions can be drawn based on the experiences of policy makers and industry stakeholders. The next paragraph discusses the conclusions from the policy perspective, followed by the conclusions from a business perspective in the second paragraph.

3.1. Summary of policy perspective

Belgium is a federal state, consisting of seven autonomous entities: the Federal Government, three regions and three communities. Each entity has exclusive responsibilities, but the federal government level in Belgium has no responsibilities for the support of innovation; this is delegated to the regional governments. The regional governments concerns the Flanders Region, the Walloon Region, and the Brussels Captial Region.

In Flanders, the concept of KETs is incorporated through the KETs platform Flanders, established in November 2012. It aims at the development of roadmaps for KETs in Flanders, in alignment with the European roadmaps, PPPs, platforms and programs targeting KETs. The KETs Platform Flanders focuses on five KETs, since it is still unclear how to incorporate the nanotechnology KET due to its interrelatedness with other KETs. The Agency for Innovation by Science and Technology (IWT) implements the Flemish policy measures for supporting R&D and innovation, with specific support being available for SMEs. The support by IWT is mainly related to the lower TRLs, although there are some ad-hoc initiatives for demonstration projects. Yet systematic support for pilot lines is lacking at the moment, although the Flemish government is planning to substantially increase the funding available for pilot lines in the coming years. The roadmaps developed through the KETs platform Flanders will be used as an input, in which cross-linkages for multi-KETs activities were identified.

KETS are also addressed in the support and stimulation of specific cluster initiatives and strategic research centres. Several competence poles focus on KETs or represent important application domains of KETS. Yet the strategic research centres mainly focus on TRL levels 1 to 5, notable exception being the IMEC institute focusing up to TRL7 and assisting companies in the upscaling of micro-nanoelectronic based components. The attention of the Flemish Government will mainly go to the support of such strategic research centers and multi-purpose facilities. In other words, the government very much focuses on open innovation and stimulating the collaboration between companies. Governmental support of closed industry owned pilot lines can be considered as state support and is not possible due to the state-aid rules. In this respect the Flemish Government aims at opening up of existing pilot lines to allow for the participation of third parties, but this seems to be difficult to realize in practice.

One of the main pillars of the Walloon science, technology and innovation policy is the establishment of clusters and competitiveness poles. These clusters are very much oriented on SMEs and form partnerships for industrial and commercial developments and developing an ecosystem for innovation in specific sectors. KETs are on the agenda of the Poles: they have been asked to indicate which KETS are relevant for the poles, what their expectations are and how they position themselves towards KETS. The support for such Poles or clusters can be preconditioning to the support for pilot lines, since they create critical mass, needed for the ecosystem of a pilot line. The Walloon Government calls for more support for clusters at the European level. Clusters should not only be the responsibility of the regions, but it should be a EU responsibility as well: a good distribution of world class clusters over Europe would be beneficial to the competitiveness of Europe and would provide the feeding ground for pilot lines.

At the moment, the support of pilot lines is very limited in Walloon, mainly due to the fact that classical investment schemes do not match the specific requirements of a pilot project. For example, the support programs for R&D are open for multi-actor projects, but the investment and exploitation programs are often focused on one actor only. Furthermore, the state aid rules constrain the possibilities for the Walloon

government to invest in exploitation projects and in the provision of loans with low interest rates. A revision of the state-aid rules allowing for the issuing of loans with below market interest rates would be helpful in this respect. Finally, the Walloon government aims to support companies in institutionalizing European collaboration and assisting them in European calls for support. At the moment, Walloon companies are very much focused on the regional calls for support and this absorbs their attention for the international opportunities. However, internationalisation and European collaboration is key in improving the market uptake when the R&D projects are finished. Governments could play a role in improving the alignment between regional and European support measures.

In the Brussels region, the support for research and innovation is delegated to the Brussels Institute for Scientific Research and Innovation (Innoviris) is the main agency in the region for support to research and innovation. Similar to the approach in Wallonia has the government of Brussels Capital Region developed clusters of innovative companies. However, there are no specific policy measures for the support of pilot lines.

According to the policy stakeholders, it is crucial to realize new public-private funds, allowing multi-level risk-sharing in innovation projects. Public money is limited, yet large investments are needed with such pilot projects. The high risk, high gain characteristic of these investments are not attractive to regular private investment companies, creating the need for new financing instruments.

3.2. Summary of business perspective

Belgium in general, and Flanders specifically, is known for its independent multi-purpose facilities which assist companies in the upscaling of KET based prototypes. There are facilities focusing on industrial biotechnology, micro-nanoelectronics, photonics and advanced materials, pilot lines focusing on nanotechnology and especially advanced manufacturing technologies seem to be absent. In terms of technology readiness levels, the photonics and industrial biotechnology pilots address TRL5-6, whereas micro-nanoelectronics address TRL5-7. All industry stakeholders agree that these multi-purpose facilities should be industry led and industry owned, to ensure that the output of a pilot line feeds into the commercialisation steps which follow on the pilot line and ultimately create market impact.

Multi-purpose facilities serve a range of different companies, from SMEs to large enterprises, but they seem to be particularly well suited to support SMEs in their innovation processes, since SMEs often lack the financial and human resources to build a pilot line themselves or lack sufficient knowledge and capabilities to do so. Customers claim it is crucial that multi-purpose facilities operate as independent companies, rather than belonging to a larger conglomerate, to safeguard secrecy and the appropriate selection of pilot projects. In terms of intellectual property, the facilities use different approaches, yet it seems that a licensing system is in general less suitable for SMEs due to the high costs involved.

Stakeholders identify public funding as the most important policy instrument to support pilot lines. Especially given the current economic times, industry have increasing difficulties in attracting sufficient funds to engage in high-risk pilot projects. The support of such pilot lines can be done both on a national and a European level, although the higher the technology readiness levels, the more regional and national funding and involvement becomes important. Furthermore, a change in the state-aid rules is considered very important, since they do not distinguish between the support of technology platform which enables the production of other companies and the support of pilot lines of private enterprises. The latter creates market distortion, whereas the first offers new opportunities to the market. To conclude, the process of applying for funding under a Framework Programme takes too long and involves too much administrative work, according to industry stakeholders.

3.3. Recommendations to support pilot lines

Several recommendations can be made based on the interviews and desk research conducted in this country study. First, it seems crucial to support multi-purpose facilities or pilot plants with public funds, since they play an important role in assisting SMEs with upscaling processes. For policy it is furthermore important to

differentiate between the projects executed and the infrastructure itself at pilot plants. The latter is generic and pre-competitive, funded by government subsidies in most cases and is completely independent. The projects are competitive and companies are not always willing to share knowledge, although this seems to be dependent on the KET involved.

Second, open pilot plants should be independent and public policy should pay attention to this when it comes to the support schemes under Horizon 2020. Especially for SMEs, such independent facilities have a major advantage over pilot plants which are operated by large conglomerates, since they are usually competitors and not inclined to collaborate through an open pilot plant.

Third, the focus should be on stimulating the competition between Europe vs. Asia and the USA, rather than preventing unfair competition between EU member states. A revision of the state aid rules which incorporates this perspective is crucial.

Fourth, it is crucial to increase the alignment between European and regional efforts in several branches. Very important in this respect is the recognition that although multi-purpose facilities are open to companies in all EU member states and that the region where such a facility is located is therefore of secondary interest. The worst case scenario would be to create 27 pilot plants in 27 EU member states, such sub-optimization would not help Europe forward, due to the lack of capacity of each plant. Rather, public policy should focus on supporting those facilities that are already operational and make them accessible to companies and research institutes in all EU member states. Policy should aim for an expansion of existing pilot plants to a European scale: build on pilot plants that are already operational and create a critical mass at such facilities. This way, one creates a critical mass of equipment and services at existing pilot plants, rather than building the same facilities in several EU member states. The focus should be on supporting excellent centres, such as the Networks of Excellence, instead of only regions that are behind.

Fifth, Europe should play a larger role in the support and development of regions. Some regions are too small to finance own open and shared facilities, especially for large scale facilities it should be an EU effort. Regions can become pilot lines leaders, yet they will need the support from the Commission for this. For example, Europe and the Member States should focus on collaboration and alignment of pilot lines and upscaling initiatives, in combination with smart specialisation of European regions. The European Investment Bank could play a role here as well, by organizing open calls for proposals for multi-KETs pilot lines.

Sixth, concerning the criteria to select among projects which are eligible for such investments, it is crucial to focus on the output variables of a project. In the end, what counts are the results and the focus should therefore be the outcomes from a pilot project. The selection criteria should also be extended beyond the creation of jobs in Europe. Jobs are important, but the KET ecosystem is not confined to the boundaries of Europe and rather is worldwide. The pilot lines should support the EU industry by making them stronger and better positioned in the international markets and in international collaborations. This implies that international firms and other regions outside Europe will also come to Europe to develop the high end knowledge, skills and tools. It should not be perceived as problematic that tools made using European knowledge will land outside Europe for production. Usually there are very few jobs associated with the production of high end tools, since these process are usually highly automated. Europe should focus on producing high-end tools and on R&D, since this results in far more jobs for Europe. Finally, there is a high need for stability, consistency and coherence in terms of public policy. This is crucial to support the long term and high risk investments which are associated with pilot projects.

Seventh, the negotiation of standards for new technologies or components as well as bringing the various parties across the value chain together could improve the coherence and increase the speed of adoption of new innovations.

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4.2. Interviews

The following persons were interviewed for this country study:

Name	**Function**	**Organisation**	**Industry/policy**
Chris Decubber	Research Programme Manager	Agoria	Industry
Hugo Thienpont	Managing Director	B-Phot	Industry
Inge Cools	Programme Office Director	Living Lab EV	Industry
Vincent Lepage	Acting Director - Economic Policy Directorate	Walloon government	Policy
Wim Soetaert	Director	Bio Base Europe	Industry
Jan Larosse	Scientific Advisor	Department Economy, Science & Innovation - Flemish government	Policy
Ludo Deferm	Vice-President	IMEC	Industry
Thomas Bossuyt	Sales engineer	Layerwise	Industry

5. Annex: list of pilot lines

Name of pilot activity	Description	Internet
Bio Base Europe Pilot Plant	BBEU provides the facilities and equipment to develop and scale up biobased products and processes up to production scale. It positions itself as a one-stop-shop: BBEU can perform the complete bioprocesses, from biomass raw material to the pure and refined bioproduct. In other words, the pilot plant is capable of performing the entire value chain in a single plant: from the green resources up to the final product. The Bio Base Europe Pilot Plant focuses mainly on second generation technologies to convert agricultural waste products and non-food crops such as wheat straw, corn cobs, wood chips, Jatropha and algae oils into bio-fuels, bio-plastics and other bioproducts. Next to the pilot plant, Bio Base Europe covers a training center in Terneuzen to address an industry-wide shortage of skilled process operators and technical maintenance specialists for biobased and sustainable energy processes.	http://www.bbeu.org/
B-phot	The main objective is to shorten the time to market by developing photonics based components up to preproduction levels. Covering the complete value chain from modeling&design, metrology, component fabrication up to proof of concept demonstrations. B-Phot can support companies in developments either by offering consulting or customized trainings or by offering complete development services. It can offer the complete value chain from design to ultra-fast prototyping and pre-production. Next to industrial research, B-phot is active in various national and European projects focused on fundamental research and it offers various education related services. B-Phot is an independent facility which is open to companies and research institutes throughout the world.	http://www.b-phot.org/
IMEC	Imec aims to bridge the gap between fundamental research at universities and technology development in the industry. IMEC is headquartered in Leuven, Belgium, but has additional R&D teams in The Netherlands (Holst Centre in Eindhoven), China, Taiwan, and India, and offices in Japan and the USA. Like B-Phot and BBEU, IMEC is an independent R&D organization, yet it receives funding from the Flemish Government to cover operational costs. IMEC is a program oriented organization which focus on assisting the realization of industry roadmaps on micro-nanoelectronics. IMEC research broadly divides into two different approaches : 1) Programs related to scaled CMOS, the “Core CMOS Program”. These programs are associated with efforts to continue the doubling of scale (“More Moore" programs); 2) Programs related to ‘Heterogeneous Integration’ Application Oriented Programs. These CMORE programs go beyond Moore scaling (“More than Moore”) by adding functions other than logics and memory on the chips of CMOS micro- and nanodevices. The CMORE solutions are implemented in IMECs 200 & 300mm pilot lines.	http://www2.imec.be/be_nl/home.html
Henkel	Henkel participates in the Flex-o-fab project. The overall objective of this project is the demonstration of a reliable manufacturing process for OLED lighting foils, enabling market introduction within 3 years after the end of the project.	http://www.flexofab.eu/

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