mKETs-PL working document

Country report Spain

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Content

1. Policy perspective

The goal of this chapter is to describe the main policy perspectives and initiatives aimed at deploying KETs (and their cross-fertilisation) in Spain. Due to the linkages among KETs policy and Smart Specialisation Strategies (S3), and the importance of local specificities and economies in the latter one, this Member State approach is completed with a broad picture of the issue at stake in the Basque Country. This region has one of the most important industry concentrations in Spain and the GDP per inhabitant in this region is €29,988, higher than the Spanish average and 136% of the EU27 average (2010). Basque Country is well recognised by its continuous and long term R&D policy, well prepared human capital, as well as technology and export intensity in certain industrial sectors, such as automotive, machine tool, aerospace, electric equipment and renewable energy. This region is embarked in the last decade in a process of strategic technology planning addressing particular emerging technologies due to their enabling character: biotechnology, nanotechnology, renewable energy and advanced manufacturing. Firstly, R&D capacities in academia, public and private research organisations, and even in company research centres were articulated around the so called Co-operative Research Centres (CIC) in those strategic and emerging technologies and sectors. This research oriented measures encompassed by those strategies are lately being combined with R&D exploitation and market oriented measures, in order to valorise the existing R&D results, skills and infrastructures.

The Spanish economy has evolved rapidly in the last decades as indicated by the GDP growth. This growth was accompanied and partially caused by a continuous R&D investment by the Spanish government (and its regional counterparts). Nevertheless, the structural deficiencies of the Spanish productive system (e.g., largely based on construction and tourism, low technology intensity) exposed critically the country to the international financial and economic downturn. Consequently, the rhythm of growth of the last years was abruptly interrupted: The GDP has decreased in the last 3 years and reached the 2007 values, and unemployment rate is increasing dramatically (around 25% in December 2012). This halted the positive trend of the public and private expenditure on R&D. But still, the Spanish government, as well as its regional counterparts, considers R&D and innovation as a main driver for future competitiveness. In fact, they are looking for innovative measures to address the major bottlenecks of the productive and innovation system. The new Science, Technology and Innovation Law (2011)[1] and the new strategies derived from it, the Spanish Strategy for Science, Technology and Innovation 2013-2020[2], and the National Plan for Scientific and Technical Research and Innovation 2013-2016[3], show that the R&D supply focused innovation policy of the last decades is being replaced by measures oriented to reinforce collaboration among public science and technology system and the productive fabric, so as to valorise the national R&D. Likewise, they are aimed at addressing other deficiencies of the national productive and innovation system, that will be tackled in Chapter 1.1. Similarly, the Basque Country R&D&I policy, is shifting to R&D transfer oriented policies so as to address the major weaknesses of the regional innovation system and thus solve the negative effects of the crisis on the domestic and international trade (consequently on GDP) or on the unemployment rate (13.8% in the first quarter of 2013, similar to the rates in the early nineties). The Basque R&D policy is well recognised for having evolved over time, along with the rapidly changing economic and social reality and should now be able to adapt to the current challenges.

1.1. Country specific innovation system with emphasis on KET

The current round of Spanish STI policies, under the aforementioned Science, Technology and Innovation Law, is aimed at addressing the major bottlenecks of the national productive system, particularly those which regard to innovation, namely, (1) the risk averse and low innovation based productive structure, (2) low coordination between research (mainly public and academic, but also from RTOs) and commercial or societal needs, (3) limited financial resources to innovative companies and venture capital activities, (4) underestimation of the importance of collaboration among various actors, and (5) limited internationalisation of the STI system. Overly

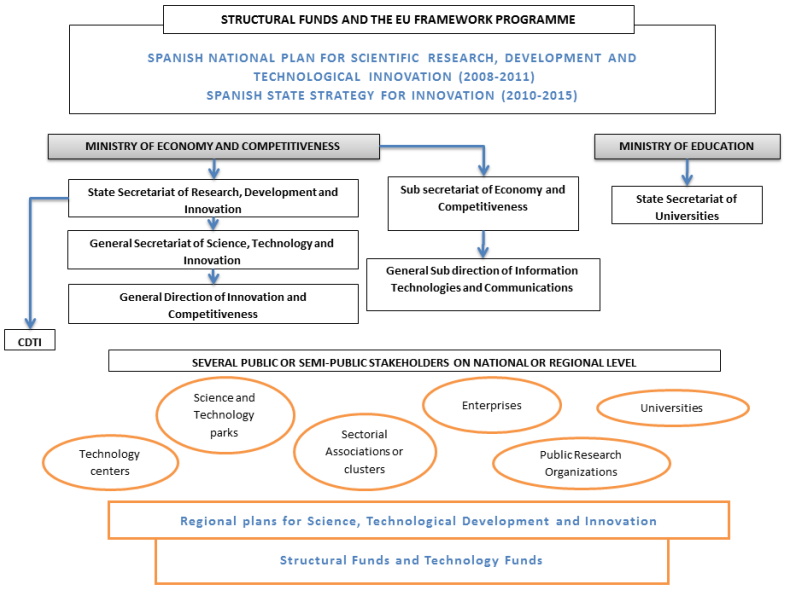
[2] Estrategia Española de Ciencia y Tecnología y de Innovación 2013-2020
[3] Plan Estatal de Investigación Científica, Técnica y de Innovación 2013-2016

rigid and complex Public Administration is also often regarded as an important hampering factor. To this end, Promotion of talent and its employability; Promotion of excellent scientific and technology research; Industry Leadership in R&D&I; and R&D&I oriented to grand challenges are the main goals pursued by the Spanish Strategy for Science, Technology and Innovation 2013-2020 and the National Plan for Scientific and Technical Research and Innovation 2013-2016, the main instrument to deploy the aforementioned strategy. A set of measures under the *Industrial Leadership in R&D&I* objective addresses the Key Enabling Technologies. The strategy states that "the key enabling technologies, due to their cross-cutting nature, have a big impact on the rest of the economy by enhancing the productivity of the industrial sectors and by improving the delivery of services by Public Administration." Furthermore it is recognised that advances in areas such as micro- and nanoelectronics, photonics, nanotechnology, biotechnology, advanced materials and manufacturing systems of the future, are laying the foundation for future competitive advantage in a wide range of companies and sectors. Integration of those technologies to the traditional manufacturing sectors deserves special attention in policy papers which pursue the ambitious goal of changing the production model in Spain. Promotion and set-up of structures that facilitate a better use of scientific knowledge and technological development, reforms in the financial framework in order to encourage innovation and promotion of innovation through public demand outstand among the policy measures to address those goals

In the **Basque Country,** KETs form the basis of the Science, Technology and Innovation Plan 2015. The KETs are called "cross-technology domains" that are defined as the transversal capacities fostering the development towards identified focus markets (ageing, energy, transport, digital world and industry of science). The plan is focusing on biotechnology, nanotechnology and advanced manufacturing technologies as key cross-cutting technologies. Basque Innovation policy has evolved from the so called R&D supply approach in the eighties, mainly focused on the creation and articulation of the regional innovation system, to the so called R&D demand approach in the nineties, with the cluster policy as a flagship initiative. The new century came along with combined R&D supply and demand side measures, and diversification to the aforementioned emerging technologies sectors was placed at the forefront of innovation policy together with excellence in research.

As far as the innovation policy governance is concerned, the Spanish **Ministry of Economy and Competitiveness (MINECO)**[4] is the responsible of R&D&i policies, that have shaped the Spanish science and technology system and thus responsible for the organisation of those policies within the country including the system players; the regulatory framework, the specific programmes through which the government implement their actions. It embraces the Centre for Industrial Technology Development (CDTI), the main governmental body for innovation policies[5]. The following chart illustrates the innovation policy governance:

[4] The responsibilities of the Ministerio de Ciencia e Innovación (MICINN) in the former government are now undertaken by the Ministerio de Economía y Competitividad (MINECO) after the new government took office in late 2011
[5] The set-up of the State Research Agency is announced for the end of 2013



Source: Erawatch

Additionally, regional governments (Basque Government and SPRI in the case of the Basque Country) are crucial players in the STI policy landscape, as they have developed their own STI structures and instruments, in accordance with their autonomous competences.

The R&D supply side in Spain is mainly made up by universities, public research organisations (subscribed either to national or regional governments), Health Organisations, Corporate R&D, RTOs and Singular Scientific and Technology Installations[6]. In the Basque Country, the absence of national public research institutes is successfully fulfilled mainly by five universities, public research organisations subscribed to the regional government (e.g., Basic and Excellence Research Centres – BERC[7]), the Cooperative Research Centres[8] focused on key cross-cutting technologies and other relevant sectors, RTOs (being TECNALIA and IK4 the largest ones)[9], and the corporate R&D units.

1.2. Organisation of mKETs policy

The National Plan for Scientific and Technical Research and Innovation 2013-2016 recognizes the benefits of combining different KETs. The strategy envisages boosting new advances in those technologies with particular attention to the *integration of these technologies to the traditional manufacturing sectors* and by *combining* them to industrial technologies, products, services and novel applications. Future competitiveness of Spanish manufacturing sector is regarded as largely depend on the development and implementation of these new technologies, that are seen as the main source of higher value-added products and hence considered as important pillars of the pathway to improved production capacity and growth.

[6] Instalaciones Científicas Técnicas Singulares (ICTS)
[7] Centros de Investigación Básica y de Excelencia
[8] Centros de Investigación Cooperativa – CICs. CIC biomaGUNE (biomaterials); CIC bioGUNE, (bioscience); CIC marGUNE (advanced manufacturing); , CIC microGUNE (micro-nanotechnologies); CIC energiGUNE (energy technologiges); CIC nanoGUNE (nanoscience); CIC tourGUNE (Tourism).
[9] TECNALIA is the result of a merger of 8 technology centers in 2011, while IK4 groups a research alliance of 9 technology centres

KETs and measures to bridge the so called Valley of Death underlie the four main objectives of the National Plan for R&D&I, but are most intensely addressed under *Promotion of excellent scientific and technological research* as well as the *Industrial Leadership in R&D&I* objectives, which embrace a wide set of measures aimed at addressing different steps in the innovation value chain:

- The *promotion of excellent scientific and technological research* objective dedicates a set of measures to the development of emerging technologies which include: exploratory initiatives[10] aimed at evaluating technologies and looking for new applications[11]; instruments to finance the valorisation of R&D project results[12]; and instruments to cover the initial costs of setting up technology based companies[13]. Besides this, it entails a set of measures aimed at making the national/public science and technology infrastructure and equipment available to the entire national innovation system in order to facilitate high quality research and highly competitive company R&D activities. Shared infrastructures, public-private collaboration, cross-sector collaboration, engagement of industry in the use of those infrastructures, collaboration with international research organizations, as well as transfer of results are underlined to reinforce the existing science and technology infrastructure.
- *Industrial Leadership* objective on the other side, dedicates one set of measures to Key Enabling Technologies and particularly to (a) support exploratory activities within close to the market company driven R&D&I projects (by means of the *Company driven R&D&I projects* instrument), (b) increase the technology absorption of companies, particularly SMEs, as well as to (b) support the technology take-up by mature sectors (the latter two goals addressed under the so called *Innovation and Technology Modernisation projects*). Therefore, despite KETs are being tackled rather individually on the policy papers, some of the above listed measures are deemed to contribute to the cross-fertilisation of multiple key enabling technologies. Unfortunately and due to the recentness of the current STI policies (and also due to the R&D&I budget reduction), none of the instruments are in place yet.

CDTI has recently launched a public-private working group around KETs with the aim of sharing relevance information concerning KETs, agreeing the positioning of Spain and advising on KETs policy. The group where experts in different KETs converge is made up by the Spanish representative in the KETs HLG, the Spanish mirror of PPP Factories of the Future for Advanced Manufacturing (represented by TECNALIA), the Joint Technology Initiative BRIDGE (bio based industry) as well as other public research centres and RTOs, companies and public authorities.

At **Basque Country** level, the Science, Technology and Innovation Plan 2015 (PCTI 2015) of the Basque government already considers the KETs as "cross-technology domains", that are defined as the transversal capacities fostering the development towards identified focus markets (ageing, energy, transport, digital world and industry of science). Elaboration and implementation of specific strategies addressing those cross-cutting technologies and the creation of Cooperative Research Centres[14] to reinforce regional R&D capacities in those technologies (as well as in the Energy sector where multiple KETs converge) outstand in the regional STI policy in the last years. More recently, and after more than three decades of regional industrial and STI policy, the major concern is to valorise the R&D results and reach the market, in full alignment with bridging the Valley of Death. Convergence among micro-nanotechnologies and biotechnology is addressed in both the BioBasque and NanoBasque strategies and illustrates how combination of KETs is being considered.

Innovation policy evaluation is not sufficiently developed and rooted in the country. Recently and in order to fill this gap and duly follow-up the STI strategies, the Information System on Science Technology and Innovation has been created. The National Strategy for Science, Technology and Innovation 2013-2020 is going to be monitored following a set of input-output indicators. Intermediate (2016) goals are set for those indicators, so as to revise and adjust the strategy, and to ensure that 2020 goals are achieved. One of those output indicators refers to the number of patents requested in different KETs, which is expected to be increased in 25% by 2016

[10] Proof of concept, "Prueba de concepto"
[11] Technology Exploration Projects, "Proyectos Explora Tecnología"
[12] Complementary Actions, "Acciones complementarias"
[13] Facilitating Actions, "Acciones de Dinamización"
[14] Centros de Investigación Cooperativa (CIC)

and in 50% by 2020. Same objectives are pursued in the case of patents in emerging technologies or patents addressing grand challenges. Other indicators, related to KETS in some way, refer to companies engaged in technological innovation as a percentage of total companies with 10 or more employees (the current 18.58% is expected to be increased up to 20% in 2016 and 25% in 2020); % of SMEs engaged in technological innovations – product and process (the current 14.6% is expected to be increased up to 16% in 2016 and 20% in 2020); medium-high tech exports as a percentage of total product exports (the current 4.7% is expected to be increased up to 6% in 2016 and 10% in 2020); Number of companies engaged in product and process innovation activities, in collaboration with public research centres and universities (the current 23% is expected to be increased up to 30% by 2016 and 45% by 2020).

Legal environment

The aforementioned new Law on Science, Technology and Innovation lays the ground for the new wave of Spanish national STI policy. Valorisation of R&D results is at the forefront of this new policy context, and technology transfer and dissemination measures, promotion of collaboration among different players in that process and engagement of the finance sector are the major issues addressed by this law. In order to facilitate the public-private cooperation the law envisages collaboration agreements aimed at financing singular projects or shared use of installations, among others. The contracts or agreements aimed at valorisation and transfer of results will be subject private law. Those agreements will rule the contribution made by the participants, as well as the distribution and protection of IPR and R&D&I results.

One of the novelties brought by this law refers to the open-access of research results (those coming from projects or activities that have been majorly by State Funds).

The Sustainable Economy Law (2011) is also aimed at favouring the business diversification and the transformation of research results into sustainable socioeconomic development. According to this law, knowledge transfer measures not oriented to business exploitation, such as the creation of shared infrastructures, will be also stimulated.

The consultation process undertaken in Spain illustrates that Intellectual Property Rights and State Aid regulation and the market distortion that the intervention of the State can cause (particularly in closer to the market steps) are an issue. Therefore, unless the related regulation is developed and adapted to the purpose of the KETs policy, success of this initiative will be limited.

Main policies for Pilot lines

Several measures and instruments in the State STI policy (mostly launched under the former STI policy, as the measures and instruments planned in the current policy are not yet in place) are aimed at achieving the overall goal of valorising the results of the research conducted by the sophisticated research infrastructure created in the past decades, in order to bridge the so-called Valley of Death.

Some of those pursue stimulating company investment in innovation activities. Direct grants are being replaced by fiscal incentives to R&D, which encompasses tax deductions for R&D&I activities (up to 50%-60% of the corporate income tax), favourable fiscal treatment (patent box) to incomes derived from patent licensing (the latter two are non-restrictive with each other) as well as tax credits derived from R&D personnel (since 2007). However, those incentives are majorly used by large companies and not SMEs, who find difficulties in their application (Corchuelo, 2007). Fiscal deduction of the R&D activity has undergone significant changes since the fiscal reform in 2006, followed by an interruption until the approval of Economic Sustainable Law in 2011, which increased the deduction coefficient as well as the limit of the total amount to be deducted. NEOTEC aid is aimed at supporting the creation and development of technology based companies. Companies get a flat interest rate loan, which can be amounted up to 70% of the costs approved in the five year business plan (limited to €250,000). Company gives returns of the loan as positive cash-flow is generated. INNVIERTE pursues private capital contribution in SMEs in order to support their innovation activities (and also internationalization, improved management systems, etc.). Likewise, and as far as the venture capital is concerned, CDTI and the European Investment Fund are behind NEOTEC Venture Capital (The Spanish

Programme of Venture Capital investment), an innovative programme that pursues the creation of a solid Spanish Venture Capital market. Various finance and industry actors have been incorporated to that programme.

Public procurement is also gaining importance as a way to reinforce the demand for innovative products, particularly in emerging technologies and/or KETs. Two modalities of R&D procurement are considered in the Guidelines for R&D procurement:

- Commercial/business procurement or innovative technology procurement consists of procurement of a good or service that does not exist in the procurement moment, but that can be developed in a reasonable time period. This entails development of new technology or improving an existing one.
- Pre-commercial procurement is a R&D services procurement, in which the public procurer share with the companies the risks and benefits of the R&D required to develop innovative solutions. The aim of the first type is to improve the public service offered to the society as well as to make easier the internationalization of the R&D supplier (as local market is proved to exist), while the second type pursues conducting research around solutions to future public demands as well as upgrading technological skills of companies/R&D suppliers. INNODEMANDA is oriented to support the companies competing in the R&D procurement by covering the cost of the technological innovation required in a call. This stimulates the number of competitors, quality of the offers, and consequently, is expected to increase the existence of innovative products and services in the public authorities.

Collaboration of various actors in the innovation system and particularly the research side and companies is crucial if the valorisation of the research results is pursued. Measures to promote collaboration among those actors are being reinforced and the so-called reverse transfer of technology led by the business sector addressed. Several measures (still under the former STI policies and some of them interrupted in 2011-2012) are bound to address those goals:

- INNPACTO promotes joint (research organisations and companies) market oriented projects that pursue demand driven exploitable products. The overall goals are creating innovative companies, reinforcing the innovative activity of existing companies, mobilizing private investment, creating jobs, as well as stimulating participation of beneficiaries in European and international programmes. More than 2.6 billion € has been allocated to this measure in 2010-2012 (€827.5 million in 2010, €951.9 million in 2011 and €851.7 million in 2012). Support provided by this measure, partially funded by Structural Funds, varies from grants to loans. Similarly, and during 2006-2010 CENIT stimulated public-private collaboration in industrial research oriented large projects in emerging technologies with great industrial projection. Those projects, aimed at generating new knowledge to create new products, processes or services, were supported by means of grants covering up to 50% of large dimension joint projects, oriented to future oriented and international projection objectives. In that period, 91 projects were supported and €1,071 million allocated to more than 1,250 companies and 1,580 research groups.
- INNPRONTA is aimed at supporting large and strategic integrated industrial research projects concerned with the development of new future oriented technologies with great international projection. Promotion and optimization of existing public and private infrastructures and participation of SMEs in large industrial research projects outstand in the objectives of this measure. Projects dealing with Energy, environment and climate change; biotechnology, health and alimentation are prioritized but other sectors are also considered as far as projects ensure high value added, high technology standards and highly qualified job creation.
- Valorisation of technologies and results of R&D activities conducted mainly by public research organization is the main goal of INNOCASH policy measure, which is aimed at addressing results into the market with the support of industry investors, and private investors, in addition to public ones. This measure encompasses assessment of business exploitation opportunities as well as a virtual showcase to get companies and funders on board. During 2008-2011, INNOCASH funded projects addressing the priorities set by the strategies in force, namely biotechnology, health, energy, climate change, telecommunications and ICT, nanoscience, nanotechnologies, new materials and new processes.

- INNFLUYE is aimed at supporting the creation and maintenance of technology platforms as public-private working groups, in order to stimulate collaboration of interested parties in a particular technology. Public and private actors along the value chain in a particular sector identify and prioritize the research and technology needs in the medium and long term and consequently advise policy makers in charge of STI policies. They are also deemed to improve technology readiness and competitiveness of the national productive system by undertaking technology development and innovation projects both nationally and internationally.

In the Basque Country, in addition to measures oriented to support R&D&I projects aimed at developing new products (GAITEK, partially funded by ERDF) or integrated industrial research projects on public-private collaboration basis in strategic areas[15], also including experimental development activities (ETORGAI), demonstration and exploitation oriented measures are gaining importance and pilot demonstration projects are explicitly mentioned in the PCTI 2015. Establishment of cooperation agreements between the public sector, companies and scientific and technological agents for testing and trials of new technologies that are not yet on the market are foreseen for those projects. A new policy measure devoted to demonstrate the results achieved in previous R&D initiatives, and particularly in those priority areas, is in the agenda of regional policy makers. Infrastructures built up in the last years around those priority areas are planned to be used as technology testing installations on a shared use basis. However, the current budget constraints are hampering the design and release of such an initiative and information about the content of this initiative is limited at the moment (more details under Chapter 2).

[15] Biosciences, Nano sciences, alternative energies, electronics for smart transport, eco-innovation and social innovation are prioritised

2. Business perspective

2.1. Implementation of multi-KETs pilot lines

Pilot lines identified in the desk research and consultation process are driven either by public authorities, companies or the research side.

Publicly driven:

In response to the complexity of scientific research, the National Government has lead the creation of **Singular Scientific and Technical Infrastructures** (in Spanish ICTS)[16] as a way to promote research on advanced technologies by highly qualified scientists and technical staff. The ICTS are installations, resources and services that the national R&D&I system require to undertake cutting edge and high quality technological research, as well as to promote technology transfer, which require very high investments. They are aimed at revitalising the regional economy and call for a critical mass of scientists and technologists, as well as international collaboration. Singularity and openness (totally or partially for the use of the entire ST and industrial community, both at national and international level) are two features that the ICTS have to meet. In their vocation of tools at service of the ST and industrial community, they can be physical infrastructures (with a specific location), virtual or a network of distributed infrastructures. The State Industry (Ministry of Economy and Competitiveness - MINECO) is in charge of coordinating those installations and financially supporting them (funding interrupted in the last years). The label of ICTS can be obtained by answering to a call published by the MINECO, being the openness to use by other players one of the criteria used to issue the label. In general terms, 20% of the facilities capacity have to be open to external users (external to the ICTS). Access to the facilities is regulated by a public "Access Protocole" which is applied by the co-called "Access Committee" (external to the ICTS) in charge of evaluating and priotizing the applications. The network of ICTS is currently made up by around 35 installations. The ICTS are not conceived for industrial demonstration purposes. Consequently, they could be assimilated to a research pilot line, instead of a demonstration pilot line. The CNM - National Centre for Microelectronics (Catalonia) manages and operates a ICTS oriented to micro and nanofabrication, the so called "Sala Blanca integrada de micro y nanofabricación" or the Integrated Micro and Nanofabrication Clean Room. , It is an open access facility for any R&D institution or SME needing its processing and technological capabilities for R&D purposes or small series production of prototypes. The clean room is under operation since 1989 with a surface of 1000 m2, and has been recently upgraded to 1500 m2. It has the capability of fabricating integrated devices with CMOS processes and includes microsystem-specific and nanofabrication processes.

The Basque Government is currently working on the valorisation of the R&D infrastructures built up in the past, particularly those addressing the priority areas set by the STI strategy: **BIMEP Biscay Marine Energy Platform**; DEMOTEK – Demonstration Unit of Innovative Technologies in Healthcare (biosciences); Competence Centre of Environment health and safety (micro and nanotechnologies); and the **Advanced Manufacturing Facility**. These installations are planned to be used as technology testing installations on a shared use basis and be accompanied by a program aimed at supporting companies and other organizations in pilot test technologies that are not yet on the market[17]. BIMEP is a physical infrastructure, while the others are working on a distributed and remote basis. This is aimed at combining and offering the wide (and complementary) set of infrastructures across the Innovation System to the industry. Additionally, the Ente Vasco de la Energía (Basque Energy Board) that is the Basque Government's energy agency is leading the Electric Vehicle action line. The objective of the action line is to promote introduction of electric vehicles (EV) in the Basque Country as a means of improving energy efficiency in transport as well as opening new business opportunities for the Basque industrial sector. The target scenario for this strategy is that by 2020, 10% of the vehicles sold will be electric (pure or plug-in hybrids). The initiative aims specifically to (1) create a network of charging points throughout the regional territory; (2) Support the Basque electrical and electronic equipment industry in developing industrial and technological skills in the area of the EV; (3) Support the Basque automotive industry

[16] Infraestructuras científico-técnicas singulares
[17] Delayed due to the current budget constraints

in developing systems and components for the EV; (4) Facilitate access to the EV among organisations and individuals in the Basque Country; (5) Encourage development of a legal framework to favour the introduction and use of the EV at all levels and in all geographical areas.

Research driven:

KUBIK Experimental Infrastructure for the Configuration of Zero Energy Buildings: As being part of TECNALIA's strategy in the field of sustainable buildings and communities, KUBIK is the infrastructure where all new developments could become physical. New ways of more sustainable construction as well as new products developed together with industrial partners to build up more energy efficient buildings are tested in KUBIK. This aims to increase the energy efficiency of new buildings as well as to find new market niches for the Construction and Energy sectors, being affected by a strong crisis, as a way of increasing their competitiveness by innovating and developing more added-value products and services.

Flexible LED-display system using roll to roll technology: This pilot line is an outcome of the FP7 project LIGHT ROLLS led by PRODINTEC (Asturias). A roll of flexible polymer that goes through different manufacturing modules that results in a ready to work (lighten) flexible system that incorporates electronics, integrated and encapsulated led, etc. Any item that incorporates electronics (photovoltaic cell, mobile phone, tablet screen) can use this product.

INGRID Smart Grids Lab: advanced power system architectures, microgrids for buildings and districts, new power converters for grid connection, smart metering and grid automation, electric mobility (infrastructure, V2G), demand side management and demand response are the main research and testing activity of the recently inaugurated Smart Grids Laboratory and Interoperability Centre.

Photovoltaic Solar Energy Lab by the TiM (Institute of Microelectronic Technologies) at the University of the Basque Country (UPV/EHU). It is a laboratory that is fully equipped for the manufacturing, characterization and simulation of photovoltaic devices.

Company driven:
Use of optics technologies in the field of current and voltage measurement transformers in power stations: Grupo Arteche (Basque Country) is in charge of pilot line, which is aimed at replacing current technologies (induction technologies, resistive dividers, etc.), which would mean a major technological change in this sector.

Microalgae for energy: The petroleum company, Repsol (Madrid), and the electricity utility, Iberdrola, are focusing efforts on producing energy using microalgae. PIIBE project (under the national CENIT programme) revealed that using algae to produce fuel oils serves a dual purpose: They absorb carbon dioxide emissions and produce green energy without interfering with food crops, helping to combat two of the greatest challenges facing today's society. Repsol is also embarked on other pilot lines related to oil refinery processes or electric vehicle.

G10X 4.5 MW Wind Turbine Blade Manufacturing for off-shore farms by Gamesa (Navarra). Blades are manufactured in segments for transport, and assembled at the off-shore farm.

UDEX - Demonstration and Experimentation Unit: electrical network testing in a safe and controlled environment, a facility in the world with a short-circuit power of 2,500 MW. Velatia Research and Innovation Centre (Basque Country) is in charge of this pilot line

Pilot lines are well considered by organizations and companies dealing with R&D but some doubts arise about the opportunities for pilot lines in certain sectors (e.g. the electric sector).

Legal aspects (legal issues, State Aid regulation) as well as limited financial support are the major hampering factors to embark on a pilot line, particularly for companies. When objectives and technology is very clear, some companies (large ones with significant own resources) decide to embark on pilot lines on their own and thus avoid dealing with some issues such as IPR. When a company (specially an SME) is planning a Pilot Line, obtaining funding to minimise the risk of the investment is a rather complex issue. Some large companies are able to build a Pilot Line using own resources. But those Pilot Lines are self-dedicated, being hard to allow other companies to use it, even if they agree to pay for the use. When a Pilot Line is built by an RTO, university or public body, the required investment is partially or fully funded by the government. Depending upon the amount of public funding that corresponding Pilot Lines is opened to be used by third parties. However, experience concerning shared facilities is not always satisfactory. Sharing facilities can make more sense when the various actors engaged in the pilot line play a different role in the value chain.

Looking at how pilot lines are addressed and managed across sectors, it is observed that in Machine tool manufacturing sector, pilot lines are normally placed at client's facilities, and that is just possible after engineering, manufacturing and in-house validation of the pilot line is done. Additionally, placing the pilot installation in the client's facilities is also a laborious reassembling process that can take from one to six months, depending on the complexity of the pilot line. Some Pilot initiatives in the electric sector and particularly those aimed at incorporating a new technology to power stations also show some particularities. Utilities ask several providers to test their technologies at the same time in the same pilot line, so as to compare different alternatives (which can be also assimilated to a shared facility). As far as the value chain is concerned, a combination of manufacturing big series products and a unique product is the normal rule. Position in value chain determines the desired and achievable TRL.

Success Factors

- Success factors for a Pilot Line remain very much on a real ownership. When a Pilot Line is conceived for demonstration purposes at the end of a project, its sustainability becomes a problem. Funding is closed, ownership is not clear, and sometimes the industrial surface is needed. Immediate dismantling of the pilot line is the most probable option. But if the surface is not immediately needed a worse thing will happen, Pilot Line will be abandoned waiting for an uncertain future. When the owner of the Pilot Line is perfectly identified, this owner wants the Pilot Line be "productive". That is fulfilling its purpose, which is no other than adjusting, fine tuning, and shifting to actual manufacturing facility.
- In the case of a pilot line originated from an R&D project, large consortium is regarded as crucial as it enables bringing different technologies in a single pilot line.
- Trust among the various parties engaged in the pilot line, together with R&D excellence in sophisticated technologies and manufacturing expertise is crucial.
- Technologies that are demonstrated in the pilot lines have to be able to offer the same functionalities (and bring other advantages) as the conventional technology that they are aimed to replace. Suitability of these new technologies to address new market niches is deemed fundamental.
- Bearing in mind the industrial production conditions and addressing commercial issues since the very outset of the R&D activity are regarded as key factors in order to ensure that R&D reaches the market successfully.

Barriers

- The investment/cost that a Pilot Line could bring about to a company is one of the major barriers, although this varies from sector to sector, and very much depending on position of the enterprise in the value chain.
- Mismatch between long decision making processes around public calls and quick action required by the fast moving technology, prevents some pilot lines to be supported by public authorities and may limit their complexity and functionalities
- The limited support to the exploitation phase in R&D supports is observed as hampering technology improvements that could make easier the go to the market step
- Pilot lines that combine different technologies provided by different parties (sometimes located in different Member States with diverse regulation) leads to complex negotiation processes.

- National governments are more and more replacing direct grants by loans. Additionally, Venture capital does not understand new product and manufacturing lines. Financing final steps from TRL8 and MRL8 to get actual product manufacturing is not easy and some companies are obliged to look for finance at different world markets (Dow Jones Sustainability, FTSE4Good and Ethibel).
- Technological changes derived from KETs are not always well accepted by the major players of the sectors they are aimed to and technology adoption by the market can be a long process. This is observed in the electric sector, which is quite conservative and change-averse.
- Concentration of the technology aimed at addressing the same market need in a few companies does not facilitate the development of the market.

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

Companies agree on the need for public programmes aimed at counterbalancing the risk that building a Pilot Line brings about. Feasibility demonstration activities, prototype manufacturing, or even pre-series manufacturing are the main activities that could be carried out in those pilot line. A great doubt remains about whom and how will assess a Pilot Line project addressing TRL5, TRL6, TRL7 or TRL7+. Determining the Manufacturing Readiness Level (MRL) is even more complex, as it fully varies from sector to sector. While in some sectors, where size of series exceeds 1 million units, the top level reaches MRL9 (e.g., electronics, car manufacturing), in other sectors it is not possible to reach more than one unit, or going beyond tests (e.g., very specific capital goods, like in chemical industry, construction).

The previous main innovation policy document, Spanish Strategy of Innovation (E2I) was not focused on any priority key technology. Large companies, leading in partnership with other large companies and SMEs in their value chain, and RTOs, were engaged in four year big strategic technology projects (CENIT, INNPACTO). The results of those large projects were proof of concept of technology oriented to demonstrate industrial feasibility and, so, exploitation. Upon the results of those projects, partners might develop their own strategies aimed at a successful industrialisation and commercialisation of product or processes arisen from. The bridge over the valley of death was thus stopped just in front of the scarped wall to be climbed in order to reach the market. Even pre-commercial demonstration was not funded by those projects. Hence, multi-KETs Pilot Lines or even single KET Pilot Lines are totally covered by companies.

Additionally, it is observed that the existence of industry capable of adopting the results derived from R&D projects and other investments has not always been sufficiently considered when setting the R&D priorities and making decisions about the public R&D investments.

Spanish STI policies have just started to address aspects dealing with the KETs deployment, as it is clearly illustrated by the sub-programme oriented to the take-up of KETs in the new National Plan for Scientific and Technical Research and Innovation 2013-2016, which covers both R&D&I projects and Innovation and Technology Updating projects. Projects developed under the measures envisaged by this sub-programme are supposed to support those closer to the market steps. Unfortunately, none of those measures are in place yet.

In addition to the innovation policy measure to stimulate the KETs deployment, there are some policy-decisions that can accelerate technology take-up in certain industries, similarly to the boom of photovoltaic sector in Spain supported by a Real Decree, or the combination of active policies and changes in regulation that are driving the renovation of power stations in countries like Brazil.

3. Conclusions

3.1. Summary of policy perspective

Policy measures addressing public-private collaboration are well accepted and have led to interesting industry research results that in some cases have turned into pilot lines (normally not funded by public funds). Expectations on fiscal incentives to R&D are not fully met, and doubts arise about R&D procurement measures meeting the ambitious goals set by the State Strategy for Innovation.

The fact that KETs and pilot lines are explicitly mentioned in the recently launched national STI papers and accompanied by several policy measures oriented to their deployment and addressing closer to the market stages in the innovation value chain is remarkable. However, the recentness of the shift to more exploitation and market oriented measures together with the fact that some of the new policy measures are not in place yet, make complex judging their adequacy.

Long term approach and continuous adaption to the evolving challenges have been the main drivers of the STI policy in the Basque Country. Diversification of the economy to new technology intensive areas, but also reinforcement of existing local industry underlies the innovation policy making in the last decade, which is built upon some cross-technology domains and focus markets. Some of the debates around KETs and their deployment are already in the regional innovation agenda (not necessarily under the same terms), being the valorisation and commercialisation of the existing R&D results recognised as the major challenge at this moment. A new policy measure has been announced (but not released yet) to articulate technology demonstration in priority areas making use of existing testing facilities on a shared basis (e.g. BIMEP in marine energy).

3.2. Summary of business perspective

Pilot lines are well considered by R&D organizations and companies and public programmes aimed at counterbalancing the risk that building a Pilot Line brings about are welcome, as investment/cost that a pilot line brings about to a company outstands among the barriers to develop pilot lines. However, doubts arise about the criteria used to make decisions about pilot line projects to be supported, as they vary depending on the sector, ownership, etc.

Bearing in mind the industrial production conditions and addressing commercial issues since the very outset of the R&D activity are regarded as crucial in order to ensure that R&D reaches the market successfully.

3.3. Recommendations to support pilot lines

- Pilot lines should be addressed differently depending on the relevant sector or technology involved as well as other factors linked to future benefits or use. (Ownership of the pilot (private, academic, non-profit), flexibility in the process (dedicated lines vs. modular lines) degree of openness to other users, (close club vs. service to SMEs or users), potential impact on jobs & competitiveness. Those aspects have to be cleared up and pilot line boundaries of pilot lines have to be clearly marked so as to avoid direct competition with existing industries
- Regulation of State Aid and IPR should be reformed if the goals set by the European KETs strategy are to be accomplished. The outcome of the current revision from the State Aid Rules should give more flexibility regarding the support to these closer to market activities. Likewise, new and innovative financial schemes must accompany the KETs strategy. E.g. combination of traditional funding and new instruments that regulate partial refunding of the grant depending on benefits obtained with the R&D exploitation activity.

- Re-industrialisation of Europe must rely on European people, giving them not only knowledge and technology but skills. R&D&I cycle must be effectively a closed circle, covering from ideas to market, and back again.
- EC should safeguard that initiatives around KETs do not stimulate/accelerate the two-speed Europe, with a few Member States leading the "KETs race" and other trying to catch-up. EC should be also concerned about strongly benefiting certain sector or technologies out of the KETs strategy and KETs initiatives under Horizon 2020. EC should also preserve that in consequence of investment in R&D and pilot lines, jobs are created in Europe and not in other countries where European companies are investing in.
- Caution has to be considered when talking about transforming this product development into production and therefore needing large multiKETs pilot lines funded to reach a high level of Manufacturing Readiness Level (MLR) to prepare the process for mass production. The investment on those pilot lines is shown to be strongly sector dependant in terms of financial needs and it should not jeopardize large parts of competitive R&D budgets only for a short set of these lines. In fact, moving towards larger projects could hamper SME participation not able to lead them and it is explicitly against the stakeholders views in response to the Common Strategic Framework for EU Research and Innovation funding.
- Successful industry participation in the applied research funded under PPP, in CIP, and in the national context in programmes addressing industry research partnerships (CENIT, INNPACTO, INNPRONTA) indicate that industrial participation can be boosted by moving forward in the TRL scale for projects, reaching TRL 6-7 in H2020 (to demonstrate prototypes in relevant or operational conditions) and also maybe reaching further if they address product development (TRL 8) in small projects. However, current reach of collaborative projects (up to TRL 4-5) should still play a key role in H2020 to guarantee sustainability and competitiveness of the European industry at long term.
- EIT KICs on "Advanced manufacturing" may create strong regional hubs across their co-location centres and strongly influence their RIS3 strategies; therefore, it should be placed among the first wave of KICs to be funded under H2020
- Management of the Pilot Lines, could it be outsourced. Replication of a pilot line in several locations or even industrial sectors is suggested in the current budget constraint scenario and balance among size (investment) and expected impact has to be duly measured.
- The existence of local industry able to take-up the R&D results is also crucial and should motivate decisions about the R&D and pilot lines to be supported by public authorities.
- For large and very costly cases, a financing plan must be established for both the setting up of the pilot and, more important, for its future sustainability, which means considering the actual manufacturing phase in the planning stage. Projects could be divided into different phases and intensity of financial support as well as the financing instruments should vary. Starting phase or setting up should be totally funded, and financial support should diminish as market is reached. Readiness of public funding at the very beginning of the project makes things easier. This funding could be paid back to the funding authority once the Pilot Line is introduced in actual production manufacturing facility. EIB loans or similar financial instruments are mentioned to cover TRL 8-9.

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4.2. Interviews

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