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 Austria

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Number of pages:	17
Number of Annexes:	0

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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
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Content

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1. Policy perspective

The last two decades in Austria's RTDI (Research, Technology , Development, and Innovation) performance were characterized by a fast catch-up process. The R&D ratio was increased from 1.9 % to 2.8 % within the last decade, which contributed to Austria's rise to the group of "Innovation Follower". To continue this positive development, the Austrian federal government's RTI Strategy ("Becoming an Innovation Leader: Realising Potentials, Increasing Dynamics, Creating the Future") was published 2011 (Federal Chancellery et al., 2011; European Commission, 2013). Target of the strategy is to make Austria a member of the group of "Innovation Leader" until 2020 together with countries as Germany, Sweden, Denmark and Finland. The RTI Strategy resulted from an intensive exchange of ideas and numerous detailed analyses of the Austrian research and innovation system. Involved parties in this multi-annual process were relevant stakeholders, such as social partners and international experts, and ministries (the Federal Chancellery, the Federal Ministry of Finance, the Federal Ministry for Transport, Innovation and Technology, the Federal Ministry of Science and Research, the Federal Ministry of Economy, Family and Youth, and the Federal Ministry of Education, Arts and Culture). The commitment of the Austrian federal government to science, research and innovation is expressed in its target to increase Austria's R&D ratio up to 3.76 % in 2020 (Federal Ministry of Finance et al., 2011).

The funding system plays a central role in the Austrian federal government's RTI Strategy. It covers bottom-up funding, top-down thematically defined programmes and indirect funding instruments, where bottom-up funding captures the largest share. The RTI Strategy emphasises the importance of adjusting the funding system regarding its maximum efficiency and effectiveness. This should be reached by reducing programme diversity and concentrating resource allocations, streamlining and harmonising of funding instruments and working out a modern, standardised body of regulations for research funding to serve as the foundation of all federal funding. The Austrian Federal Government defined the following key areas in its RTI strategy in accordance to objectives at the European level: climate change, scarce resources, quality of life and demographic change (Federal Ministry of Finance et al., 2011).

The view on Key Enabling Technologies in Austria is mainly positive. Public and industry partners are actively participating in the discussions of the High-Level Expert Group on Key Enabling Technologies. Additionally they participate in international platforms regarding Key Enabling Technologies as the ENIAC Joint Undertaking and the Joint Technology Initiative ARTEMIS.

1.1. Country specific innovation system with emphasis on KET

The responsibility for research and technology policy at the federal level is borne by the Federal Ministry of Science and Research (BMWF), the Federal Ministry for Transport, Innovation and Technology (BMVIT) and the Federal Ministry of Economy, Family and Youth (BMWFJ). The allocation of financial resources and the standards for the design, implementation and monitoring of the programmes are directed by the Federal Ministry of Finance (BMF). The Austrian Council for Research and Technology Development advises the government on all matters related to research, technology and innovation, while the Austrian Science Board is the main advisory board for all university-related affairs and advises the BMWF, the parliament and the universities. The Austrian Science Funds (FWF), the Austrian Research Promotion Agency (FFG) and the Austrian Economic Service (aws) are the three major agencies which manage funding for research, technology development and innovation. The FWF is mainly responsible for the promotion of basic research, the FFG is the major funding body for promotion of applied research and development (TRL 1-4) and the aws is specialised on funding innovation projects in companies (starting at TRL 5) (erawatch, 2013a). Figure 1 shows the structure of the Austrian research system:

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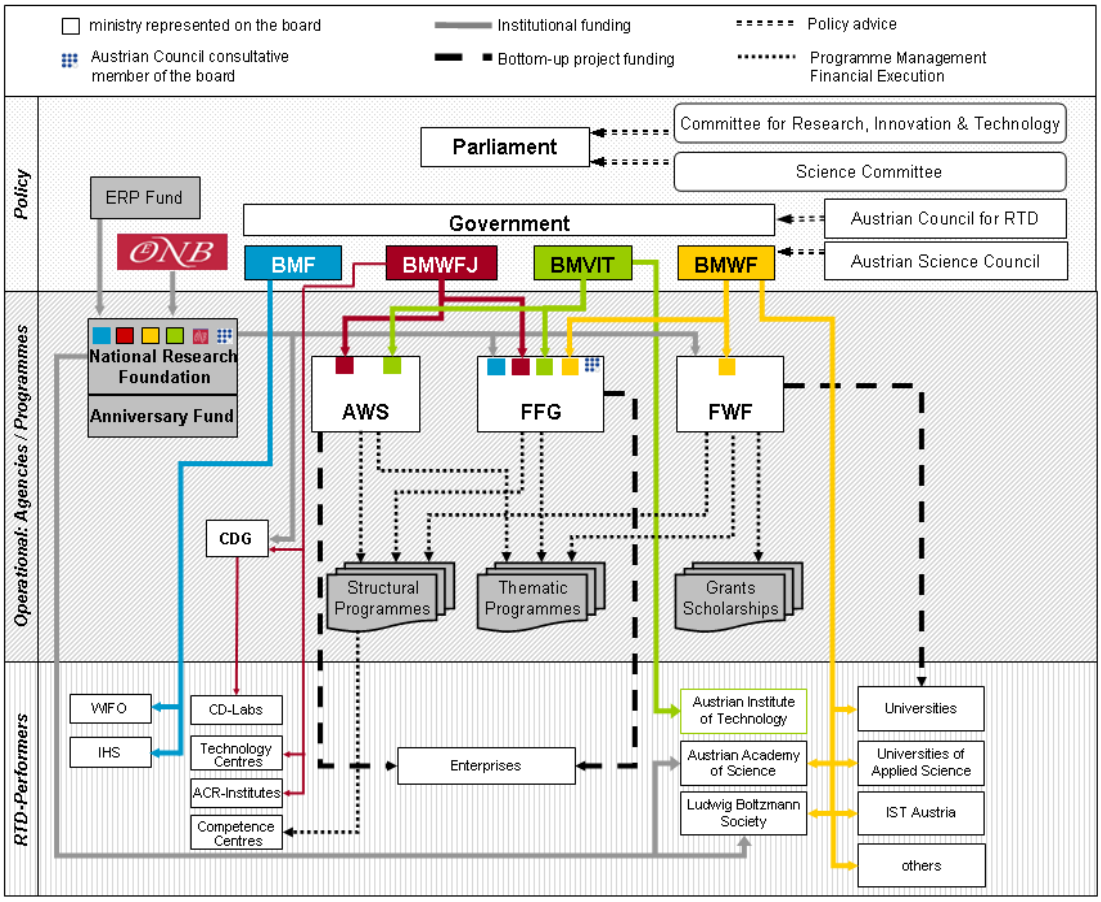
Figure 1: Structure of the Austrian research system



Source: (erawatch, 2013a)

The number and variety of targeted thematic and structural support programmes has increased in the last decade. This led to a significant increase of R&D cooperation in Austria and to a smaller gap between science and industry. The share of thematically targeted R&D priority funding in Austria is relatively small. About two third of direct public funding is not pre-assigned to any thematic priority while the rest is distributed over structural and thematic programmes. Thematic programmes support application-oriented research and technology development in joint projects or industrial research projects. These projects are pre-defined in a relatively moderate way, which enables implementations in a thematically large field of technologies. Key Enabling Technologies (KETs) are included but not explicitly mentioned in thematic and structural programmes. Such programmes are mainly bottom-up funded by FWF and FFG and address selected fields of science and particularly new technologies. In addition to direct funding, policy support takes place through loans (sometimes with reduced interest rates), refundable or non-refundable financial support, extensive consulting, conditionally repayable grants etc. (erawatch, 2013b).

Innovation policy in Austria supports companies and research institutions by overcoming the barrier of high costs and risks of performing highly specialized research. In this process, reducing costs by funding and other supporting instruments should encourage companies and institutions to contribute to the Austrian innovation system.

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1.2. Organisation of mKETs policy

Multi-KETs (mKETs) or KETs are not mentioned explicitly in Austrian innovation policy documents or programmes. They are included in the general target of improving the innovation system through funding and supporting of cooperation between research and industry. The main drivers on a national basis were already identified in the former section. These are especially the Federal Ministry of Science and Research (BMWF), the Federal Ministry for Transport, Innovation and Technology (BMVIT) and the Federal Ministry of Economy, Family and Youth (BMWFJ), which assign the FFG and the aws to manage the funding for applied R&D and innovation in Austria.

Different kinds of policy measures on national basis are used to foster industry-science cooperation and interaction between different KETs in Austria. Most of these policy measures are thematically open and none of them addresses explicitly Key Enabling Technologies. Some of them are structural programmes managed by the Austrian Research Promotion Agency (FFG). These comprise the programmes COMET, COIN and Research Studios Austria and are characterized by functional priorities. All these programmes support cooperation between science and industry to make the transfer from research results to industrially useable applications easier and are open for all technological fields. COMET (Competence Centres for Excellent Technologies) supports the development of competence centres, where new specialized knowledge should arise by cooperation between science and industry in top-level research (FFG, 2013a). COIN (Cooperation & Innovation) aims to stimulate and increase activities in research and technology development, especially for SMEs. This should be reached through intensified cooperation between research institutions and companies and thus more efficient industrial realization of research results (FFG, 2013b). The Research Studios Austria is a programme which supports the development of small, flexible research units, which should enable a faster usage of research results for industrial application (FFG, 2013c).

Further kinds of policy measures regarding KETs are thematic programmes managed by the FFG. These thematic programmes are characterized by thematic priorities and define key research areas in order to encourage and promote Austrian participation in internationally recognized research fields of future importance. The programme should lead to long term cooperation between science and industry, encourage synergies between research areas and achieve international visibility. KETs related programmes are Intelligent Production (FTI Initiative), ICT of the future, GEN-AU (The Austrian Genome Research Programme), NANO EHS (Environment, Health and Safety), Austrian NANO Initiative, ARTEMIS (Advanced Research and Technology for Embedded Intelligence and Systems) and ENIAC (European Nanoelectronics Initiative) (FFG, 2013d).

As already mentioned above, the aws is specialised on funding innovation projects in companies. It is a business development bank which provides funding, information, know-how, consultancy and services to support innovation in all business sectors. Particularly relevant regarding KETs are the erp – Technology programme, PreSeed and Seedfinancing. The erp – Technology programme focuses on projects which develop new products and processes, environmental and power engineering, prototypes and pilot and demonstration plants, while PreSeed and Seedfinancing focus on start-ups and potential founders (aws, 2013abc).

The Christian Doppler Research Association (CDG) supports temporary laboratories at universities, which work on application-oriented fundamental research. In this programme, universities cooperate with industry companies which have to contribute 50 % of the laboratory's budget. The other half of the budget is funded by the BMWFJ. Thematic coverage includes for instance chemistry, life sciences, electronics and materials. Similar to the CD-Laboratories work the Josef Ressel Centres. In contrast do CDGs, this centres support public-private cooperation between industry and universities of applied research and works (erawatch, 2013d).

Additionally to the already mentioned policy measures exist platforms and initiatives which are heading for KETs and multi-KETs. One of them is the Austrian NANO Forum which is a national platform for nanotechnology and part of the Austrian NANO Initiative. Target of the platform is to increase cooperation between research institutions and companies in nanotechnologies. This should lead to new developments of technologies and products and help to implement research results into products (Austrian NANO Forum, 2013). The platform Photonik Austria is an initiative of the Federal Ministry for Transport, Innovation and Technology (BMVIT). The platform serves as network for Austrian photonic companies, research institutions and universities (Photonik

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Austria, 2013). Similar tasks have the platforms bionikum:austria for bionics, the mechatronics platform and Manufuture-AT for manufacturing.

From the nine Austrian provinces ("Bundesländer") are especially Styria, Upper Austria and Lower Austria using support measures to stimulate multi-KETs. In Styria, the Styrian Business Promotion Agency (SFG) is providing monetary and other supporting measures. The SFG is a 100 % subsidiary of the Styrian Government and has the task to contribute to the consolidation and growth of the Styrian economy. This should be achieved through different programmes which support the implementation of innovation processes to develop new products, processes and services, raising money to fund the realization of new ideas and performing the transfer of technology (SFG, 2013). The Lower Austria Technopol Programme offers technology-oriented companies an innovative European high-tech location. The programme is managed by ecoplus, the business agency of Lower Austria. The established Technopols combine high-tech companies, and educational and research facilities at one location. Existing Technopols perform R&D in high-technology sectors as biotechnology, materials, sensor technology and actuators (ecoplus, 2013). The economic and research programme "Innovative Upper Austria 2010plus" is relevant for knowledge and technology transfer in Upper Austria. The programme supports cross-linkages between large numbers of R&D institutions in Upper Austria and is managed by the Upper Austrian economic agency (TMG) (TMG, 2013). None of the policy measures of the Austrian provinces explicitly mentions Key Enabling Technologies. Their focus is rather on innovation and high-technology, which implements KETs and multiKETs.

1.3. Main policies for Pilot lines

One of the most important policy instruments to increase cooperation between science and industry in Austria is the COMET (Competence Centres for Excellent Technologies) programme. The programme has no explicit focus on Key Enabling Technologies, but they are included through the meeting criteria of high industrial relevance. COMET has been launched in 2006 and is expected to end in 2017. The programme distinguishes three different types of competence centres, which differ in their ambition, complexity, ratio of public financing and duration: K1 Centres, K2 Centres and K-Projects. Target of the programme is to develop new specialized knowledge by initiating and supporting long-term research cooperation between science and industry in top-level research. Further, technological leadership of companies should be established and secured. Main objectives of the project are:

- strengthen the culture of cooperation between science and industry in order to achieve joint strategic top-level research;
- align strategic interests between industry and science, thus enabling joint research expertise, initiating new scientific and technological developments and preparing implementation of results;
- bundle players in research by using thematic synergies, thereby preparing the institutions involved for international competition;
- establish a number of centres which achieve international visibility through top-level research as well as by integrating researchers and companies of international reputation, thus strengthening Austria as a research location;
- strengthen human resources by attracting outstanding researchers, supporting the transfer of expertise to industry, and creating attractive career opportunities for research staff to be used in science and industry.

As a meeting criteria, competence centres have to be initiated and to be run by a consortium with at least one scientific partner and five (three for K-Projects) industry partners. To be eligible for funding, projects can be implemented from industrial research up to the development of prototypes and pilot lines. The programme is managed by the FFG on behalf of the BMVIT and BMWFJ and has no specific thematic focus. COMET competence centres are funded up to 60 %, dependent on their type. The overall budget for this policy measure is € 691 million, the budget for the year 2011 was € 27.749 million. International partners are welcome to participate in the programme, in K2 Centres a participation of international partners is even compulsory (erawatch, 2013c). Competence centres regarding KETs and multi-KETs exist for different Key Enabling Technologies, for example

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- Competence Center for Pharmaceutical Engineering,
- Carinthian Tech Research AG – Competence Centre for Advanced Sensor Technologies,
- Integrated Research in Materials, Processing and Product Engineering,
- Austrian Center of Industrial Biotechnology,
- Austrian Center for Medical Innovation and Technology,
- BioEngineering of Macromolecules, and
- K-Project for non-destructive testing and tomography.

The quantitative criteria for the evaluation of the programme are already determined, even if the evaluation was not performed yet. These criteria include publications, patents, increase in R&D intensity, trends in the qualification of researchers etc. (FFG, 2013).

Another important innovation policy measure, as mentioned in part 1.3, is the erp – Technology programme. In this programme, the aws provides loans at reduced interest rates on behalf of the Federal Ministry of Economy, Family and Youth (BMWFJ). Targeted groups are innovative companies which perform industrial and experimental research and development. Further, the programme refers mainly to stabilization measures and mature firms and does not fund basic research projects. Funding for one project is possible from at least € 100,000 to a maximum of € 7.5 million. The maximum duration of supported projects is three years. The credit period is usually six years, but can be extended up to twelve years. The erp – Technology programme supports R&D projects which develop new or improve existing products and processes, environmental and energy technologies, and establish prototypes, pilot or demonstration plants. It is thematically open, but focuses on high-tech industries with disproportional long stages of development, where specific attention is on future-orientated industries such as biotechnology, environment technology or energy technology. An additional target is to establish research departments of multinational corporations within Austria. To get a loan at reduced interest rates, the aim of the project has to be either the implementation of new or substantially improved products, methods of production or services, or the construction of prototypes, pilot plants, demonstration plants or test plants. The primary objective of the programme is to help companies to overcome the barrier between research results and their industrial realization and utilization (aws, 2013a).

The PreSeed programme was launched in 2000 and consists of refundable and non-refundable financial support for researchers and companies in an early pre-start-up stage, potential founders and start-ups. The programme is funded by the Austrian Economic Service (aws) on behalf of the Federal Ministry of Economy, Family and Youth (BMWFJ). The maximum funding is € 200,000 per project, usually for one year. The target of the PreSeed programme is to support young, innovative and high technology intensive start-ups and help them to bear the high risk of starting a company. This programme should help to increase the amount of innovative high-tech companies in Austria and improve the transfer from research results into competitive products, processes or services. Support can occur as business consulting for founders, financing of start-ups, business training for scientists or creation of awareness. General criteria for admission in the PreSeed programme are projects in the field of applied R&D, which are economically implemented in terms of a start-up through development of a first proof-of-principle or a pilot line, high technology intensity and novelty, the potential to create long term employment of qualified workers, and contribution to the consolidation of the trade balances. The programme supports highly technology-oriented pre-start-up projects, where a particular focus is on information and communication technologies, physical sciences, nanotechnologies and life sciences (aws, 2013b).

Another programme to support companies in an early stage is the Seedfinancing programme. It consists of a conditionally repayable grant which has to be refunded if the company is making profit or if it is sold. The maximum possible grant for innovative start-ups is € 1 million. Similar to the PreSeed programme it is funded and implemented by the Austrian Economic Service (aws) on behalf of the Federal Ministry of Economy, Family and Youth (BMWFJ). The programme exists since more than ten years and the current programme period lasts from 01/01/2012 till 12/31/2013. The payoff period for one project is usually between one and two years, the repayment period can be extended up to twelve years. The project period itself can last between four and seven years. Grants are possible for all high-tech sectors, where a particular focus is on information and communication technologies, physical sciences, nanotechnologies and life sciences. Meeting criteria to receive

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a conditionally repayable grant are unique characteristics by technology intensity and novelty, a high potential for growth, high commitment and readiness to accept risk by founders, an existing business plan, and no holding of medium or large companies over 25 %. Target of the programme is to close the money gap in high-tech sectors, help to implement innovative ideas and increase the number of innovative high-tech start-ups. A special focus lies on the support of projects, which develop new processes, products and services. Seedfinancing was not evaluated since 2004, but indicators for the evaluation after the programme period already exist. These are for instance the number of new established companies, number of new high-tech companies, number of Seedfinancing applications, size of the project teams, funding volume, newly created places of work, number of successful high flyers, number of insolvencies and juste-retour volume (aws, 2013c).

Interviews with funding institutions and companies showed that two public-private-partnership (PPP) initiatives within the Seventh Framework Programme also have a high relevance for pilot lines in Austria. One of them is ARTEMIS, which is an important funding initiative in the sector "Advanced Research and Technology for Embedded Intelligence and Systems". The programme has a total budget of € 72.292 million from which about € 4 million is kept for Austrian applicants. Projects are expected to last typically for three years, but there is no formal minimum or maximum duration. In Austria, the project is managed by the Austrian Research Promotion Agency (FFG) and national funds are provided by the Federal Ministry for Transport, Innovation and Technology (BMVIT) (FFG, 2013e). The programme supports industry-driven research projects in the field of embedded systems, which aim at generating new and improved technologies and in applying them in products, processes or services in order to strengthen the competitiveness in European industry, improve sustainability, and facilitate the emergence of new markets and applications that respond to the societal needs. Projects should have proper balance of application focus vs. generic technology development (ARTEMIS, 2013). A special focus is on market-orientated research, which develops prototypes and demonstrators with domain-spanning applicability (FFG, 2013e).

While the ARTEMIS programme influences all Key Enabling Technologies, the second important PPP, namely ENIAC, focuses on nanoelectronics. ENIAC (European Nanoelectronics Initiative) is also a funding initiative within the Seventh Framework Programme (FFG, 2013f). ENIAC is supposed to increase private and public investment in the sector of nanoelectronics in Europe and contribute to Europe's growth, competitiveness and sustainable development. .Further, the programme should be an instrument for implementing policies for Key Enabling Technologies. The first of the 2012 calls focuses on projects with activities as formulation of technology concepts, experimental proofs and validation in laboratory conditions, i.e. projects with a TRL of 2-5. The second of the 2012 calls focuses on pilot line activities with a TRL of 4-8, with the aim of validation and demonstration in relevant and operational environments (ENIAC, 2012). The national budget for the two 2013 calls is € 3.2 million. Austrian companies participated on 4 project proposals in the first call of 2011 (Council of the European Union, 2013). Similar to the ARTEMIS programme, ENIAC is managed by the Austrian Research Promotion Agency (FFG) and funding is provided by the Federal Ministry for Transport, Innovation and Technology (BMVIT). ENIAC was established to expand European research in nanoelectronics and increase the European share in this market. The programme supports particularly market-orientated research in nanoelectronics, which develops prototypes and pilot lines (FFG, 2013f).

A still new but relevant initiative is Frontrunner. The programme started on 02/25/2013 as a funding programme for frontrunner-companies. It was designed to support R&D projects of companies which are technological or innovation leader in their sector. Such companies are important for the competitiveness of regions and need to use offensive market strategies. The programme should help to reduce the risks of offensive strategies and encourage firms to stabilize and extend their leading position. The initiative is thematically open and has a total budget of € 15 million for the year 2013, which is provided by the Federal Ministry for Transport, Innovation and Technology (BMVIT). The maximum funding for one project is € 2.99 million and the maximum duration of one project is 36 months. Frontrunner is relevant for Key Enabling Technologies and pilot lines as the projects have to be highly innovative and both technologically and economically risky to be supported. The programme is jointly managed by the Austrian Research Promotion Agency (FFG) and the Austrian Economic Service (aws) on behalf of the Federal Ministry for Transport,

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Innovation and Technology. In this process, the FFG is responsible for the funding of R&D projects and the aws is responsible for the funding of innovations (BMVIT, 2013).

A successful example for a Public-Private-Partnership is the Campus Vienna Biocenter. The campus was created through cooperation between the Center for Innovation and Technology (ZIT), the technology promotion agency of the city of Vienna, and the PRISMA consortium. More than 1,400 scientists are working in an area of 67,000 m^2, which makes the campus to Austria's most important location for life sciences. The importance of the Campus Vienna Biocenter is emphasized by the membership of important firms as AFFiRiS GmbH, Intercell AG, Baxter Innovations GmbH and universities as the University of Applied Sciences Campus Wien and the Vienna School of Clinical Research (ZIT, 2013).

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2. Business perspective

"*In its Europe 2020 strategy, the EU Commission outlined that Europe's real economy has to be strengthened*." (EU-Commission (2009)) In line with the statements of the Commission, public policy support for KETs pilot activities (pilot or demonstration lines) can be a highly effective lever for this strategy. On initiative of the European Commission, a High-Level Expert Group (HLG) reported on Key Enabling Technologies (KETs) and introduced the metaphor of a bridge that crosses a "valley of death" to describe the project life cycle. Technology Readiness Levels (TRL's) were grouped into pillars underpinning this metaphorical bridge. Specifically the second pillar, which deals with pilot projects, was emphasized (TRL 5-8). The identified KETs (Advanced Materials, Micro- and Nanoelectronics, Nanotechnologies, Photonics, Biotechnologies, Advanced Manufacturing Systems) are key for innovation and growth in Europe - and this is common understanding of industry, large research organizations, the European Commission and the Member States (MS), as expressed in the Commission's 2009 Communication, in the Council and in the recommendations of the KETs High Level Expert's Group. (HLG, Final Report, 2011)

Austria has good prospects regarding the production and marketing of innovative technological systems and solutions: it has a well-developed research founding system; it has a skilled labor force; and it has the necessary financial capital. Austria just has to combine these competencies and encourage risk taking in order to accelerate innovation speed in the field of KETs and generate new markets and production sites. This innovation process will only accelerate if the knowledge base for markets and products is sound, if there is a clear return-on-investment and if the entire value chain interacts. This is especially true for Key Enabling Technologies.

"*The supplier of Key Enabling technologies has to learn about the market and the market has also to learn about leading-edge Key Enabling Technologies. KETs pilot activities (pilot or demonstration lines) are the best means to generate the knowledge base and the visibility in the country. The sooner a system provider like an automotive OEM is enabled pilot components, materials or equipment, the sooner innovative systems such as electrical cars can be delivered to the market. KETs pilot activities are the most efficient catalysts for innovation, opening up the bottleneck, and enabling crossing of the valley of death between invention and market. KETs pilot actions create win-win situations: for the Austrian industrial value chain and for the public.*" (Interview with AWS)

In Austria, the national funding programmes that directly address business driven pilot lines or pilot activities are covered mainly by the join technology initiatives as well as by the fiscal policy instruments. In the pilot lines identified in this case study, the technologies initiatives ARTEMIS (for of Embedded system) and ENIAC (for nanoelectronic) play, as the ERP Technology programs of AWS, a substantial role.
As already mentioned in chapter 1.3 Joint Technology Initiatives (JTIs), as ARTEMIS and ENIAC, are a quite new mechanism for performing and funding research at the EU level. They are long-term public-private partnerships (PPP) and are managed within dedicated structures based on Article 171 of the EC Treaty (Maastricht consolidated version). One basic principle of a JTI is that at least 50% of their costs are funded by the private sector (mainly through in-kind contributions). The remaining costs are financed through FP7 (specific programme "Cooperation"), and in some cases also by participating member states. In case of Austria they are funded by BMVIT. In line with AWP 2013 (ARTEMIS JU, 2013) project calls of ARTEMIS targeting pilot pine activities (on Technology Readiness Levels 5-8) will be announced in 2013. Project calls of ENIAC are announced since 2012. Further calls of the technology initiatives focus on projects dealing with technological research and development activities such as formulation of technology concepts, experimental proofs and validation in laboratory conditions corresponding to Technology Readiness Levels 2 to 5. The JTIs will organize calls for proposals, monitor selection procedures and put contractual arrangements in place for projects set up to implement the research agenda of the respective JTI. By adapting the concept of "pilot lines" to embedded systems for ARTEMIS or to nanoelectronics for ENIAC, the innovation pilot project approach will pave the way to the coming FP8 /Horizon 2020. Triggering this concept in a number of meaningful areas for Europe industries

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based on selected domains aims to contribute in achieving high level targets from the joint technology initiatives.
In Austria, two of the identified initiatives were promoted in the frame of initiative JTI. The first one, CESAR - Cost-efficient methods and processes for safety relevant embedded systems, is funded by ARTEMIS and coordinated by AVL List GmbH in Graz. The second ones EPT300 - Enabling power technologies on 300mm wafers, is funded by the ENIAC JU and coordinated by Infineon Technologies in Villach.

The ERP Technology Programme administered by the AWS, attempts to promote firms in forward-looking industries such as biotechnology, nanotechnology and environment-energy technologies. This priority setting, however, is not binding. Because the projects in these future-orientated industries have an uncertain outcome, the ERP funds aim at closing this financial gap by granting loans at minor interest rates. The ERP Technology Programmes supports R&D projects to improve products, processes, environmental and energy technologies to establish proto-types and pilot- and demonstration facilities. (erawatch, 2013e)

To create synergies between the technology fields of multi KETs is a major step into the future. The new programme “Frontrunner” means a radical shift in the Austrian innovation policy from an innovation policy in the narrow sense to a comprehensive one. In a frontrunner project firms and researchers strive for excellence and market dominance in niches and Key Enabling Technology segments, increasing market shares in sophisticated industries and technology fields, and in areas of particular relevance to society. The frontrunner programme aims at supporting Austrian firms to achieve and sustain economic leadership through product innovation and productivity growth. The programme aims for a broader base of innovative firms, more business startups, a large number of firms locating research facilities in Austria and more PPP based research products. Individual projects will be financed by increasing the net present value of ERP Technology Programme of the AWS and by the bonification of the basic funding from FFG. This strategy calls for a new and better defined role of the ministries and supporting agencies (FFG and AWS) in charge of innovation policy.

The mKETs pilot lines demand high research level and high innovation states, well developed research infrastructure, formulation of technology concepts, and validation in laboratory conditions corresponding to Technology Readiness Levels 2 to 5. Pilot lines on Technology Readiness Levels 5-8 require also an essential change of the funding landscape. That would also include that by promotion the basic and applied research, and also the industrialization of the research results, gets more and more attention. The existing KETs pilot lines in Austria are mainly driven by industry and in many cases by large industry representatives. The main reason is that pilot lines on TRL 5-9 may accrue very high investment costs and these could be double-digit sums of millions of euros.
Finished pilot lines are built on costly R&D projects, numerous process steps and existing research infrastructure (or major upgrades of existing ones). Sharing of the infrastructure with R&D partners or with preferential suppliers or customers is frequently an option. According to our interview partners currently activities for building up large research infrastructure do not receive adequate public support in Austria. Generally, only large companies have sufficient capital to build up technological infrastructure with own resources. According to a recent stock-tacking study on research infrastructures (Austin, Pock + Partners GmbH, 2010), Austria is comparatively well supplied with small research infrastructures, but a deficit concerning larger, internationally visible infrastructures is evident.
Cross-organizational cooperation is rarely formed for the acquisition and operation of research infrastructures. The regional distribution of research infrastructure reflects demographic realities, which resist and underscore university and industrial sites (focuses mainly Vienna, Graz and Innsbruck, in addition, also still Salzburg, Linz and Leoben). A specially-focused research infrastructure funding program exists only for the universities in the form of “University Infrastructure Programme” (focus on profiling). The University Infrastructure Programme financed by the public authorities since 2001, successfully strengthened joint research priorities between universities and within universities.
In 2009, the Austrian Council recommended to connect Austrian R&D closer with international infrastructures, to plan research infrastructures in a more integrative manner through the implementation of a national

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research infrastructures platform, which should prepare a national research infrastructure roadmap embedded in a long-term master plan, and to secure adequate financial resources sustainability.
Nevertheless, Austria is a member in major inter-governmental RIs, such as ESFRI (European Strategy Forum on Research Infrastructures). The ESFRI is a multi-disciplinary forum for the member states of the European Union and the associated countries, for discussing and coordinating projects and general developments in the area of research infrastructures (RI), e.g. supercomputers, specific internet architectures (GRID), data bases, virtual libraries, or large-scale research infrastructures in general. According to the latest available ESFRI implementation report (2009), a national Austrian road map is still in preparation but has not yet been published. Austria participates (cut-off date March 2010) in three ESFRI projects, namely ESRFI Upgrade and ILL20/20 in the field of materials and analytical facilities and BBMRI in the field of biological and medical sciences. (Austrian Research and. Technology Report, 2012)

In course of the interviews we have conducted with relevant stakeholders such as industry actors, policy makers, and managers of pilot infrastructures the following comments, suggestions, and proposed improvements were mentioned in order to obtain more activities in the area of pilot lines in the country. These are in summary:

- **Increasing funding schemes**: The funding for KETs pilot lines should be substantial to reach the intended goal of bridging the gap: SME's should be able to get 50% of their expenditures compensated, for larger companies this should be 40%.
- **Smart Exploitation of IP and Technology**: It is likely that pilot initiatives will generate technological knowledge that is suitable for patenting. The project partners should initially exploit these patents and technology in Europe in addition to later movement to the global market place. For this reason the partners of pilot actions should file an exploitation plan within their proposals. The exploitation plan may be amended in line with the progress of the project.
- **Smarter and Faster Project Decisions**: The innovation cycles in KETs (mainly high technology) industries are short, thus fast decisions about funding and swift administrations processes are seen as pivotal by industry representatives. This fact has to be reflected and respected regarding the decision processes within technology programs at EU and national level. A less detailed top down programming and a more bottom-up approach could speed up this process significantly. The disadvantage could be calls for proposals with a broader scope. This would attract more proposals and could delay the decision process for funding.
- **Better Management of existing Calls**: Currently proposals within application oriented calls are very often evaluated by peers from academia. This leads bad marks for such projects and reduced chances to get public funding. Juries for pilot action oriented calls should thus be more balanced and include peers with a profound background in practical innovation management.
- **Adequate Funding of SMEs**: In order to prevent monopolization of the necessarily limited resources available for pilot lines by the more experienced and better organized entities, it seems useful to offer a separate basket only available for SMEs or/and smaller projects. This basket should be available with lower administrative hurdles and the criteria list should be shorter.
- **Adequate Funding of Pilot Activities**: The aid intensity for pilot activities in Europe is hampered by the constraints of the R&D&I framework. The EC definition of R&D is be extended to include the R&D typically performed within the context of KETs pilot lines development and ramp-up of new processes, technologies and products.
- **Smarter Regional Policy**: It is noteworthy that the biggest share of the EU budget is dedicated to regional policy. Regional innovation policy and KETs innovation policy should be linked. Cooperation of DG Regio with other KET related DGs should be improved. Joint financing of KETs pilot actions which are in line with the regional policy of the EU should be fostered. The European

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Regional Development Fund (ERDF) could be a strong motor for regional clusters and innovation based on KETs.

2.1. Implementation of multi-KETs pilot lines

As the Austrian experience shows, KETs pilot lines develop and fine-tune manufacturing technology, and deliver KETs-based pilot prototype products, materials, or manufacturing equipment to lead customers such that they can be sampled and subsequently introduced successfully into the customers' production lines. Such pilot prototype products, materials or equipment enable new product innovation for the downstream industry earlier than with existing capabilities. This will greatly enhance the industry's ability to quickly turn R&D into innovative products and so gain market share or emerge new markets. Moreover, the experiences achieved in a pilot line reduce production costs in the subsequent high volume manufacturing. In technological terms, a pilot line follows on fundamental R&D where the proof-of-concept of the product, material or equipment in a laboratory environment already has happened. These must-have preconditions are the reason why only a few innovation policy measures in Austria support directly pilot lines.
In a pilot line, the basics of the production process and all details of the final product, material or piece of equipment are demonstrated in low volume prototype product production with the appropriate cost and production yield. The final product can be completed and qualified through test and demonstration. The product has to meet predefined qualification criteria. The success of the pilot line will be measured in the degree of readiness of the product, material or equipment for introduction into a high volume manufacturing environment.

In Austria, main drivers initiating multi-KETs pilot lines are clearly the industry representatives – (mostly large companies). The realisation of pilot lines takes place in strong cooperation with national and international RTOs and universities. The already existing pilot lines are shared facilities. In order to provide a true link between R&D and manufacturing, there is strong evidence that the existing pilot lines are strictly linked to an industrial strategy.

In Austria exist in general two types of pilot lines:

- A stand-alone KET pilot or demonstration line is constructed only for the purpose to mature, qualify and produce pilot products in order to allow downstream users the fast implementation of the pilot product in their system. After the achievement of this milestone, the pilot line may be closed or reconstructed for other missions. An example for that can be the micro-electromechanical system SD755 from SensorDynamics
- An embedded pilot line is the first part of a following mass production (the seed of a production line). It may even share some line equipment with already existing lines in order to save money and time. The purpose of the pilot line is to deliver early-stage prototype products through production in low volumes. If the pilot line is co-funded with public money, these volumes should be sufficiently low, as to avoid market distortion. Pilot lines will be industry led and owned. Due to the requirement to strongly connect the pilot line with future high-volume manufacturing, the pilot will likely be dedicated to a single industry owner. However it is also expected that some technologies may lend themselves to shared facilities where a certain amount of commonality exists in technology roadmaps and/or the cost of executing the pilot is beyond the means of a single industry. Example for that can be the EPT300 wafer from Infineon.

Austria has meanwhile g experiences in creating pilot lines, especially in microsystem networks, in electric power generation and in nanotechnology. Test beds and pilot projects are common to save time and money, to reduce risk and to accelerate innovation. It should be noted, that the respective pilot lines have been publicly co-funded. This was a good deal for the Austrian governments and also for the EU, as the return on investment was strong in additional taxes, jobs and technology.

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The distinguishing feature of KETs is their enabling effect. New KETs products, materials or equipment drive innovation in the downstream industry. Government-supported pilot activities can speed up this process but political support is not a substitute for entrepreneurship. In line with the subsidiarity principle, public support should only be granted to activities which would not happen in the EU without support and which are essential for achieving the EU 2020 objectives.

Pilot activities have to be based on a minimum technology readiness level. Otherwise the probability for failure is too high. With respect a technology readiness level between 5 and 8 is required for pilot line activities. The following showcases represent four already existing best practices pilot lines in Austria. The presented pilot lines were driven by industry and there are integrated in an existing industry production line.

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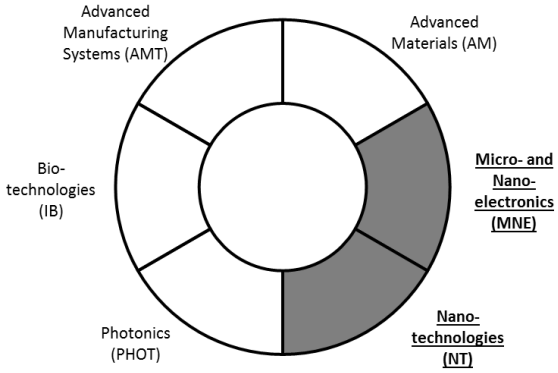
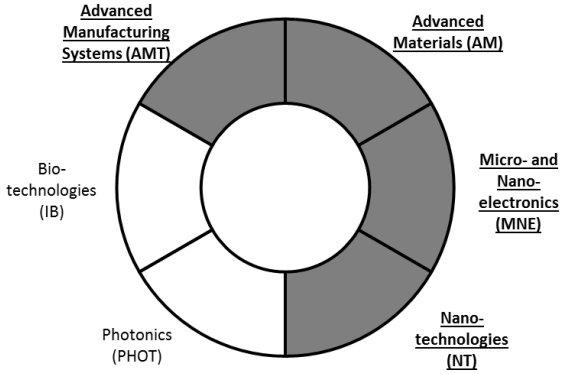
Figure 1: Examples: Austrian experience on existing pilot lines

Pilot Line - SensorDynamics, MEMS (micro-electromechanical system) SD755:



The Sensor Dynamics SD755 is a combination of a gyroscope and accelerometer in one package. According to SensorDynamics, the SD755 inertial sensor is the first MEMS (micro-electromechanical system) product combining a gyroscope and accelerometer on a single chip. The patented encapsulation technology used for SD755 is a solution which allows a high level of integration within inertial sensors. This technology forms the basis of the 6 Degree of Freedom Inertial Measurement Unit single MEMS chip solution (6DoF IMU) which is in high demand by the marketplace. SensorDynamics today announced the launch of the micromechanical combisensor SD755 for the automotive integrating gyrometer and accelerometer in one single package.

Pilot Line - Infineon EPT300 - Enabling power technologies on 300mm wafers:



EPT300 aims to develop and implement technology to achieve full-scale production of power devices on 300 mm wafers. The volume manufacturing benefits of 300 mm silicon wafer fabrication are well-established with regard to digital integrated circuits, but the ability to use them in the production of power semiconductor devices has so far eluded large-scale producers. This will place European fabs at the forefront of power semiconductor manufacturing worldwide and open up further employment opportunities both in the fabs and across the entire European electronics industry. EPT300 is a project funded by the ENIAC JU.

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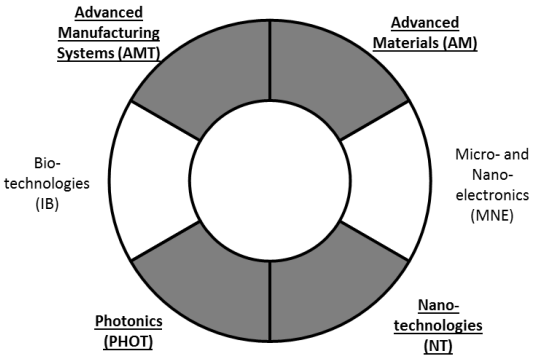
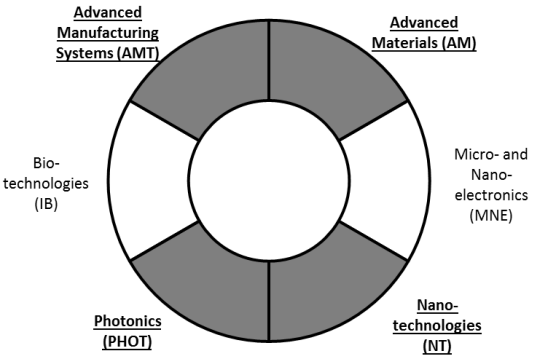
Pilot Line - JR MATERIALS Roll-to-roll nanopatterning pilot facility (NanoR2R):



The Roll-to-Roll nanopatterning pilot facility (NanoR2R) for large-area fabrication of nanostructured surfaces, nanomaterials and nanoscale devices is Europe's first and unique address for rapid, low-cost and user-oriented prototyping of flexible multifunctional surfaces and large-area electronic, photonic, and bionic applications by combining extraordinary and industry–driven expertise in multiple Key Enabling Technologies. NanoR2R, a coordinated PPP action, aims for bringing the powerful world of nanotechnology to many existing technologies by exploiting radically innovative but industry-proven processes in a R2R concept thus creating the next level of disruptive demonstrators (TRL 5 to TRL 8).

Pilot Line – NTCW The Printed Electronics Prototyping Lab (PEPL)



Printed Electronics Prototyping Lab for smart integrated systems is the one-stop solution for rapidly prototyping printed electronic and photonic applications with the aim to advance existing technologies and demonstrators from TRL 4-5 up to TRL 8, by a coordinated Public Private Partnership action along the industrial value chain combining multiple Key Enabling Technologies.

The EU has long recognised that Printed Electronics (PE) is set to revolutionise the electronics industry over the next decade, merging the Key Enabling Technologies (KETs) nanotechnology, photonics, and advanced materials with smart production processes along the KETs value chain. The direct printing of conductive, resistive, capacitive and semiconducting structures offers a simpler, lower cost and more flexible process over traditional printed circuit board and semiconductor manufacturing techniques which is of importance to organic and large area electronic (OLAE) applications (e.g. printed displays, printed sensor systems & smart integrated systems).

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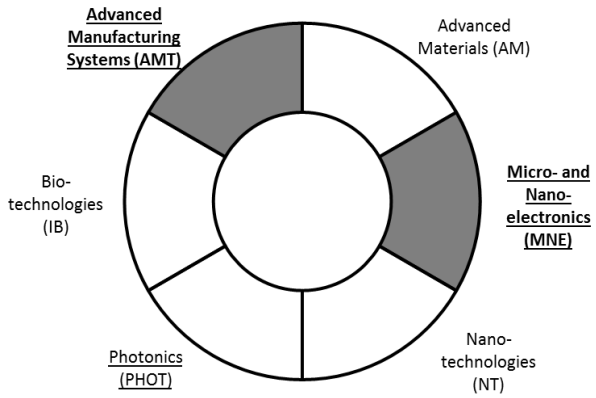
Pilot Line – AVL CRYSTAL-Critical Systems Engineering Acceleration)



CRYSTAL deals with the problem of constantly growing complexity of embedded safety-critical systems and increasing regulatory and economic constraints that have to be met at the same time. This requires adequate processes, methods and tools which are currently facing significant deficiencies. Hence, the target of the project is to foster Europe's leading edge position in the design, development and deployment of interoperable safety-critical embedded systems. This is done by increasing the maturity, reusability and the ease of integration of technology bricks (which are defined as building blocks of integrated tool chains), and by establishing the Interoperability Specification (IOS) and the Reference Technology Platform (RTP) as a relevant "de facto" standard for future embedded

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

The realization of a successful KET policy is only possible, if additional focus and resources are provided by industry and public authorities. There are several ways mentioned by interview partners to increase the effectiveness of direct or indirect policy support on KETs.

- ☐ The first one could be the introduction of **combined funding mechanisms**. This means a tripartite financing approach based on combined funding mechanisms involving industry, Commission and national authorities (member states and local governments), if this is required by the high costs of the KETs RDI projects, and put in place the appropriate programme management and mechanisms to allow the combination of EU funding (Horizon 2020, structural funds, etc.). Instruments should be modified or created to allow European funding for efficient cross border co-operation. Member states and regions should consider complementary budgets and regional development plans which enable regions to spend structural funds for KETs and innovation.
- ☐ The second one follows an integrated view and forces **building, strengthening, and retaining KETs related skills**. Austria and each EU nation should promote individual excellence in technologically focused engineering, research and innovation, and establish the appropriate framework conditions through the ESF regulation in order to support KETs skills capacity building at national and regional level. Specific focus should be given to an increasing need of highly skilled engineers with the ability for interdisciplinary work.
- ☐ The third relevant one would lead to **a systemic policy approach for key enabling technologies** that needs adequate coordination at national and regional level. In Austria, such a joint approach dealing with the systemic nature of key enabling technologies is currently generally missing. Pilot lines presume the availability of large industrial research infrastructure; however the general conditions of public support of such industrial research infrastructure is currently not sufficiently.

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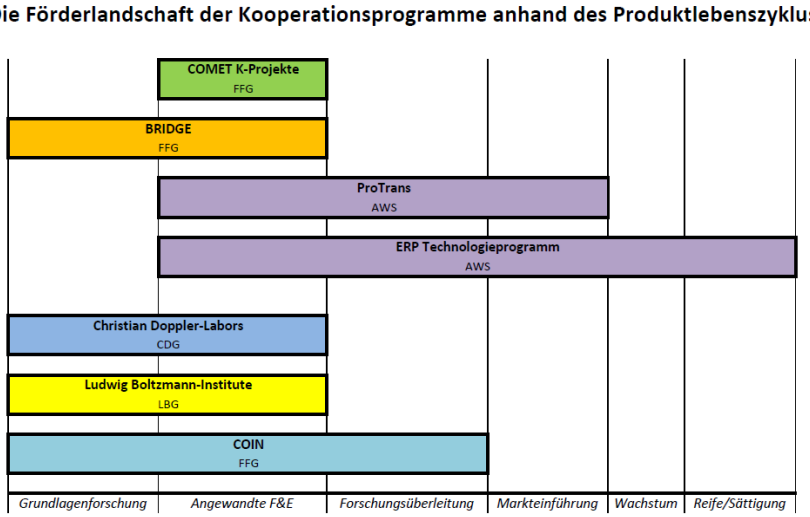
3. Conclusions

3.1. Summary of policy perspective

Austria's national innovation system is characterised by an already well developed portfolio of funding instruments along the value chain of knowledge production (Figure 2). Further room for improvement exists with regards to policy coordination at national level and between the national government and the regions.

Figure 2: Portfolio of Austrian RDI Policy Measures



Source: LISA 2012

Albeit KETs and mKETs are addressed by public policy mainly implicitly - through programmes that thematically open - successful applications in the COMET and COIN programmes show clearly that industry and science have well captured the importance of key enabling technologies.

3.2. Summary of business perspective

In Austria, the main drivers initiating multi-KETs pilot lines are clearly the industry representatives – (mostly large companies). The realisation of pilot lines takes place in strong cooperation with national and international RTOs and universities. The already existing pilot lines are shared facilities. In order to provide a true link between R&D and manufacturing, there is strong evidence that the existing pilot lines are strictly linked to an industrial strategy.
Austria has meanwhile experiences in creating pilot lines, especially in microsystem networks, in electric power generation and in nanotechnology. Test beds and pilot projects are common to save time and money, to reduce risk and to accelerate innovation. It should be noted, that the respective pilot lines have been publicly co-funded.

3.3. Recommendations to support pilot lines

Firstly the introduction of combined funding mechanisms could foster future pilot actions. This would imply a tripartite financing approach based on combined funding mechanisms involving industry, Commission and national authorities (member states and local governments), if this is required by the high costs of the KETs RDI projects, and put in place the appropriate programme management and mechanisms to allow the combination of EU funding (Horizon 2020, structural funds, etc.).

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Secondly mKETs require a systemic policy approach that needs adequate coordination at national and regional level and between different policy domains. In Austria, such a joint approach dealing with the systemic nature of key enabling technologies is currently generally missing. Pilot lines presume the availability of large industrial research infrastructure; however the general conditions of public support of such industrial research infrastructure is currently not sufficiently.
Thirdly KETs related skills need to be developed and supported. Specific focus should be given to an increasing need of highly skilled engineers with the ability for interdisciplinary work.

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