High-Level Expert Group on

Key Enabling Technologies

Final Report

EUROPEAN COMMISSION

HIGH-LEVEL EXPERT GROUP ON

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EXECUTIVE SUMMARY

STRATEGIC IMPORTANCE OF KEY ENABLING TECHNOLOGIES FOR EUROPE

The Europe 2020 strategy clearly signalled the importance of industrial competitiveness for growth and jobs as well as for Europe's ability to address grand societal challenges in the coming years. Mastering and deploying Key Enabling Technologies (KETs) in the European Union is central to strengthening Europe's capacity for industrial innovation and the development of new products and services needed to deliver smart, sustainable and inclusive European growth.

A GROWING GLOBAL COMPETITIVE ENVIRONMENT

In the KETs domain, the EU is now facing growing and overwhelming global competition from both developed and emerging economies in particular in North America and East Asia. Although the EU remains resilient, in a position of relative strength, it must now reinforce and rapidly develop its KETs industry to compete for the future. The KETs High-Level Expert Group (HLG) therefore strongly believes that the EU and its policy makers should urgently engage in a radical rebalancing of resources and objectives in order to retain critical capability and capacity in these domains of vital European importance.

A THREE PILLAR BRIDGE TO CROSS THE KETS "VALLEY OF DEATH":

The HLG has identified the major difficulties Europe has in translating its ideas into marketable products – in crossing the internationally recognised "valley of death". To cross this valley, it recommends a strategy comprising three pillars:

- A pillar focused on technological research
- A product demonstration pillar focused on product development
- A production pillar focused on world-class, advanced manufacturing.

By focusing on these key stages of the innovation chain, the HLG proposals can trigger a virtuous cycle, from knowledge generation to market flow with feedback from the market to knowledge generation support, thereby strengthening economic development in Europe.

Based on the three pillar bridge model, the HLG has made a series of specific policy recommendations for a more effective industrial development and deployment of KETs.

POLICY RECOMMENDATIONS FOR THE DEVELOPMENT AND DEPLOYMENT OF KETS IN EUROPE

Firstly, the HLG recommends a single KETs label and fully-fledged KETs innovation policy, to exploit their cross-fertilising impact and their pervasive enabling nature. The HLG considers that the success of such a policy requires KETs to be positioned as a technological priority for Europe and for this to be demonstrably translated into the EU's main political and financial instruments in the next financial perspective 2014-2020.

In particular this priority must be reflected in the upcoming Horizon 2020 (Common Strategic Framework for Research and Innovation Financing - CSF), the instruments related to the EU's Regional Policy and the policies of the European Investment Bank group. In this regard, the EU should recognise the need for the full and simultaneous implementation of the three pillar bridge

model along the innovation chain, from basic research, through technological research, product development and prototyping up to globally competitive manufacturing. This notably requires the application of appropriate R&D definition aligned on the industrially-recognised Technology Readiness Level (TRL) scale in accordance with OECD practice and a radical rebalancing of RDI funding in KETs-related programmes towards innovation activities in the future Horizon 2020 (CSF).

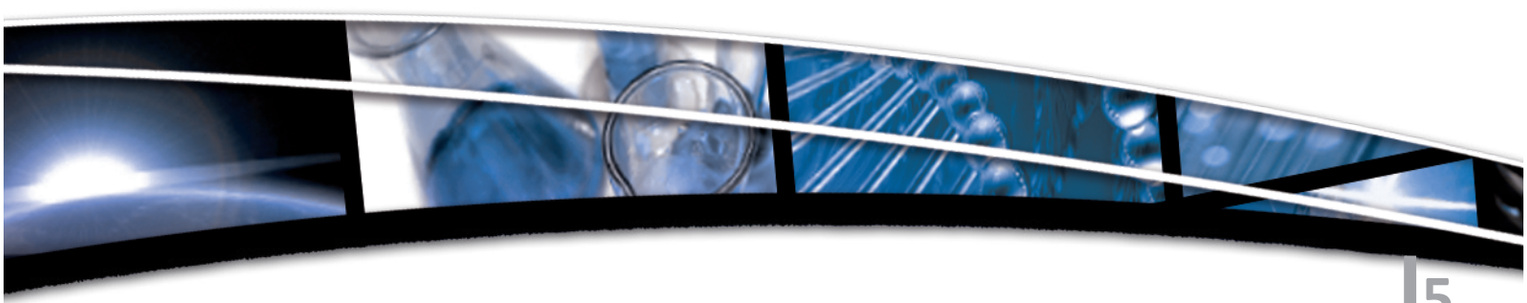
In addition, the HLG agreed on the need for a comprehensive strategic approach to a KETs policy at EU level to be implemented. The EU KETs policy should be forward-looking and driven in a long-term perspective since it concerns the innovation capabilities of EU industries in the next decade and beyond. Such a policy needs a full strategy involving all stakeholders - private and public - at European, national and regional level, and must encompass all relevant policy instruments. In particular, the HLG calls for the selection criteria and implementation rules in the CSF programme to be adapted to maximise its impact on the value and innovation chains.

Given the high costs of many KETs RDI projects, the HLG recommends a tripartite approach to financing where required, based on combined funding mechanisms to promote RDI investments in KETs involving industry, the EU and the Member States (at national and local level). It also calls for mechanisms to allow the combination of different types of EU funding to enable the optimum investment in significant KET pilot line and manufacturing facilities across Europe while respecting state aid rules. In this regard, the HLG calls for state aid provisions to be adapted to facilitate RDI activities and large-scale investment in KETs, in particular through the generalised introduction of a matching clause in the EU state aid framework, increased thresholds for notifications, faster procedures and greater use of provisions covering projects of common European interest.

The HLG considers that the rules for participation in the CSF should be strengthened in order to generate greater economic value in Europe by better protecting the technological knowledge created. Generally, the EU should clearly promote a globally competitive Intellectual Property (IP) policy based on "in Europe first" principles. Before the start of any project, consortium partners should have to demonstrate that they have a clear IP plan for both the ownership of and first exploitation of IP resulting from the project within the EU.

In the long term, strengthening the technological and industrial base of Europe requires the development of new KETs' skills and competencies in Europe. The exploitation of KETs synergies and crossing the boundaries towards KETs trans-disciplinarity requires competencies that current linear training and education cannot provide. In particular, the HLG recommends that KETs skills should be promoted within the framework of the regional policy (European Social Fund) and calls for the creation of a European Technology Research Council (ETRC) to promote individual excellence in technologically-focused engineering research and innovation mirroring the European Research Council's (ERC) promotion of fundamental science. To be competitive. Europe needs a world-class cadre of scientists, engineers and technologists.

Finally, the HLG has noted through its work an ongoing and urgent need for stakeholders to have relevant information on KETs to inform strategy and decision making. More hard data is needed on KETs to provide EU, national and regional policy makers with information to better develop and implement policies influencing the development and deployment of KETs. The HLG recommends the establishment a European KETs Observatory, Monitoring Mechanism, tasked with the mission of performing analyses and a "KETs Consultative Body" comprising stakeholders across the entire innovation chain to advise and monitor the progress achieved towards the development and deployment of KETs for a competitive industry in Europe.



Introduction

In 2009, the European Union (EU) identified Key Enabling Technologies (KETs) for their potential impact in strengthening Europe's industrial and innovation capacity[1]. In particular, KETs[2] were recognized as playing an increasingly vital role in developing the required industrial and technological base indispensable for the delivery of smart, sustainable and inclusive European growth.

It was proposed to create a High Level Expert Group (HLG) on KETs[3] tasked with the elaboration of a coherent European strategy to develop six KETs - nanotechnology, micro and nanoelectronics, advanced materials, photonics, industrial biotechnology and advanced manufacturing systems[4]- and bring them most effectively to industrial deployment.

This HLG KETs was launched in Brussels on the 13th of July 2010 in the presence of Vice-President and Commissioner for Industry and Enterprise, Mr. Tajani, Vice-President and Commissioner for the Digital Agenda, Mrs. Kroes, Commissioner for Research and Innovation, Mrs. Geoghegan-Quinn, the HLG President, Mr. Therme[5], along with the twenty-seven HLG Members (see Annex 2) consisting of representatives from European Member States, relevant European industry including small and medium enterprises, research technology organisations, academia and the European Investment Bank. Its remit, detailed in Annex 1, is to:

- Assess the competitive situation of the relevant

1. Preparing for our future: Developing a common strategy for key enabling technologies in the EU, Brussels, 30.09.2009, COM(2009) 512 final.
2. European Competitiveness Report 2010, Brussels, 28.10.2010, SEC(2010) 1276 final, Commission Staff working - document accompanying the communication An integrated Industrial Policy for the Globalisation Era –Putting Competitiveness and Sustainability at Front Stage, Brussels, COM(2010) 614
3. Idem.
4. Advanced Manufacturing Systems (AMS) comprise production systems and associated services, processes, plants and equipment.
5. M. Therme, Director of the Atomic and Renewable Energies Commission (CEA), Grenoble, France.

technologies in the EU with a particular focus on industrial deployment and their contribution to address major societal challenges;
- Analyse the available public and private R&D and innovation capacities for KETs in the EU;
- Propose specific policy recommendations for more effective industrial development and deployment of KETs in the EU.

The HLG KET gathered extra momentum in 2010 with the publication of Commission communications on the Europe 2020 Strategy[7] and related Flagship Initiatives including *An Integrated Industrial Policy for the Globalisation Era*[8], the *Innovation Union*[9], and the *Digital Agenda for Europe*[10], along with the *Regional Policy contributing to smart growth in Europe 2020*[11] , with all communications making explicit reference to the importance of KETs for Europe. The HLG KETs contributed significantly to the inclusion of KETs and shaping of these policies.

By eroding years of economic and social progress in Europe, the current economic crisis has reinforced the need to further pursue and strengthen Europe's competitive position in KETs and their deployment, as outlined in Chapter II. This latter was also confirmed during a public consultation process involving European Industry and innovation stakeholders through a series of KET Open Days (see Annex 5) and an Internet Forum. The results of this consultation process along with a focused SWOT analysis of the European KETs base with respect to our international competitors was presented to the three European Commissioners in the form of a working document at the interim formal meeting of the HLG KETs members on the 9th of February 2011. In particular, this report outlined the need for a KETs integrated approach for all six KETs, the existence of a "Valley of Death" for European KETs from ideas to marketable products, the need to establish combined funding mechanisms to promote KETs research, development and innovation (RDI) projects, and finally the outline of a three pillar bridge model and strategy, detailed in Chapter III, to reinvigorate Europe's competitive position in KETs and underpin future European competitive manufacturing.

Following unanimous formal recognition of the interim conclusions of the HLG and the proposed three pillar bridge model by the above Commissioners and the HLG Members, the HLG President, Mr. Therme, requested his HLG colleagues to identify the bottlenecks at EU level associated with implementation of this strategy. A series of workshops were organised on key transversal topics during the months of March and April 2011 (see Annex 6), along with a series of follow-on meetings with Commission services in a wide number of EC services. The policy recommendations resulting from both the vertical and transversal analysis performed by the HLG KETs are detailed in this report in Chapter 4.

The vision of the HLG KET recognises that those nations and regions mastering KETs will be at the forefront of future advanced and sustainable economies integrating cutting-edge technologies into their manufacturing and service industries, and managing the shift to a low carbon, knowledge-based economy, and ensuring the welfare, prosperity and security of their citizens. It equally recognises that the primary responsibility for the global competitiveness of the KETs industry rests with the individual companies operating in these sectors. Nevertheless, the members of the HLG now look to the EU parties best positioned to give effect to the groups recommendations, namely the European Union institutions, national and local authorities, to ensure that the energy, effort and political support which has been spent on this process is translated into demonstrable concrete actions.

HLG KET Board with EC VPs M. Tajani and Ms Kroes Interim meeting Brussels

6. EU smart, sustainable and inclusive growth: the European 2020 strategy, Brussels, 3.3.2010 , COM(2010) 2020
7. An Integrated Industrial Policy for the Globalisation Era, Putting Competitiveness and Sustainability at Centre Stage, Brussels, COM(2010) 614
8. Europe 2020 Flagship Initiative, Innovation Union, Brussels, 6.10.2010, COM(2010) 546 final
9. A Digital Agenda for Europe, Brussels, 26.8.2010, COM(2010) 245 final/2
10. Regional Policy contributing to smart growth in Europe 2020, Brussels 6.10.2010, COM(2010) 553 final
11. For more information on KETs Open Days, consult the HLG KET Website: http://ec.europa.eu/enterprise/sectors/ict/key_technologies/kets_high_level_group_en.htm

CHAPTER 1:
KETS ARE STRATEGIC TO EUROPE TO ADDRESS COMPETITIVENESS AND GRAND SOCIETAL CHALLENGES

Key Enabling Technologies (KETs) are attracting strong interest at both Member State and European Union level, as they are seen as the route to new products, processes and services capable of generating economic growth and employment, and contributing to strengthening and / or rejuvenating existing European sectors. KETs will enable sustainable, smart and inclusive growth in Europe. In addition, KETs' follow-through applications will create the substantial jobs, growth and wealth required in our future European economies to remain competitive at global level. At the same time, they will make an essential contribution to the development of products and solutions to address grand societal challenges.

The European Commission selected in its 2009 Communication[12] six KETs for Europe, on which the HLG bases its recommendations. These KETs are nanotechnology, micro-nanoelectronics, advanced materials, photonics, industrial biotechnology and advanced manufacturing systems. The Commission based this selection following the screening of the common high-tech areas and strategies at Member State level. The selection criteria included their economic potential, their value adding and enabling role as well as their technology and capital intensity regarding R&D and initial investment costs.

1.1 MAIN CHARACTERISTICS OF KETS

"KETs are knowledge and capital-intensive technologies associated with high research and development (R&D) intensity, rapid and integrated innovation cycles, high capital expenditure and highly-skilled employment. Their influence is pervasive, enabling process, product and service innovation throughout the economy. They are of systemic relevance, multidisciplinary and trans-sectorial, cutting across many technology areas with a trend towards convergence, technology integration and the potential to induce structural change"[13].

In particular KETs have two specific characteristics that separate them from other "enabling technologies": they are embedded at the core of innovative products and they underpin strategic European value chains.

o KETs are embedded at the core of innovative advanced products

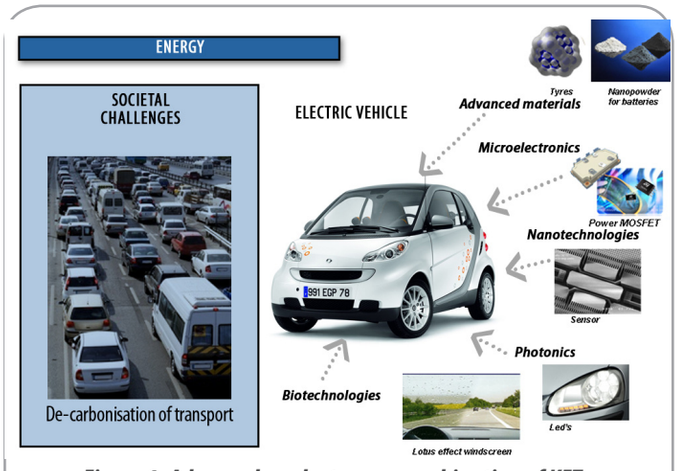


Figure 1: Advanced products are a combination of KETs: the case of the electric vehicle

Combinations of KETs are embedded at the core of most advanced products. For example, an electric car is a combination of advanced materials for batteries, microelectronics components for power electronics, photonics for low consumption lighting, industrial biotechnologies for low friction tyres and finally advanced manufacturing systems to produce electrical vehicles at a competitive cost (see Figure 1). Similarly a mobile phone incorporates microelectronic chips for communications, photonics enabled camera and optics, advanced materials for new tactile screens, and so forth (see Figure 2). A recent real-time avian flu test instrument incorporated biotech labels, microelectronics chips, laser based photonic detection, and nanotechnology optimised surfaces for fluidic processing (Figure 3). Mastering of KETs is absolutely required to ensure that we can produce within Europe, future innovative products and is therefore a strategic priority to ensure

12. Source: Commission Communication (COM(2009)512): "Preparing for our future: Developing a common strategy for key enabling technologies in the EU".

13. Source: Commission Staff Working Document (SEC(2009)1257): "Current situation of key enabling technologies in Europe". See also European Competitiveness Report, Brussels, 28.10.2010, SEC(2010) 1276 final, Commission Staff working document accom panying the communication. An integrated Industrial Policy for the Globalisation Era.

the competitiveness of European industry. It is these KET enabled products that subsequently allow Europe to address its grand societal challenges such as "De-carbonisation of Transport" which requires the development of radically new "energy efficient vehicles" enabled by advanced KETs capabilities and capacities.

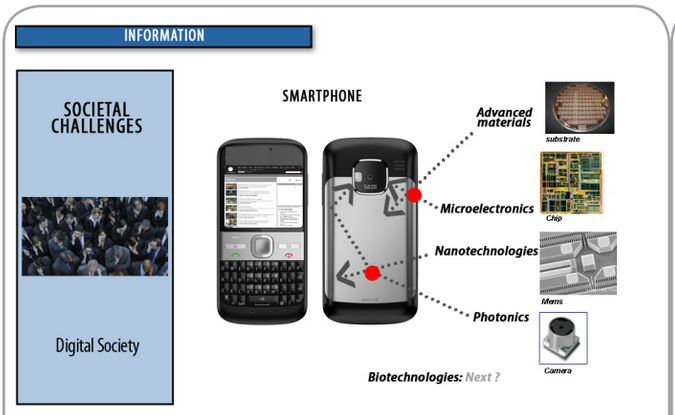


Figure 2: Advanced products are a combination of KETs: the case of the mobile phone

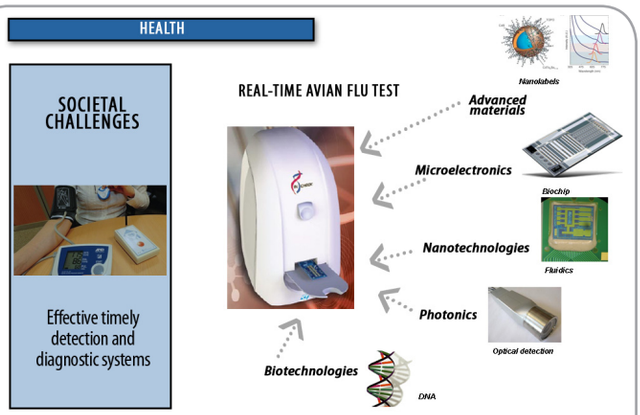


Figure 3: Advanced products are a combination of KETs: the case of real-time avian flu monitoring

o KETs underpin strategic European value chains

KETs are of systemic relevance and feed many different value chains[14] in very heterogeneous ways. This is demonstrated in Figure 4 for three specific sectorial examples: automotive, lighting and electronics value chains. It is observed that a combination of KETs is necessary at all levels of the value chain to the development and manufacturing of advanced innovative products.

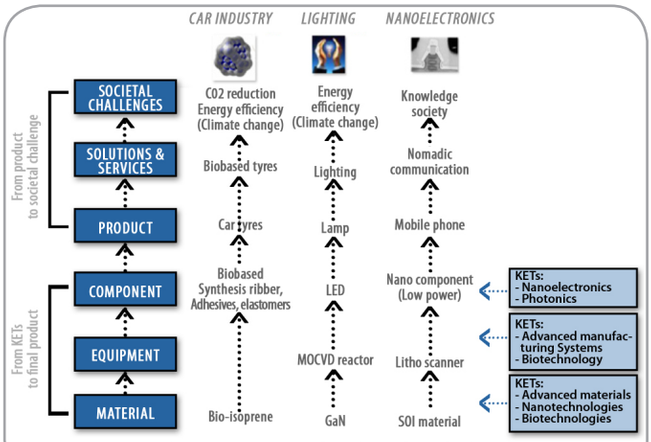


Figure 4: KETs underpin value chains

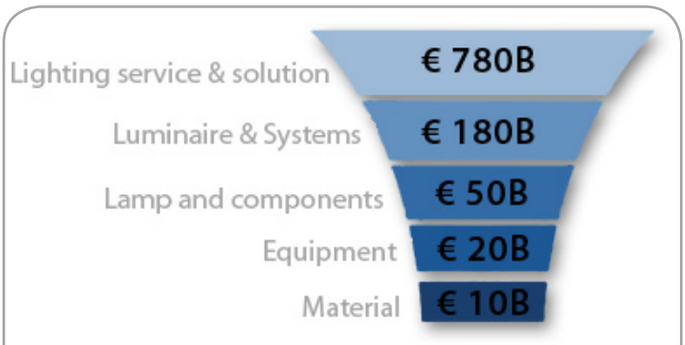
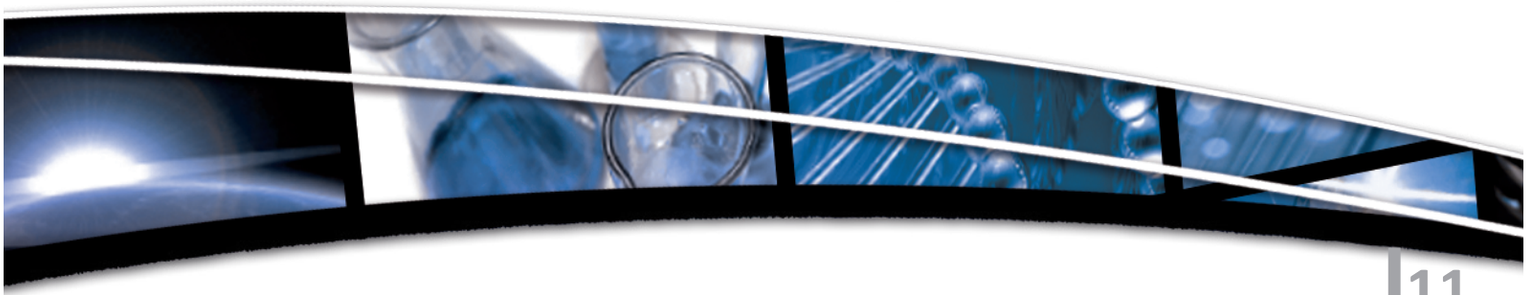


Figure 5: Example of value chains: micro nanoelectronics and photonics

The products based on KETs often serve as inputs of great value added that are integrated into more complex systems. It is these subsequent applications that drive major economic growth and competitiveness. One example of this underpinning nature in feeding a full value chain is the photonics ecosystem shown in Figure 5[15].

14. "Value chain": term used to describe the cooperation of the relevant business sectors (from raw material to final product) to ensure delivery of products and processes. This actually describes the size of the bridge (i.e. the several lanes mentioned) and the speed at which this bridge can be crossed. An example of a value chain has players such as a materials producer, a photovoltaic assembler and a final solar panel device provider.

15. *Solid State Lighting. The most promising MtM opportunity*. Prof. G.Q. (Kouchi) Zhang. Delf University



1.2 KETS UNDERPIN EUROPEAN ECONOMY COMPETITIVENESS AND EUROPE'S CAPABILITY TO RESPOND TO GRAND CHALLENGES

KETs underpin innovation in many strategic sectors and play a key role in making new products and services affordable for the population at large. They contribute to the development of disruptive technologies across sectors such as energy (e.g. renewable energies, bio-fuel, solar energy etc.), transport (e.g. lighter, safer and energy efficient transport vehicles), manufacturing (e.g. reduced material and process rates, energy saving), chemistry (e.g. green processing) and environment (e.g. sensors for environmental monitoring), information and communication (e.g. chips for nomadic, multimedia convergence and cloud computing), medicine (e.g. gene therapy and genetic testing) and consumer goods (e.g. mobile phones, lighting). They also contribute to the build-out of a more productive, competitive, energy and resource-efficient economy. Products with enhanced features have the potential to bear high economic value as well as ensure a more comfortable, healthy and safe life for European consumers and workers in a clean environment.

The mastering and deployment of KETs in Europe are expected to provide significant economic benefits, offering a widening variety of uses in an increasing number of application areas and industries, as well as contributing to energy and resource efficiency, through innovative materials, processes, technologies and applications.

Economic impact

The macroeconomic importance of KETs is that they can open up entirely new markets or underpin and enhance existing markets through accelerating technological progress with trickle-down effects on productivity and concurrent leaps in efficiency levels. In addition to feeding numerous full value chains, products based on KETs often serve as inputs of great value added that are integrated into more complex products. It is these subsequent applications that drive major economic growth and competitiveness.

The market potential for specific KETs is shown below[16].

	Current market size (~2006/08) USD	Expected size in 2015 (~2012/15) USD	Expected compound annual growth rate
Nanotechnology	12 bn	27 bn	16%
Micro and nanoelectronics	250 bn	300 bn	13%
Industrial biotechnology	90 bn	125 bn	6%
Photonics	230 bn	480 bn	8%
Advanced Materials	100 bn	150 bn	6%
Advanced Manufacturing systems	150 bn	200 bn	5%
TOTAL	832 bn	1282 bn	

Table 1: Estimated global market potentials of Key Enabling Technologies

The market size estimation data represent an average across entire market sectors. Within specific KETs, the annual growth rate of the industries that they support varies dramatically with very significant niche opportunities. For example, the average annual growth rate of the global photovoltaic industry exceeds 25%. Likewise, products

16. Source: Background study; Confindustria (2009).

underpinned by nanotechnology are forecast to grow from a volume of $254 billion in 2009 to $2.5 trillion by 2015[17]. In the industrial biotechnologies sector, the value of biochemicals (other than pharmaceuticals) will increase from 1.8% of all chemical production in 2005 to between 12% and 20% by 2015[18]. A recent report by the World Economic Forum (WEF)[19] concluded that converting biomass into fuels, energy, and chemicals has the potential to generate upwards of $230 billion to the global economy by 2020. Manufacturing industries contributed to some 17.1% of GDP and accounted for some 22 million jobs in the EU in 2007.

These sizeable markets sustain significant employment in the EU. For example, in the micro-nanoelectronics industry (materials, equipments and semiconductors) there are approximately 500 companies in Europe employing directly 200 000 people and creating around 1 million indirect jobs. These numbers do not include the electronics systems and services industry. Direct employment has remained substantially stable during the last ten years with major growth in employment generated in the related services industry.

There are approximately 5 000 photonics companies in the EU, mostly SMEs, employing 300 000 people directly. In addition, the jobs of more than 2 million employees in the EU manufacturing sector depend directly on photonics products.

Similarly, employment statistics show a 25% increase in employment in specific nano-related businesses between 2000 and 2008 globally. Extrapolating this trend, by 2015 one can forecast 400 000 nanotechnology related jobs in the EU, in sectors (e.g. process and manufacturing, automotive, ICT, medical) in which the EU is amongst the world leaders. In addition, it is estimated that by 2015 approximately 2 million nanotechnology related workers will be needed worldwide, including 300 000 to 400 000 in Europe[20].

Impact on Societal challenges:

From an inclusive growth perspective, KETs contribution to society as a whole is particularly significant in terms of employment stabilisation, creation and improvement of productivity and income levels, reduction of poverty through "smart specialisation", and better quality of life.

One such example is the KETs enabled societal benefits for elderly people. It is predicted that by 2050 the number of people in the EU aged 65 or more will have grown by 70% and for those in the 80+ age group by 170%. As aging people are more prone to illness, keeping people healthy and active, while managing healthcare costs, is an important societal challenge which KETs address[21]. Early diagnosis using photonic technologies will help prevent severe illness, and may also provide effective new treatments leading to early stage cures. The combination of photonics and microelectronics in healthcare has been estimated to offer potential health cost reductions of 20%. Nanotechnology combined with biotechnology provides optimised formulation and delivery of drugs. Sensing, interacting, destroying, monitoring and tracking biomolecules involved in pathological processes is of paramount importance for diagnosing, curing and monitoring human illnesses that mostly start at the molecular level.

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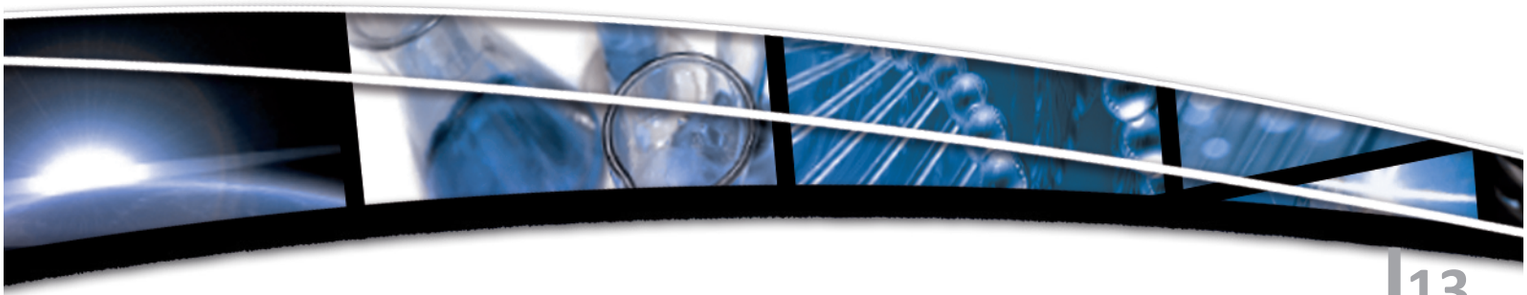
17. According to Ireland's Nanotechnology Commercialisation Framework 2010 – 2014, Forfas, (Aug.2010) http://www.forfas.ie/media/forfas310810-nanotech_commercialisation_framework_2010-2014.pdf.
http://ec.europa.eu/enterprise/sectors/ict/key_technologies/kets_high_level_group_en.htm
According to OECD, "Nanotechnology: an overview based on indicators and statistics" (2009), based on Roco, MC and WS Bainbridge, Societal Implications of Nanoscience and Nanotechnology, Kluwer Academic Publ, (2001)

18. OECD (2009) – The Bioeconomy to 2030: Designing a Policy Agenda

19. World Economic Forum (2010) – The Future of Industrial Biorefineries.

20. According to OECD Nanotechnology: an overview based on indicators and statistics (2009), based on Roco, MC and WS Bainbridge Societal Implications of Nanoscience and Nanotechnology, Kluwer Academic Pub., (2001

21. World Economic Forum (2010) – The future of Industrial Biorefineries
See http://www3.weforum.org/docs/WEF_FutureIndustrialBiorefineries_Report_2010.pdf



Remote health care monitoring will allow citizens to age longer and more safely at home and avoid hospital overcrowding. Nanotechnology and advanced materials continuously improve orthopædic implants (bio-resorbable scaffolds, fillers, pins, biocompatible coatings, etc.) and computer assisted surgery permits key-hold surgery reducing recovery time. Biochips combining advanced materials, nanotechnologies, nanoelectronics, and biotechnologies will allow rapid diagnosis of, for example, bird flu, and ICT based mental health management can provide therapy with 80% savings in therapist time compared to conventional therapy. Semiconductors offer automatic blood-pressure monitors and pain-management devices. Solid state lighting improves hospital environments as well as reducing energy costs significantly. It is clear that KETs will contribute to lower the costs of public health systems.

Societal challenges also can act as market pull, spuring KETs to provide and master solutions which can tackle societal challenges.

Environmental and energy impact

In a resource-scarce and knowledge-rich Europe, new products must have high knowledge content and low material / energy resource needs. As stated in the EU 2020 Strategy, *"Europe must promote technologies and production methods that reduce natural resource use, and increase investment in the EU's existing natural assets"*[22].

Key Enabling Technologies can play an important role in this context. By developing and implementing technological solutions along three parallel approaches, Europe's vulnerability to materials scarcity can be mitigated within the following timescales:

- short term: enhance recycling and develop recycling technologies;
- medium term : design for recycling;
- long term : develop substitution materials.

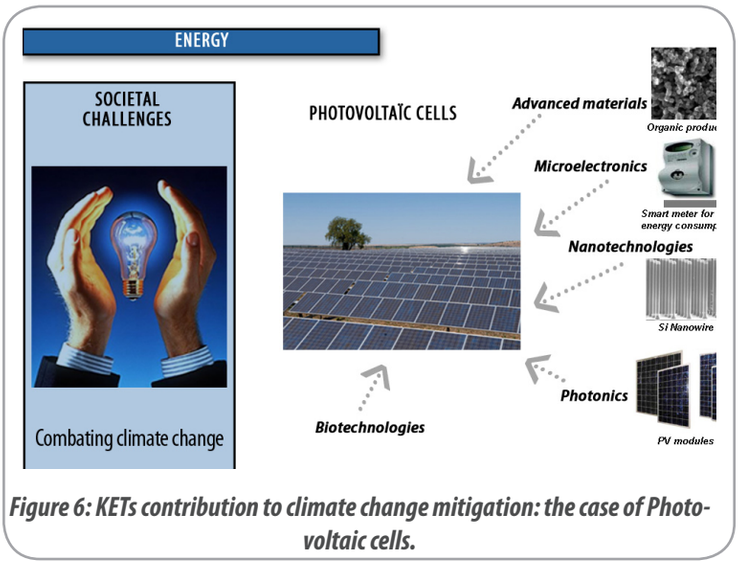


Figure 6: KETs contribution to climate change mitigation: the case of Photovoltaic cells.

Advances in materials technologies and other KETs will be required to meet such challenging requirements, but these are within the reach of European development capabilities. The progress on short and medium terms goals can be achieved within a 2020-horizon. Europe is a global leader in recycling technologies and industry, this position should be further strengthened. The conceptual stage of a "design for recycling" initiative for selected products can be rapidly set up, industry and technological research organisations have already declared their interest.

KETs are crucial in the battle to combat climate change and mitigate the effects of the mounting price and scarcity of oil and other essential raw materials. Europe's need for Energy is predicted to increase steadily, with most energy uses switching to electrical (transportation, heating, cooling). Electric energy production, distribution, storage and a more efficient use of electricity are striking examples wher the application of KETs can provide powerful solutions for improving the future Energy System. The introduction of Smart Grids and Smart Meter Technology will empower consumers to make real-time power saving decisions. Low consumption lights and LEDs will also save significant energy. Organic Light Emitting Diodes for lighting have a potential to use less energy than fluorescent lamps[23] and less resources too. Efficient new battery advanced materials such as those to be used in future electric vehicle (see example below) can

22. Europe 2020 Flagship Initiative, Innovation Union, Brussels, 6.10.2010, COM(2010) 546 final

23. http://www.bmbf.de/de/7045.php

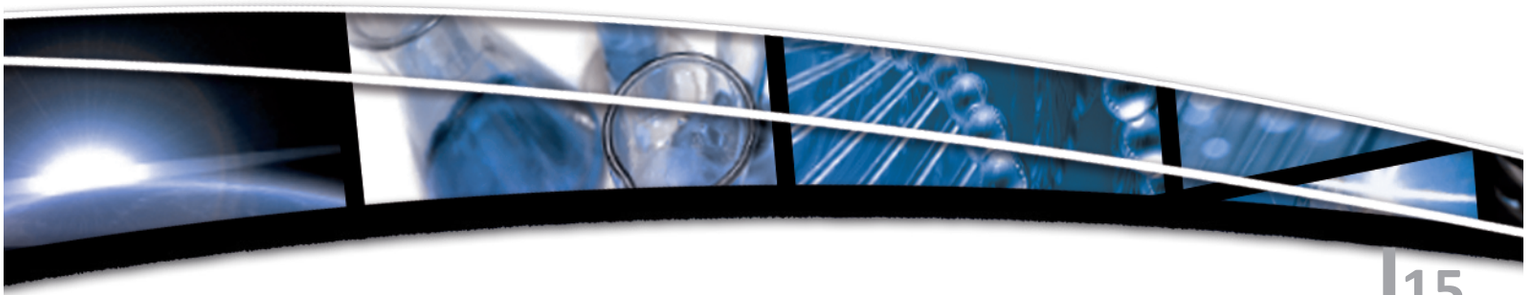
assist in making the most of renewable energy technologies, advanced materials for rotor blades can make more efficient wind turbines and breakthroughs are likely in the realisation of high efficiency fuel cells, direct hydrogen generation and new energy storage solutions such as super capacitors. Today over two thirds of global installed photovoltaic capacity is found in the EU and PV generation costs could continue to fall by 8% a year[24].

In addition, many innovative technologies are either significantly less damaging to the environment or directly applied to environmental protection. Industrial biotechnologies, based on renewable resources, can save energy in production processes. Reports on the potential of industrial biotechnology to cut CO2 emissions conclude that the full climate change mitigation potential of biotechnology processes and bio-based products ranges from between 1 to and 2.5 billion tons CO2 equivalent per year by 2030[25].

In conclusion, KETs are strategic for the competitiveness of the European industry, economy and society.

24. SET for 2020, report, EPIA, 2009

25. WWF (2009) – Industrial biotechnology: More than green fuel in a dirty economy



CHAPTER 2:
GLOBAL KETS PERSPECTIVE

The EU is facing growing global competition on KETs from both developed and emerging economies, in particular, the US and East Asia, as detailed in the section below. European policy makers must now urgently engage in a radical rebalancing of resources and objectives in order to retain critical capability and capacity in these domains of national and European importance. From a global perspective, for the time being, the EU remains resilient, in a position of relative strength, that must now be reinforced and rapidly developed to compete for the future.

2. 1 AN INCREASINGLY COMPETITIVE ENVIRONMENT

The HLG analysis focuses on four key areas:

- Global public investment in KETs and the absence of a level playing field for Europe;
- A resurgent America with a national priority focus on manufacturing;
- A strategic priority focus on Applied Research and Development in competitor national public RDI budgets;
- The rapid ascent of traditionally European value chains by Far East companies.

o Public investment in KETs – No level playing field

Europe's competitive position as a developer and manufacturer of KETs is continually being challenged. There is intense global competition to develop and commercialise KETs and for the high value R&D or manufacturing facilities linked to these. In many competitor countries, generous incentives are available to support investment projects, which are often negotiated on a case-by-case basis, and which the EU has been unable to match. Whilst it is almost impossible to present a consolidated comparison of different policies, one can however highlight the general trend with the following illustrations from different KET sectors.

Advanced Materials

Batteries Case Study

The US, using ARRA (American Recovery and Reinvestment Act) and ATVMIP (Advanced Technology Vehicles Manufacturing Incentive Program) instruments, has targeted priority KET sectors for investment and build-out of pilot line prototyping capability notably for batteries. One such strategic area is the development of electrical vehicle and batteries development infrastructure.

This US policy was successful in attracting European industry and consequently transferring complete manufacturing know-how. A new advanced battery facility is being built in the USA for a European company, which will manufacture lithium-ion cells, modules and battery packs for military, industrial, and agricultural vehicles. The facility received a $95.5 million grant from the US DoE out of a total cost of $200 million.

Nanotechnology

Magnetic Random Access Memory

The technology of magnetic random access memory was recently mastered and led to development and commercialisation in Europe. This type of memory could replace traditional memory on silicon as it is faster, less expensive and consumes less energy. The nanotechnology involved was also developed in Europe. This year, RUSNANO, the Russian government controlled investment fund, tasked with the mission of creating by 2015 a "Nano industry" took high JV stake in the relevant European industry. RUSNANO "helps" foreign companies to install manufacturing and R&D sites in Russia and so, transfer the technology.

Industrial Biotechnology

European industrial biotechnology companies find it easier and faster to get financing in the US than in the EU for its first industrial scale plant. The US department of energy (DoE) and the US department of Agriculture (USDA) have quickly established grant and loan guarantee programmes respectively with streamlined selection processes in the domain of biotechnology. They offered a $50 million grant from the DoE and a conditional commitment for a $75 million loan guarantee from the USDA to a leading European biotechnology company for a new $130 million production facility to produce advanced biofuels from waste in the USA. The European company has been able to secure financing in the US and not in the EU, although it is fully aligned with the Europe 2020 Strategy and in particular the objectives of the flagship initiative, Resource Efficient Europe[25], through its process technology to convert waste into bioethanol and renewable power.

Photonics

In 2004, Europe held five of the top ten positions in PV manufacturing. In 2010, only one European company remained in the top ten ranking. US$34 billion was provided during the last 15 months by Chinese Government Banks to China-based solar companies as very-low-interest long term loans. Most recently, Jinko, a Chinese "pretender" for the remaining two non-Asian places among the TOP10 for 2011 received a $7.6 Billion credit facility (16th March 2011).

For comparison, the EIB lent approximately 6B€ in 2010 for the entire renewable energy sector.

o Resurgent America: Focus on Manufacturing

US President Barack H. Obama, in his State of The Union speech, on January 25 2011, stated "*At stake [right now] is whether new jobs and industries take root in this country, or somewhere else. […]. The rules have changed! […] We need to out-innovate, out-educate, and out-build the rest of the world*".

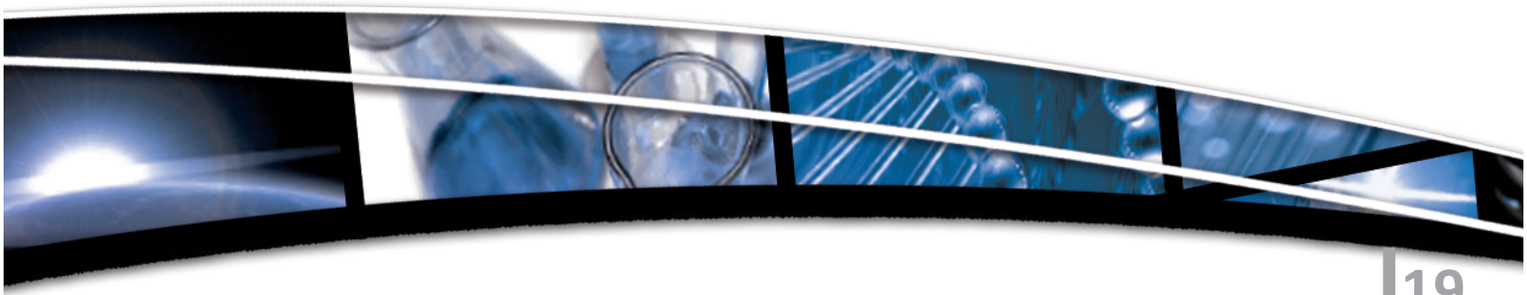
Over the past two years, US public investment has exceeded 7B$ on KETs related RDI projects and strategic manufacturing capacity. This effort will soon be expanded significantly with the unveiling of a strategy aimed at reviving the U.S. manufacturing sector. The key feature of the recommendation from the President's Council of Advisors on Science and Technology (PCAST) on May 19th 2011 is the *creation of a $500-million Advanced Manufacturing Initiative* run by the Commerce Department and involving other federal agencies. The program would fund "generic" industrial technology commercialisation projects that would have widespread economic impact and create jobs. The effort would grow to $1 billion a year over four years.

o Strategic priority focus on Applied Research and Development

Many of Europe's competitor nations, in particular, the US and East Asia, now have a determined focus on translating basic science via technology building blocks into advanced processes, products and systems.

Their national public research and innovation funding agencies and instruments are aligned with this strategy. This is clearly demonstrated in the benchmarking of the distribution of "federal" R&D funds (using OECD Frascati and Oslo agreed taxonomy for classifying public investment in research and innovation with categorisation of fundamental, applied and development research) shown in Figure 7[26]. It is observed that both the US and Asian federal R&D funds go mainly into development R&D activities. In the case of the US and Korea for example, 76% of funds go into applied R&D.

25. A ressource efficient Europe-flagship initiative under the EU 2020 strategy, 26.1.2011, COM (2011) 21
26. Source: Key Science and Engineering Indicators, National Science Board, 2010 Digest, NSF, http://cordis.europa.eu/erawatch, OECD "Research and Development Statistics ".



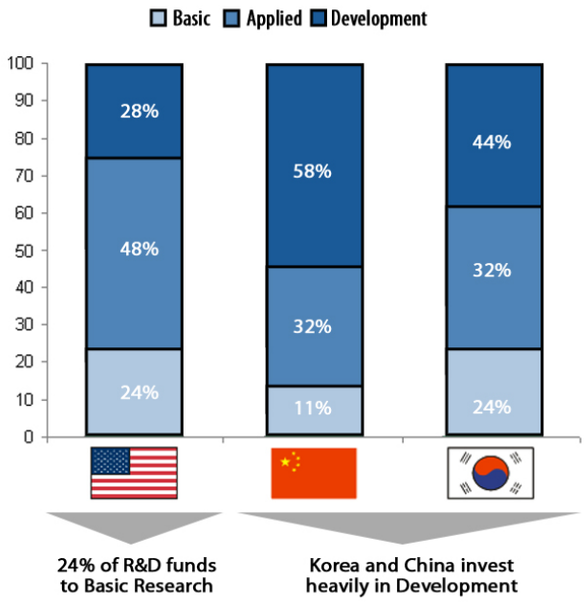


Figure 7: Strategic focus on applied research and development: the case of US, China, Korea, China.

It is revealing, using the same methodology, to analysis specific KET areas. The nanotechnology case is shown in Figue 8[27].

It is observed that whereas the EU accounts for 27% of global public nanotechnology funding and for 33% of all Nanotechnology publications, its share drops to 17% of Nanotechnology patents and to 15% regarding Nano-based products. One might conclude that the EU leads the way in Basic Research and that others commercialise the ideas.

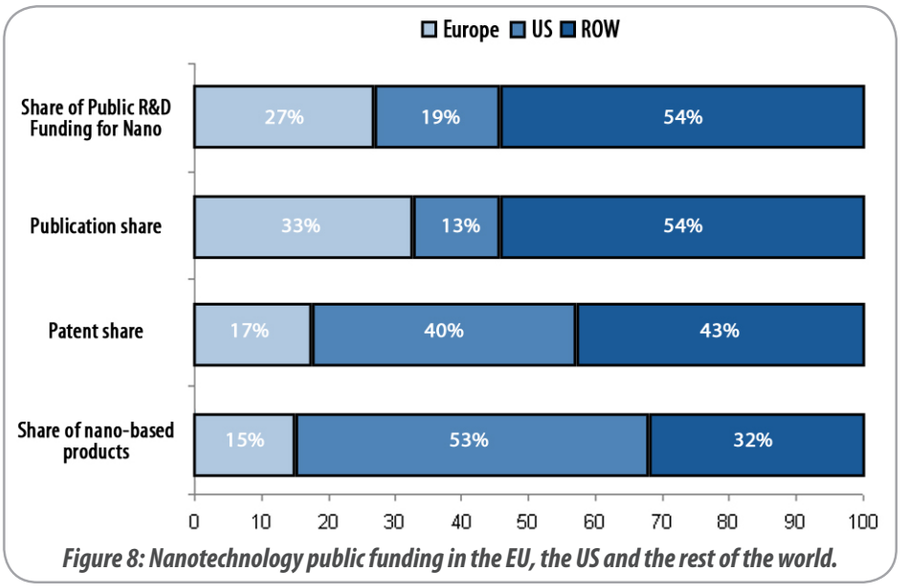


Figure 8: Nanotechnology public funding in the EU, the US and the rest of the world.

The above analysis would suggest a major rebalancing of resources towards innovation is necessary if the EU is to close the current innovation gap.

o Asia moving up traditionnally European value chains

Industry from emerging economies such as Brazil, India and China, which traditionally have played a secondary role in the global innovation landscape, have now begun to catch up in developing their own innovative capabilities

27. Source: Cross-sectoral Analysis of the Impact of International Industrial Policy on Key Enabling Technologies (Danish Technological Institute with IDEA Consult, 2011), Institute of Nanotechnology, (analysis from UNU-MERIT and VDI-TZ), 2010, OECD (2009): Nanotechnology: An Overview based on Indicators and Statistics: http://www.oecd.org/dataoecd/59/9/43179651.pdf, http://www.fas.org/sgp/crs/misc/RL34511.pdf

and some have emerged as major players in certain technology intensive KET sectors like mobile communications, electronics and information technology. For example, Chinese companies are rapidly moving up strategic industry value chains previously considered as "European".

Case study Huawei:

Huawei was founded in 1988 as a distributor of imported telecommunications switches. It is now n°2 worldwide in global mobile infrastructure equipment markets. In less than 20 years, Huawei has moved up the global telecommunications value chain, previously dominated by European global players such as Ericsson, Alcatel, Nokia and Siemens. Most recently, Huawei overtook both Alcatel-Lucent to become world's No. 3 in mobile network and the Nokia and Siemens Networks for the No. 2 position in the global mobile infrastructure equipment market. In 2010, it was named the world's top patent producer, becoming the first Chinese company to head the United Nations WIPO list (1,737 applications).

Similar case studies abound. For example, Acer, a Taiwanese company, founded in 1976 as a distributor of imported semiconductors, is now worldwide n°2 in the PC market and ranks n°1 worldwide in notebook shipments .

2.2 EUROPE IS RESILIENT

Europe is resilient and has considerable assets in this global KETs competition. From research and industrial perspectives, these assets include a strong technological research base, leveraging in particular Europe's leading Research Technology Organisations, as well as world leadership in several KET application sectors (automotive, aeronautics, health, and energy) relying, for most of them, on strong technological and manufacturing competences in large and small companies, and in production and competence networks along established and highly diverse new value chains.

An analysis of EPO/PCT patent applications (European Competitiveness Report 2010) shows that Europe is neither losing nor gaining ground in the six European KET priority technologies, judging by its share of patent applications. In all cases, Europe is confronted with increasing competition from Asia, which in the past decade has made considerable progress, whereas North America's overall share in global technology output has gradually diminished.

o A world class KET research and knowledge creation landscape

One of Europe's major strengths consists of a strong research base, highlighted by the European share of world KET patents. Europe is definitely still in the global race. Europe is second in terms of patent filling (32%) after Asia (38%), and before the USA (27%)[28].

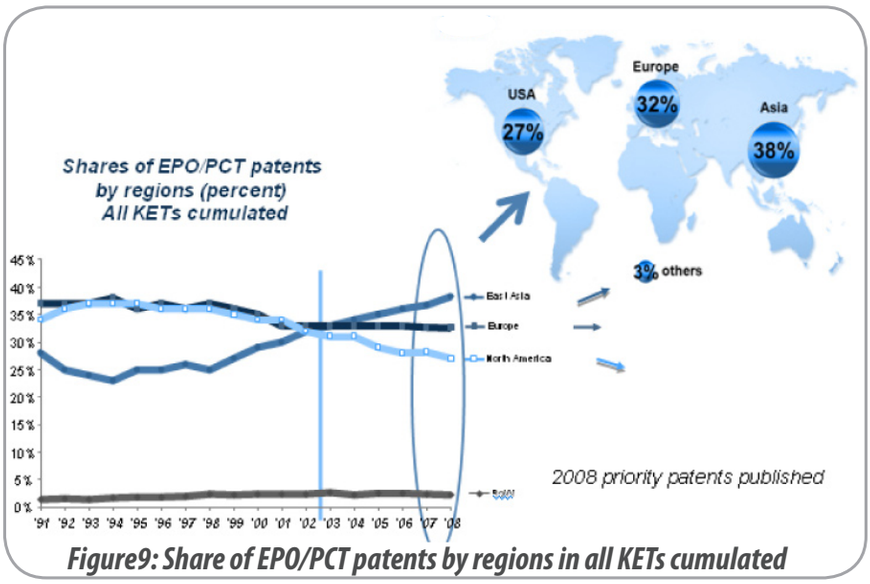
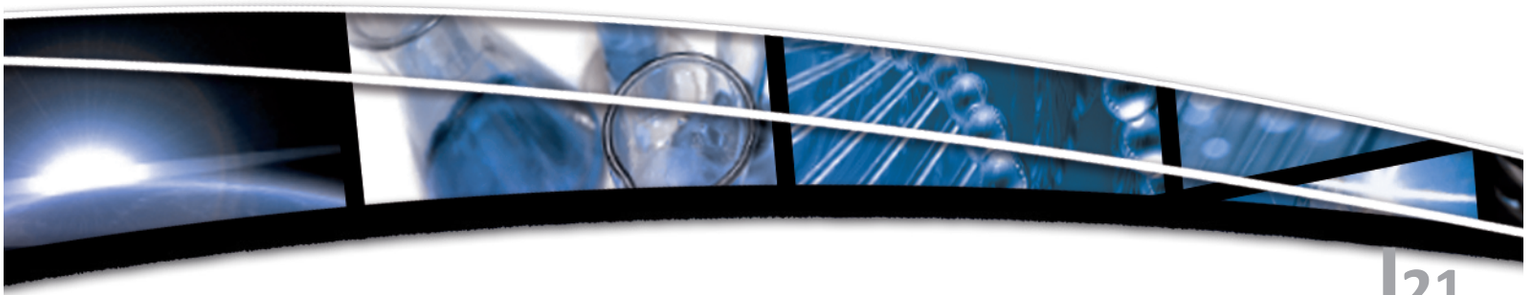


Figure9: Share of EPO/PCT patents by regions in all KETs cumulated

28. Sources of figures 9 and 10 are: EPO/PCT patents, 2000-2007 / European Competitiveness Report 2010 / European Competitiveness in Key Enabling Technologies 2011



A more detailed analysis presented in Figure 10, comparing separately the top ten EPO/PCT patents ranking for R&D organisations and compagnies based on the number of patents they filled in Europe between 2000 and 2007, demonstrably indicates that whilst Europe has considerable leadership in the R&D domain, it has more difficulties to transform this knowledge in marketable products to sustain and / or build top ten ranking companies in each KET sector.

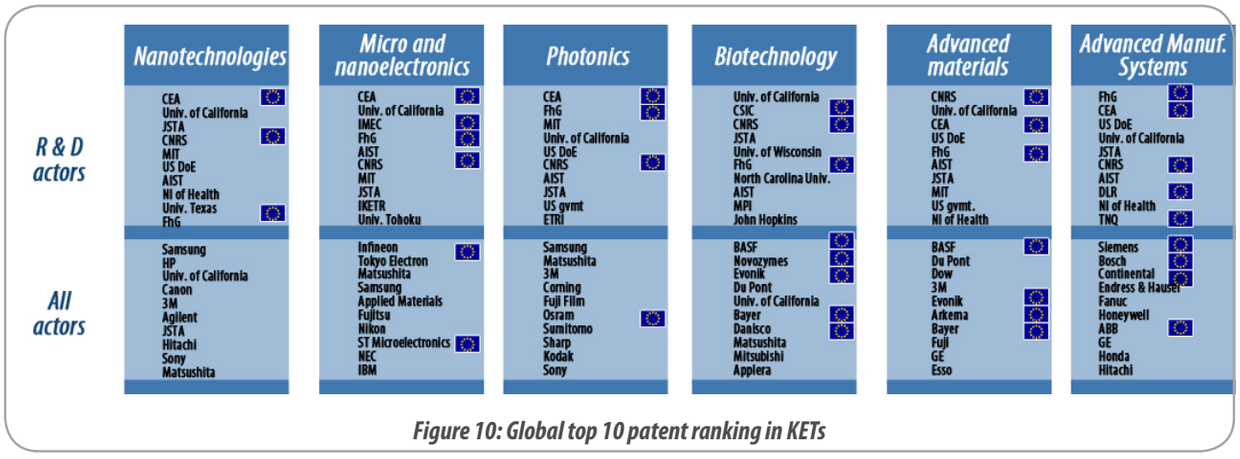


Figure 10: Global top 10 patent ranking in KETs

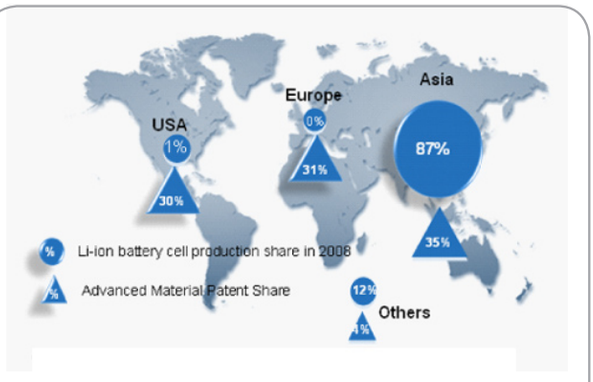


Figure 11: Global patent and manufacturing shares: the case of Li-ion battery

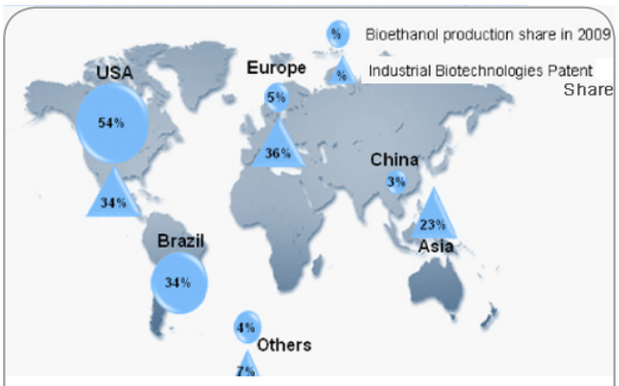


Figure 12: Global patent and manufacturing shares: the case of bioethanol

This disconnect between the production of knowledge and the "use" of knowledge in manufacturing activities and marketable products was confirmed through analysis of a number of case studies undertaken for the HLG. Such patent share and manufacturing activities data are shown in Figures 11 and 12 for the case of the Li-ion battery cells and Bioethanol production.

o European internal market with world market leaders as KETs users

With its half billion citizens and consumers, the internal market is undoubtedly one of Europe's major strength. The free circulation of goods and services provides significant market opportunities for KET producers and KET users with a geographical proximity in many application areas (health, energy, construction, space, etc.).

One of the assets of European KETs developers is their close proximity to major KETs users, i.e. world leading industries in several KETs application sectors (automotive, aeronautics, health, and energy) relying, for the most part, on strong technological and manufacturing competences in large and small companies, and in production and competence networks along established and highly diverse new value chains. Europe also offers important clusters and networks, which bring together resources and expertise and promote the cooperation between businesses, public authorities and the academic sector, which makes the European production fabric more resilient to global competition. Europe also represents the largest integrated market in the world, both rich and receptive to innovative products. It must build its innovation models on these strengths.

CHAPTER 3:
AN INTEGRATED APPROACH TO KETS FOR FUTURE COMPETITIVENESS:
THREE PILLAR BRIDGE MODEL TO PASS ACROSS THE "VALLEY OF DEATH "

3.1 EUROPEAN KETS WEAKNESS: THE "VALLEY OF DEATH"

Whilst European R&D is generally strong in new KET technologies, the HLG has observed that the transition from ideas arrising from basinc research to competitive KETs production is the weakest link in European KET enabled value chains. This is demonstrable evidence of the impact to-date of the absence of a major focus on enabling innovation in the EU and an over-emphasis on basic research both within EU research programmes and in some Member States.

This situation, namely the gap between basic knowledge generation and the subsequent commercialisation of this knowledge in marketable products, has been commonly identified across the KETs and is known in broad terms as the "valley of death" issue. Its effects can include not only relocation of manufacturing and R&D, but also the disruption of entire value chains with their ultimate consequences on the sustainability of various strategic sectors in Europe. The "valley of death" is due to many factors including the absence of smart regulation, the unavailability of pre-commercial R&D support, insufficient access to large scale finance, and lack of political support and pro-active KET policies.

This "Valley of Death" has been identified in many competitor countries, including the USA, China and Taiwan. All have established coordinated programmes in strategically important areas that cover the full innovation chain addressing basic and applied research, demonstrators, standardization measures, deployment and market access, all at the same time and, significantly, in a logical joined-up manner. Deployment is aided by targeted instruments addressing all technology readiness levels of competing technology approaches, from basic science through proof-of-concept and prototypes, to large-scale demonstration actions and public procurements. One example is the US Department of Energy's 'Solid State Lighting' (SSL) programme, for which it has "*developed a comprehensive national strategy that encompasses Basic Energy Science, Core Technology Research, Product Development, Manufacturing Research and Development Initiative, Commercialization Support, SSL Partnerships, and Standards Development*"[29].

Of particular note to the HLG were the recent mirror recommendations (May 2011) of its "sister" high level group in the US; President Obama's advisory panel on science and technology (PCAST) tasked with the elaboration of a strategy aimed at reviving the U.S. manufacturing sector. PCAST expressed concern that the U.S. innovation system was being compromised by the loss of manufacturing. "*As manufacturing goes, so too will design and R&D," they said. "We need to create ways of moving these discoveries past the "Valley of Death*".

Developing new policy issues and financial instruments to support KETs will be meaningless if the identified critical "valley of death" problem cannot be solved.

3.2 THE THREE PILLAR BRIDGE MODEL TO PASS ACROSS THE "VALLEY OF DEATH"

o The need for an integrated strategy for KETs development

The HLG KET sectorial analysis highlighted three specificities of KETs within an European context. Firstly, KETs, in general, are only differentiated by their degree of maturity. Secondly, KETs are ubiquitous in both new and traditional products. Thirdly, there is a significant interdependency of KETs in the development of advanced products. All these facts underline the need for the European Commission to stimulate and develop an integrated KET approach covering the spectrum of all six KETs.

The HLG analysis also clearly showed that it is the same key stages that determine the development of all KETs. An integrated approach to KETs is therefore perfectly possible and enables common solutions and actions, each of which can then achieve a more significant critical mass, effectiveness, visibility and impact.

It is primarily the degree of maturity along the development process of each KET, which differentiates each of

29. US Dept of Energy SSL Initiative, http://www1.eere.energy.gov/buildings/ssl/about.html

them. This degree of maturity depends mainly on their order in the history of emergence of technologies, with two extremities, that of microelectronics which emerged in the 1950's and nanotechnology which emerged in the 1980's, which represent the most and least mature respectively of the six KETs currently considered. The knowledge acquired throughout the maturation process of a KET enables innovation ecosystems and industries to accelerate the development of new KETs. An integrated approach to KETs will therefore allow the use of the know-how and feedback of experience of the more mature KETs to accelerate the development of more recent KETs. Such an integrated approach would therefore benefit from an overall "pull-along" effect for all KETs.

In addition, it has been demonstrated that the most innovative products incorporate not only a single KET but several KETS simultaneously. Each KET brings a part of the technological innovation but the accumulated benefit from a number of KETs constitutes a significantly more important technological leap-forward. All the more so, as mastering the development of different KETs all along the chain enables one to be innovative in the way to integrate them and develop new products. This holistic approach assures greater product competitiveness and in turn, a significantly higher barrier to copying. To propose a global approach to the development of KETs therefore makes particular sense given their highly interdisciplinary nature.

The HLG thus decided to focus on an integrated industrial and political approach to the development and deployment of KETs in Europe. This strategy is described in the following sections of this chapter and constitutes the framework for the subsequent analysis and recommendations from the High level Group detailed in Chapter 4.

o A European "three-pillar bridge" to pass across the "valley of death"

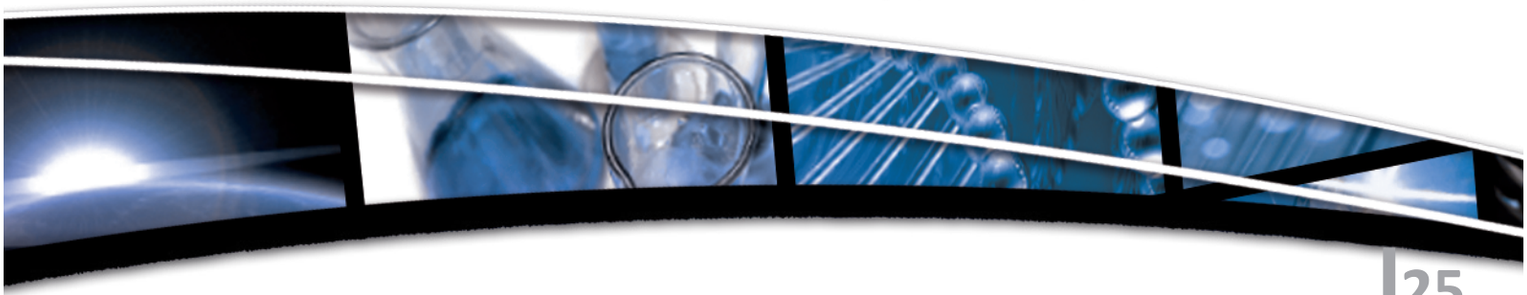
Crossing the "valley of death" in the key enabling technologies in Europe requires the delivery of solutions to the three successive stages implicit in this crossing.

The first stage, called "Technological research" consists of taking best advantage of European scientific excellence in transforming the ideas arising from fundamental research into technologies competitive at world level. These should be both shown through proofs of concept and be proprietary, that is protected by patents. It is these patents that will guarantee both the future freedom to exploit these technologies by European industry and their capacity to resist counterfeits and copying. From a more general perspective, an IPR strategy for global markets along with a single and efficient European system for IP protection and enforcement are urgently needed.

The second stage, called "Product demonstration" allows the use and exploitation of these KETs to make innovative and performing European process and product prototypes competitive at world level. This requires firstly putting in place pilot lines having both the KETs technology prototyping facilities to enable the fabrication of a significant quantity of innovative product prototypes arising from these KETs. Secondly, establishing the prototype product validation in terms of its user performance requires both demonstration and deployment operations at appropriate scale on European sites, protecting the technological advance achieved. In both cases, the objective is to make a demonstration at real scale of the relevance in terms of user value and the competitiveness of new product prototypes containing one or several KETs.

The third stage, called "Competitive manufacturing" should allow, starting from product prototypes duly validated during the demonstration phase to create and maintain in Europe attractive economic environments in EU regions based on strong eco-systems and globally competitive industries. In particular, production facilities competitive with their US and Asian equivalents in terms of production volumes and therefore price of products. This will allow further strengthening of the capabilities of EU industry to more successfully deploy KETs-based products, face international competition and master solutions to tackle grand societal challenges. In fact, in KETs where economies of scale are of importance, only advanced manufacturing based on the latest technologies and at a significant level will allow:

- The acceleration of the learning curve on new manufacturing technologies, processes and products in order to arrive amongst the first on non-mature markets with a high probability of penetration.



- To absorb the enormous fixed costs of quality production on a volume sufficiently important to attain production costs in line with those of international competitors, notably Asian.
- To retain the production know-how at the top level, this is the only guarantee of a complete mastery of all these crucial KETs steps on European soil.
- To develop an industry for advanced manufacturing generating a source of export revenues, and support the downstream producers of machinery capable to produce the most advanced manufacturing technologies in Europe (machinery, software, services, etc.), as well as the development and improvement of manufacturing systems (technology and processes) in order to build efficient, modern and high technology manufacturing facilities in Europe.
- To master the whole product life cycle, from resource efficient and energy saving production to recycling processes.

The role of globally competitive fabrication facilities at large volumes where economy of scale is required is therefore very important to nourish economic eco-systems, in particular with regard to SMEs, which act as sub-contractors and suppliers to downstream industry users. Only significant fabrication facilities will have the integrated capacity of technologies and product development to be able to react to the international competition and follow the rapid renewal dynamics in the field of KETs-based products. The improvement of framework conditions for KETs will also encourage dynamic markets for KETs.

The crossing of the "valley of death" in the KETs can therefore be imagined in the following manner in constructing a European bridge comprising three pillars:

- The technological research pillar based on technological facilities supported by research technology organisation;
- The product development pillar based on pilot lines anddemonstrator supported by industria consortia;
- The competitive manufaturing pillar based on globally competitive manufacturing facilities supported by anchor companies.

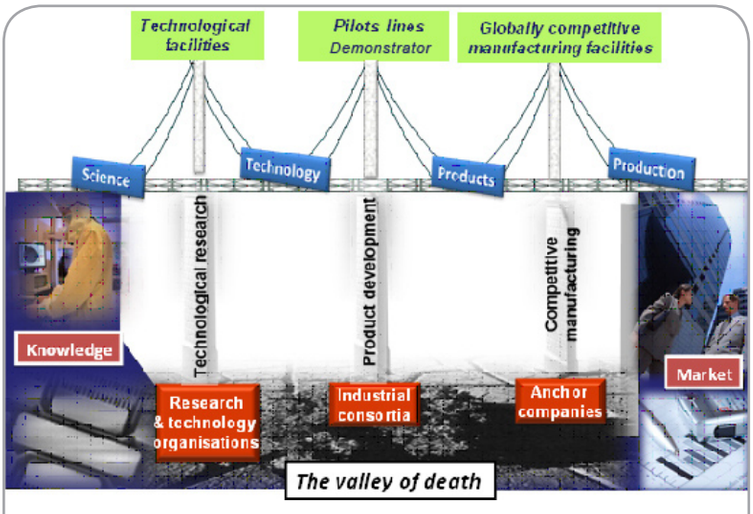


Figure 13: A European integrated initiative to pass the KETs "Valley of Death"

This bridge, illustrated in Figure 13 opposite, would be supported at one end by the European knowledge reservoir and would arrive at the other end on worldwide global markets, therefore becoming the bridge between knowledge and the market.

This crossing of the "valley of death" presupposes appropriate framework conditions; in particular that current EC financial, legal and commercial support measures would be adapted in order that European technologies KETs could be successfully developed, deployed and protected, that enterprise and especially SMEs could develop, that local innovation ecosystems could be born and grow, that the products could benefit from standardization activities, that emerging markets could be privileged and that the rules of international commercial engagement could guarantee a fair competition between producing nations at world level. It is therefore a complete political and regulatory environment which needs to be put in place in order that the efforts made across the three pillars would be crowned by success. Recommendations leading to the creation of such an environment are detailed in Chapter 4.

o Triggering a virtuous cycle

The three pillar bridge will trigger a virtuous cycle of innovation and economic development. The flow from knowledge generation to market enables companies to successively pass:

- From basic science to technology by the technological research stage;
- From technology to product by the product development stage;
- From products to large scale production stage by competitive manufacturing stage to have access to global competitive markets.

The return flow from market to knowledge generation closes a virtuous cycle leading to a competitive growth and in turn also facilitating a market pull.

In particular:

- It is only based on market experience feedback that one can acquire a true understanding of user needs and therefore the relevant specifications of future products. It is also this large volume production that ensures a significant return on investment for Europe in terms of orders, employment and taxes, thus enabling a harmonious societal development.
- From this feedback loop, products arising from the demonstration phase will have been correctly specified, they will naturally find an optimal usage value which will in turn lead to a relevant demonstration. The return on investment of this stage is therefore de-facto guaranteed.
- The product evolution expected by consumers having been identified, it is therefore easier to identify the technologies in gestation or to initiate the technological developments required to address the technological breakthrough needed. The level of relevance of the technology is in turn improved significantly along with its chances of future exploitation.
- Finally the technological developers can, in turn, identify the most relevant ideas in the knowledge reservoir arising from the European fundamental research. This research base will therefore become more "useable" and more "useful" thereby ensuring a return on investment at its proper level.
- At the same time, early feedback from the manufacturing community will allow European industry to understand and identify new possible product specifications. This is only possible if these communities remain in Europe. Such a virtuous cycle constitutes a solid bridge which links the basic science to the global market.

The combined KETs sectorial SWOT and value chain analysis identified a double condition for sustainability: technological capability and manufacturing capacity.

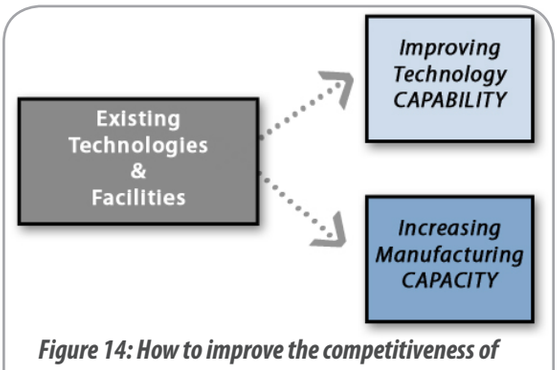
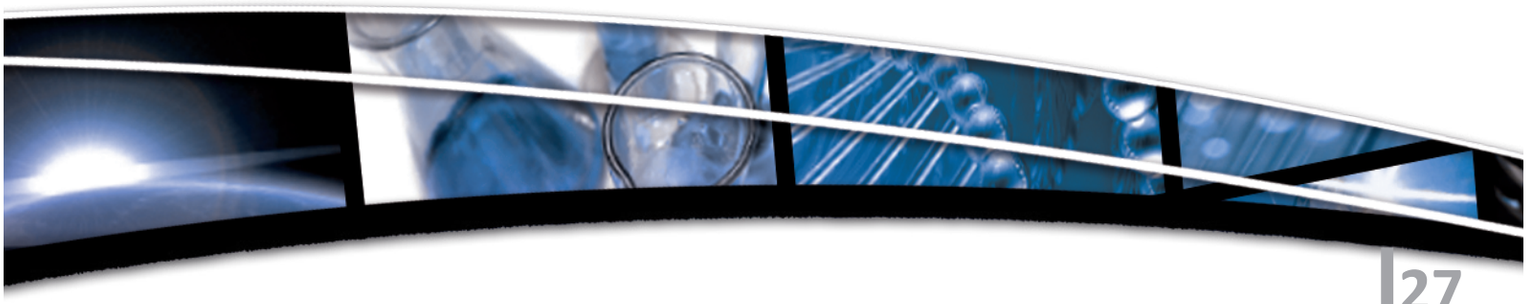


Figure 14: How to improve the competitiveness of European KETs

Therefore, KETs competitiveness improvement must follow two combined routes within the overall KETs integrated strategy as shown in Figure 14 :

- improving technology capability mainly supported by public investment;
- improving manufacturing capacity primarily supported by private investment. Returns on investment in Europe due to the increasing manufacturing capacity of existing companies and the attraction of international investment, will ensure the sustainability of the actions.



CHAPTER 4:
RECOMMENDATIONS FOR THE DEVELOPMENT AND DEPLOYMENT OF KETS IN EUROPE TOWARDS A COMPETITIVE EUROPEAN INDUSTRY

There is a common understanding among the HLG and EU stakeholders that KETs are of crucial importance to the European economy, its future competitiveness and its capability to face grand societal challenges. As demonstrated by the HLG, they underpin European value chains in strategic areas and accelerate innovation in our industrial base.

The HLG has examined the major policy areas which influence the successful implementation of the three pillar bridge strategy. Whilst many policy areas reviewed in this KETs exercise impact the KETs landscape in Europe, the High Level Group has decided to focus on a small number of areas which require specific and urgent attention HLG. The recommendations are grouped under the following headings:

4.1. A single KETs and fully-fledged innovation policy at EU level
4.2. A comprehensive strategic approach to a KETs policy at EU level
4.3. Combined financing to promote RDI investments in KETs
4.4. Globally competitive IP Policy
4.5. Education and skills
4.6. Follow up

4.1. A SINGLE AND FULLY-FLEDGED KETS INNOVATION POLICY AT EU LEVEL

o An integrated KETs policy at EU-level

For Europe to succeed in the deployment of KETs in EU industries, to maintain its global technological leadership in the coming years, a single integrated KETs policy has to be implemented, that supports the development and explotation of KETs accross the value chain from science to market deployment and which recognises the importance of facilitating the integration of KETs, which in essential to create technology-based products and services.

For such a policy to succeed, it is vital to position KETs as a technological priority for Europe and to align the EU's main political and financial instruments in the next financial perspective consistently with the goals of EU 2020 to achieve this goal. In particular this must be reflected in the upcoming Common Strategic Framework for Research and Innovation Financing, Horizon 2020 (CSF), the instruments related to the EU's Regional Policy and the policies of the European Investment Bank group.

Such policy coordination would reverse current trends and make the EU attractive for KETs industry and investors in competitive manufacturing facilities, generating growth and jobs for Europe.

More precisely, the following should be envisaged:

- A distinct "KETs box" should be established within the CSF Competitiveness Programme, to enable common and integrated calls for all KETs with KETs specific rules in the calls, such as value chain correctness, etc. ;
- KETs should be identified as a clear investment priority for regions within the ESF and the ERDF Research and Innovation category notably in the context of the concept of smart specialisation;
- The EIB/EIF should pro-actively support KETs-related projects through its financial instruments and clearly identify such RDI and manufacturing projects, with a KETs label, in line with Commission policy.

Recommendation n°1: Make KETs a technological priority for Europe

The High Level Group recommends that an integrated KETs policy should be implemented, that KETs should be visibly prioritised in EU policies and financial instruments and that the European Investment Bank group should pro-actively support KETs initiatives in Europe.

o Implementation of the three-pillar-bridge

The High Level Group has identified three priority recommendations to address the implementation of the three pillar bridge strategy:

- A full and simultaneous implementation along the innovation chain[30] applying the TRL chart;
- Adaptation and clarification of the R&D definition to take into account the explicit inclusion and systematic application of Pillar 1 and 2 R&D activities;
- Rebalancing of EU RDI funding programmes towards Innovation activities, in particular in the CSF programme.

o Applying the technology readiness levels (TRL)

The internationally recognised and industrially applied concept of "Technology Readiness Levels" (TRL) outlines in detail the different research and deployment steps, which support the innovation and industrialisation process of technologies to transform ideas to the market.

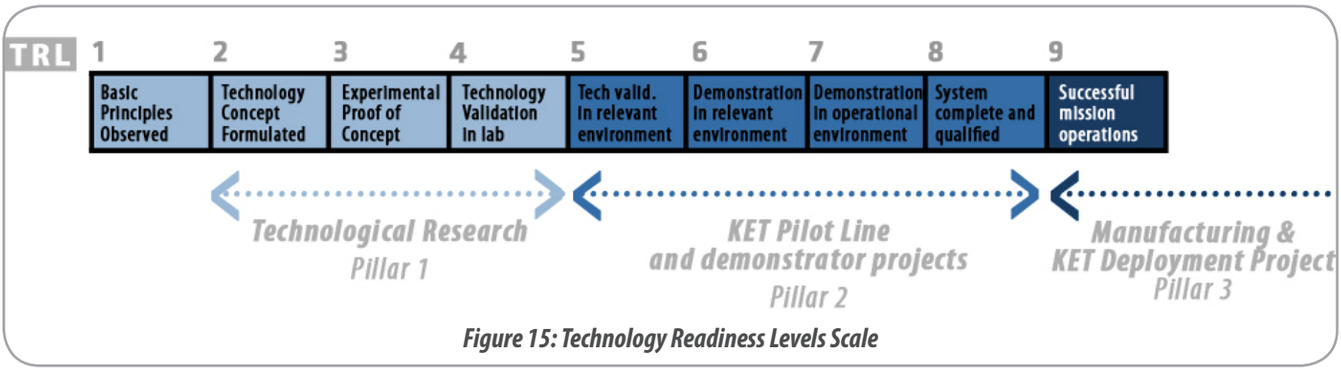


Figure 15: Technology Readiness Levels Scale

The TRL concept fully applies to the three-pillar-bridge approach. As indicated in the above graphic, level 1 concerns basic research, levels 2 - 4 describe the activities of technological research (pillar 1), and levels 5 - 8, product develpoment (i.e. process technology development in pilot lines, prototyping, and demonstrators actions - pillar 2). The future KETs programme in the CSF should include an "integration initiative" for these platforms to create European-added value through coordinated access for external stakeholders and collaborative development support actions. The deployment of KETs with manufacturing activities starts at level 9. The future KETs programme in the CSF should fully and simultaneously support all these activities up to and including level 8 along with the supporting infrastructures (technological platforms and pilot lines along with first-in-kind equipment and facilities).

Recommendation n°2: The EU should apply the TRL scale R&D definition

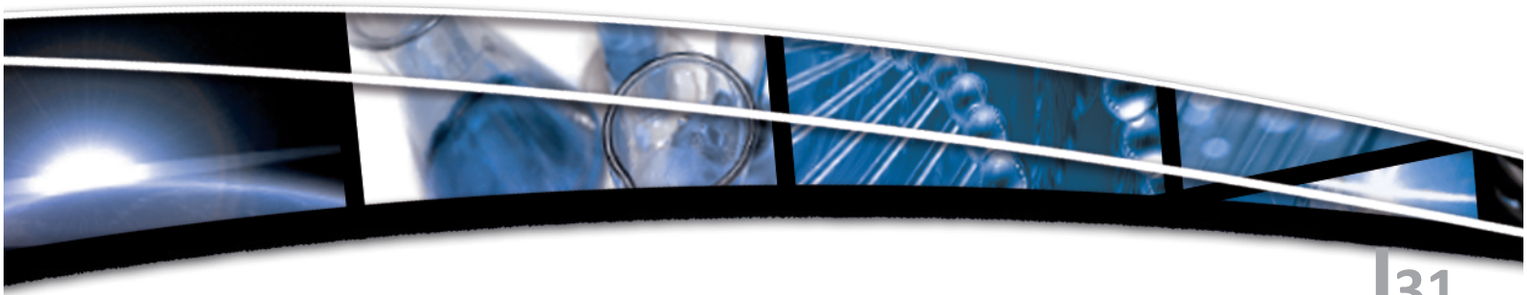
The High Level Group recommends the EU to align its RDI activities on the TRL scale in line with the OECD definition. The Commission should also systematically apply this definition in order to include technological research, product development and demonstration activities within its RDI portfolio.

o More adapted application of R&D definitions

The OECD has provided authoritative definitions for R&D and Innovation in the Frascati and Oslo Manuals[31]. In the

30. **"Innovation chain"**: a term used in various political debates to describe the way from research to innovation up to competitive manufacturing with players such as academia, RTOs, industry, public sector. This is actually synonymous to the KET Bridge across the valley of death.

31. An agreed taxonomy for classifying public investment in research and innovation, to enable effective international data gathering and comparison. These definitions form the basis of WTO and EU rules on subsidies.



context of these references, a fully-fledged definition of R&D has to cover three aspects that can be related to the three pillar bridge model proposed by the HLG KET:

- Fundamental research, knowledge science, required to firmly anchor the bridge;
- Technology development, strengthening Pillar 1;
- Product development including process, technology, and prototype development strengthening Pillar 2.

A definition for these three aspects of R&D can easily be formulated by paraphrasing existing definitions as outlined in the Frascati Manual:

- Experimental and/or theoretical work undertaken to acquire new knowledge of the underlying foundation of phenomena and observable facts, either as a goal in its own right or directed towards a specific practical aim or objective.
- Systematic work that translates acquired knowledge into technology and that is directed towards developing new materials, products, processes or services.
- The further elaboration of the thus developed technologies and methods to achieve stable processes yielding reproducible prototype products and/or value adding and allowing the design of state-of-the-art equipment. (Note however that projects that have a significant market impact and generate substantial revenue are not covered.)

Recommendation n°3: Fully exploit the scope of relevant R&D definitions

The High Level Group recommends that the EU should apply R&D definitions in its programmes which support the full and simultaneous implementation of the three pillar bridge model along the innovation chain, from basic research, through technological research, product development and prototyping up to globally competitive manufacturing.

o Rebalancing of EU RDI funding programmes

In order to implement a fully-fledged EU programme on KETs, financial resources need to be re-allocated. Currently, the largest part of funding within the 7th Research Framework Programme (FP7) in the area of KETs is dedicated to basic research projects – the resources for applied and development research are notably insufficient. Within the Competitiveness and Innovation Programme (CIP) only a very small budget and number of projects are dedicated to product demonstration activities for KETs. This should be significantly increased.

Europe's main trading partners in North America and East Asia, have shifted the focus of their resources towards applied research and product development activities (further details in chapter 2). The HLG considers that in the next financial perspective the EU should prioritise its funding in the area of KETs for pillar 1 (technological research) and pillar 2 (product development including pilot lines, prototypes and demonstrator activities).

Pilot line activities are approximately 5 to 10 times more expensive than other R&D activities, depending on the respective KETs domain. The re-balancing in the EU resource allocation therefore has to be significant, not only to take account of the new focus but also because high costs of prototypes and pilot lines.

Recommendation n°4: Rebalancing of EU RDI funding programmes

The High Level Group recommends that the EU and Member States firmly rebalance their RDI funding in KETs-related programmes towards technological research, product development (including pilot lines, prototypes, first-in-kind equipment and facilities and demonstrator activities). In particular in the future CSF, the EU should set indicative targets for the percentage of funding dedicated to basic research, technological research and development activities.

4.2. A COMPREHENSIVE STRATEGIC APPROACH TO A KETS POLICY AT EU LEVEL

The EU KETs policy should be forward-looking and driven in a long-term perspective. It concerns the innovation capabilities of EU industries in the next decade and beyond. Such a policy needs a full strategy involving all stakeholders - private and public - at European, national and regional level, and must encompass all relevant policy instruments.

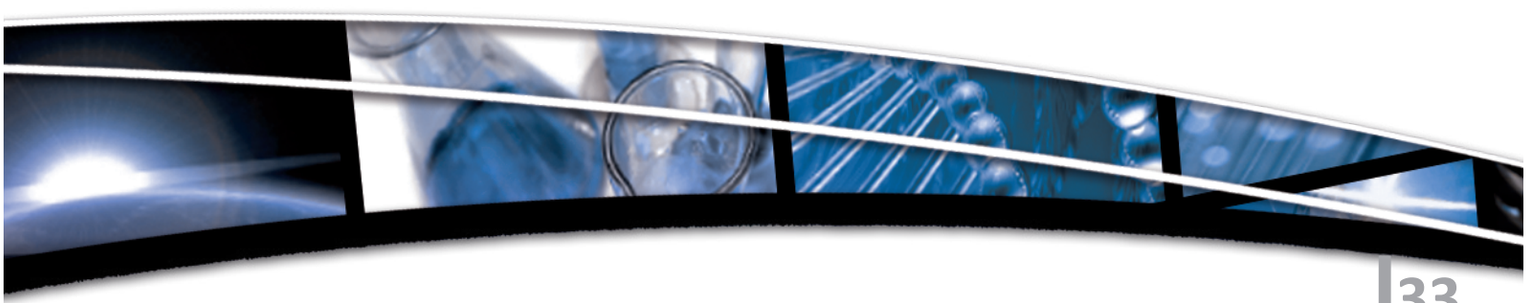
The Commission, in cooperation with Member States, should design such a KETs-strategy with a vision of the EU's future position in a global context. Such a strategic policy approach can only reinforce the Europe 2020 strategy.

In the context of the ongoing reflections on the future EU programmes and financial perspectives, the HLG has deliberately not elaborated a comprehensive set of recommendations for implementing a fully-fledged strategy, in particular with regard to the role of Member States. Rather it has focused its reflections on the future CSF and the regional aid instruments (ERDF, ESF), given the urgency of such input to the EU discussions. In this regard the HLG believes that a strategic and industry-driven approach should be followed in the CSF including :

- A new political approach and governance that simultaneously incentivises innovation and cooperation, both through frameworks policies and funding, at crucial stages of European value chains;
- The governance of KETs programmes should prioritise projects involving different KETs;
- The involvement of industry in the design of the programmes and evaluation procedures of projects should be strengthened to reach a minimum 50% participation in the respective committees;
- The implementation of KETs-programmes should be done by tender-like calls with detailed specifications and flexible funding combinations whilst requesting specific industrial commitments;
- All current RDI programs and instruments should be reviewed and tested according to their future suitability to actually support the goal of enhancing innovation in the European Union.

A wide range of public policies have an impact on the competitive position of the EU, and influence the level and direction of innovation and technology development, and the scale and operation of markets for these products. If the EU is to remain a globally competitive location for the development and commercial exploitation of KETs, and to capture a significant part of the value chain related to these, it will need to develop mechanisms that can effectively co-ordinate a range of key policy areas for KETs. These include:

- Ensuring that regulation does not prove a barrier to KETs, and using future-focused regulation and regulatory approaches (e.g. to support projects such as the implementation of smart grids in the EU, or in the area of environmental standards and waste recycling for new materials) to encourage the development and adoption of KET-based products and services;
- Better integrating standardisation and research in order to use standards to drive markets and build consumer confidence;
- Making greater use of public procurement mechanisms to support demonstration projects and for the public sector to act as a first customer for KET-based products (e.g. Solid State Lighting);
- Ensuring a fair access to raw materials through fluid and transparent international markets and developing adequate strategies for systainable production and use of critical raw materials.
- Using multilateral and bilateral trade negotiations to open markets for EU companies, to reduce unfair subsidies, and using trade defence mechanisms to protect EU companies from unfair trade practices.



Recommendation n°5: A strategic approach to KETs programmes

The High Level Group recommends that the European Commission defines and implements a strategic, industry driven and coordinated approach to KETs programmes and related policies across EC RDI funding programmes and instruments (CSF, ERDF).

o The implementation rules of the CSF

These rules are of key importance to the design, governance and evaluation of KETs programmes and policies and to select the appropriate projects, that maximise their impact on European value and innovation chains, have the most potential market relevance and increase industry participation. A new criterion on "value chain correctness" should therefore be introduced.

Value chain correctness

The tender applicant should propose a business model with an analysis of the value chain, showcasing the exploitation of the project result. The consortium should consequently include partners from upstream and/or downstream industries utilising instruments similar to the current Coordinated Support Actions (CSAs), to initiate broader cooperation along the value chain. Critical parts of the value chain sectors (upstream and/or downstream) have to be actively engaged in the governance of the programmes/projects to ensure engagement along the value chain. This engagement needs to be continuously monitored by public authorities throughout the project (not just upfront in the planning stage).

Criteria for industrial pilot lines and demonstration projects

Regarding research and development activities in pilot lines of the innovation chain, where decisions are targeted at higher investment in specific locations, the European added value should be guided by the smart specialisation policy. With regard to KETs pilot line projects specific criteria should be included in the selection process of calls, taking into account their proximity to the market and the willingness to amplify impacts. A proposal for such criteria and stakeholder commitments is made in Annex 6.

The attractiveness of the CSF, notably for SMEs, will depend on costs for project applicants. Firstly, for the success of KET pilot lines and KET demonstrator projects, fast processing of proposals is needed; "Time-to-contract" should be reduced to no more than 6 months. Project implementation could be simplified and made more flexible by defining performance indicators for different stages of projects, as currently practised with the reward system of the EU's Marco Polo programme. Such a system would make undertaking each stage conditional on the success of the previous one in order to facilitate the re-orientation of projects during their development, or their abandonment at an early stage, if required.

Recommendation n°6: Establish an appropriate set of rules to implement KETs programmes

The High Level Group recommends that the European Commission adapts its selection criteria and implementation rules in the CSF programme to maximise its impact on the value and innovation chains. In particular, a "value chain correctness" criterion should be added.

4.3. COMBINED FINANCING TO PROMOTE RDI INVESTMENTS IN KETS

In times where public resources are under severe constraint, it is all the more important to exploit synergies between different funding mechanisms to allow for their most efficient use. Typical pilot line expenditures in the KETs domain range from 10 million to several hundreds millions of EUROS, including both investments (Capex) and operating costs (Opex) and even higher for microelectronics. Such very high costs require the establishment of mechanisms,

which combine funding from different resources, i.e. from public and private actors as well as from different public funds (European, national and regional). Currently, no tripartite funding mechanism offers the flexibility and the efficiency required to meet industrial needs in the EU. Such a tripartite approach is thus necessary.

Some basic principles with regard to tripartite funding mechanisms should be respected:

- The outcome should be jointly defined by all partners;
- The commitment to fund should be made simultaneously by all partners through fast decision making process on a case by case basis, for each project;
- In return for public support, industry should — apart from adequate private financing — make commitments such as, for example to create jobs, involve EU lead customers and/or suppliers (preferentially SMEs) to ensure European added value, use of pilot line for appropriate skills / education training, install pilot lines and establish manufacturing facilities in Europe;
- Public support costs (from the taxpayer's point of view) should be compared with expected economic return.

With regard to combined EU funding mechanisms, the HLG also draws attention to the need to allow, where appropriate, the combining of funds from different EU sources (e.g. CSF and ERDF) as long as the maximum state aid levels are respected. This refers notably to Art. 54 (5) ERDF that should be adapted to allow the combining of contributions from various EU funds.

The Commission should consider how all Member State funding could be recognised as a contribution to a project.

For the KETs strategy, it is of great importance to ensure that all actors, including SMEs and large enterprises as well as research organisations, along the value chain are covered through the eligibility criteria for future EU funds.

Recommendation n°7: Combined funding mechanisms

The High Level Group recommends that the EU should introduce a tripartite financing approach based on combined funding mechanisms involving Industry, Commission, and national authorities (Member States and local government), when required by the high costs of the KETs RDI projects, and put in place the appropriate program management and mechanisms to allow the combination of EU funding (CSF, structural funds), to enable the optimum investment in significant KET pilot line and manufacturing facilities across Europe.

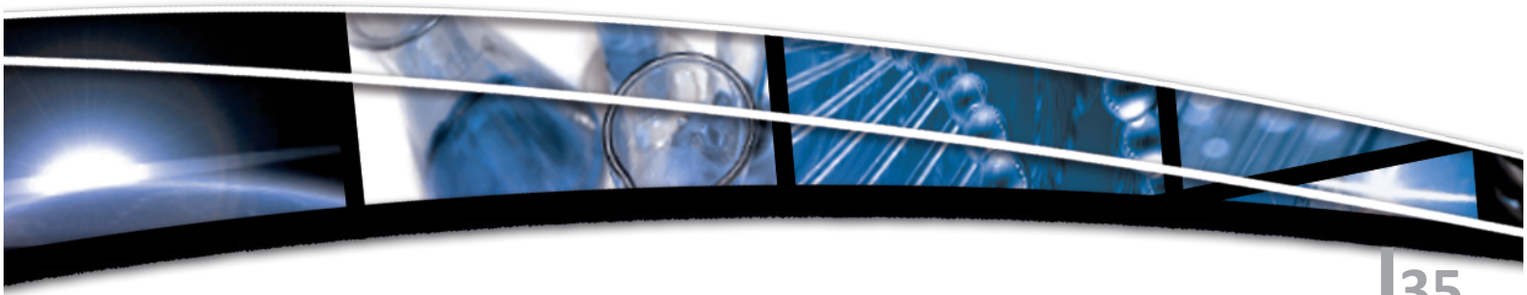
o Adapted application of state aid rules

KETs are by nature technology and skill-intensive. The innovation chains bridging the gap between the scientific knowledge and the market are complex and risky. Their enabling nature leads to positive externalities that cannot be captured by private stake holders. Their strong contribution to the competitiveness of regions has lead to focused policies and strategies by competing world regions (notably the US and Asia) based on public support which impacts the global level playing field and may create competitive disadvantages for EU companies.

Competition-distorting state aids must primarily be addressed in the international context of the WTO frameworks, other international institutions such as the OECD and G20 as well as in the bilateral free-trade agreements. However, a long time may pass before effective implementation of such standards. Furthermore procedures under these agreements can be time-consuming and no interim legal protection exists. In this context, public support, notably state aids, are required in the EU. Without changing the current practice of the EU state aids policy, the HLG considers that the KETs specificity require some adaptation of these rules.

Matching clause

A matching clause, analogous to that contained in the EU Framework for State Aid for Research and Development and Innovation, should be introduced in the general EU state aid rules to allow Member States to match funding up



to the maximum levels of support provided elsewhere for product development and manufacturing activities while respecting WTO rules. Such clauses may not serve to balance differences in general economic conditions between countries but rather to counter significantly higher state aids by third countries resulting in an unfair distortion of international competition. The introduction of matching clauses could also be considered at the occasion of the prolongation of the relevant state aid frameworks for regional and environmental state aid which are due to expire at the end of 2013 and 2014 respectively.

Thresholds for notifications

The costs of projects envisaged in the KETs policy may be significantly higher than current FP7 projects. To reduce administrative burdens, and avoid notifications of too many projects, the current thresholds for project notifications in the General Block Exemption Regulation (GBER) should be increased in particular for experimental development and industrial research to €20 million (in alignment with current thresholds for fundamental research).

It would also be useful to align the existing definitions in the RDI framework and consequently GBER, to the CSF in order to take full account of product development activities such as pilot lines and demonstrator programmes.

The current *decalage* system[32], or scaling-down mechanism is an active disincentive for any larger-scale investments and should therefore be discussed with a view to its removal in the review of the regional state aid rules in 2013.

Notification procedures

A simplification and streamlining of the procedures relating to State Aids notifications is also required to cut the time for deciding cases and applying block exemption rules to projects within a programme. A fast decision-making process is necessary to raise Europe's attractiveness for manufacturing investments. The aim would be to cut the decision time to 2-3 months in most cases, notably by avoiding repetitive requests for information. To achieve this objective, an improvement of mutual understanding by all involved parties of required information is essential. From the launch of the notification procedure, onwards all participants (European Commission, national and regional authorities and beneficiaries of the support) should be involved in all stages of the negotiations.

Additionally and independently of the instruction of any cases, the business community needs to better understand the data needed, the purpose of their use and the rationale of the compatibility assessment. This could be facilitated through explanation meetings organised by the Commission and better alignment of concepts between the EU authorities and the business world. The data to be provided by the proposed EU monitoring mechanism on KETs may contribute to the assessment.

Project of common European interest

The EU should consider how to use the rules of Article 107 (3)b TFEU to support large scale open-access technology development, testing and demonstration facilities, including pilot lines and demonstrators in KETs where these would make a significant contribution to strengthening EU competitiveness (see box below).

Project of common European interest

Article 107 (3)b of the TFEU permits "aid to promote the execution of an important project of common European interest or to remedy a serious disturbance in the economy of a Member State". This article allows projects to be funded outside EU programmes and financial limits in exceptional circumstances. However, projects funded via this mechanism are still subject to WTO disciplines and could be made the subject of a WTO dispute. Projects also need political agreement amongst Member States. Therefore, this mechanism needs to be used sparingly, although it could be a means of supporting key projects that will build technology capability or help to create new markets for products and services. For example, this could be a mechanism that could fund large scale demonstrators of new manufacturing technologies (e.g. pilot lines) or KET-based applications that would prove these technologies can be deployed on a large scale and thus create lead markets for these in the EU.

32. Guidelines on national, regional aids for 2007 – 2013 (2006 / C 54/08)

Recommendation n°8: KETs state aid provisions

The High Level Group recommends that the EU adapts state aid provisions to facilitate RDI activities and large-scale investment in KETs, in particular through the introduction of a matching clause in the EU state aid framework across the board, review of the scaling-down mechanism for larger investments increased thresholds for notifications, faster procedures and the use of projects of common European interest.

4.4. GLOBALLY COMPETITIVE IP POLICY

Economic benefits flow from the wide adoption of innovation therefore efforts to increase the positive impact of public investment should be a constant objective of policy. In the case of KETs, this could be achieved by ensuring that project results are commercially exploited and trigger manufacturing within the EU.

Current EU programme rules (e.g. Annex 2 of general conditions relating to FP7) do not provide an adequate incentive in this regard. Indeed, the application of the various clauses of EC's general conditions, results in low level patent filings and licence agreements after FP7 projects along with low percentage of exclusive licences: < 10%.

The HLG considers that the EU rules for participation in the CSF should be strengthened in order to better protect the technological knowledge of the EU. Generally, the EU should clearly promote an "in Europe first" IP policy. At the start of any project, consortium partners should have to demonstrate in their proposal that they have a clear IP plan for both the ownership and first exploitation of IP resulting from the project within the EU.

At the end of any project, rules should be implemented to favour the EU exploitation of the results of projects.

- For example, the European Commission should have discretion over whether to allow a Public Research Organisation or an industrial company to license such results to a non-EU party and to decide whether reimbursement of all or part of the funding received for the R&D project was required within a reasonable timeframe. Moreover, it should not be possible to sublicense the access rights of industrial companies to the results of the other partners of the consortium. The affiliates' definition should also be restricted to European affiliates in order to avoid circumvention.

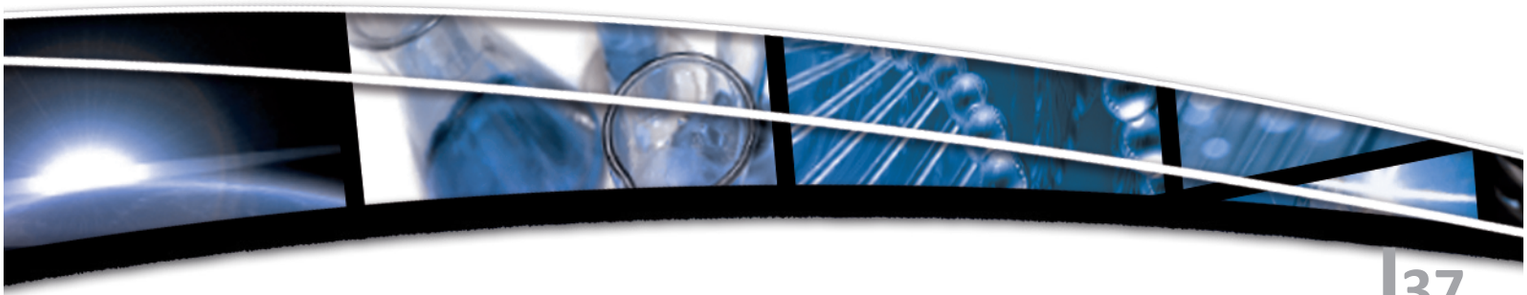
- Unless otherwise agreed, licenses from public laboratories should only be granted to European based manufacturing industries. In this context, the example of US policy is instructive. A delegation from the European Commission, comprising representatives from DG Research and DG Enterprise & Industry visiting the USA in 2007 highlighted that overall the Bayh-Dole act appeared to have a significant positive effect: *"In our opinion the BDA helps to explain the dynamic and efficient system of knowledge and technology transfer from research to the market place in the United States"*[33].

The implementation of the above rules will require detailed consideration to maximise the EU added value with respect to the industrial strategy of the research organisation involved.

Recommendation n°9: Globally competitive IP policy in Europe

The High Level Group recommends that the selection criteria and terms of the consortium agreements of EU RDI funding programmes should be amended to ensure that participating consortia have a clear and explicit plan for both the ownership of and first exploitation of IP resulting from the project within the EU. It should explicitly include provisions similar to those of the "Bayh-Dole Act" and "Exception Circumstances"-like provisions to encourage the first exploitation and manufacturing of products based on this IP within the EU.

33. Proton Europe: Experiences on the US knowledge transfer and innovation system, April 2007. available at http://www.proinno-europe.eu/sites/default/files/page/10/07/US-knowledge-transfer-innovation-system.pdf.



4.5. EDUCATION AND SKILLS

In order to exploit KETs technological fields and their industrial dimension, new skills and competencies will be necessary. Exploitation of KETs synergies and crossing the boundaries towards KETs trans-disciplinarity requires competencies that current linear training and education cannot supply. These new skills have to be sought at different levels maths, science and technology should be further promoted at second level. Academia and training institutions should devise mechanisms to offer KETs training and education since the supply of skilled workforce at all levels is already lacking today. At the same time, research and engineering skills will have to adapt to satisfy KETs needs. In particular, competencies to satisfy the build-up of the different pillars will be required.

Regarding KETs human resources two gaps have to be filled. One is related with the need to know what interdisciplinary competences are required for KETs in terms of future industrial needs. The second is quantitative and consists in assessing the numbers of engineers and scientists required at European Level in order to supply future European industrial needs. In both cases, the gap should be filled by assessing what is required and what exists. The EU should define and implement the procedure to make this diagnosis and apply the appropriate measures to fill these gaps. Instruments are needed to provide the education and skills of the future KETs engineers. To reach these objectives, the HLG recommends promoting KETs skills within the framework of the ESF.

The HLG also recommends creating a European Technology Research Council (ETRC) to promote individual excellence in technological focused engineering research and innovation (similar to what the ERC does for pioneering fundamental research scientists). Here the goal is to create a future world class cadre of engineers and technologists to ensure European competitiveness. Europe should produce at least one world-class research engineer or technologist for every fundamental research scientist. A significant rebalancing of output is required to underpin the innovation called for in Europe 2020.

Recommendation n°10: Build, strengthen and retain KETs skills

The High Level Group recommends that the EU should create a European Technology Research Council (ETRC) to 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.

4.6. FOLLOW-UP

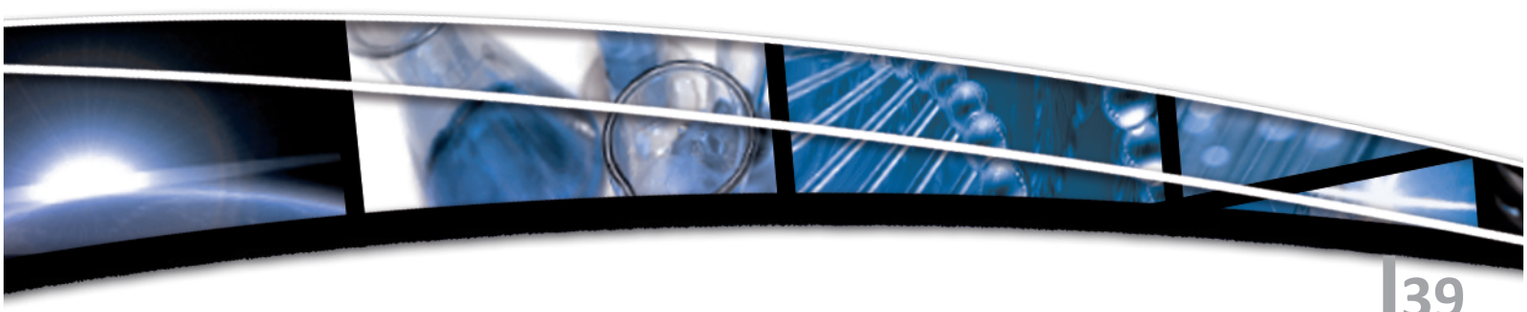
The High Level Group has noted through its work an ongoing and urgent need for stakeholders to have relevant information on KETs to inform strategy and decision making. More hard data is needed on KETs to provide EU, national and regional policy makers with information to better develop and implement policy frameworks regarding the deployment of KETs. The elaboration of relevant information will be required to assess and evaluate the situation and in particular to monitor KETs value chains in Europe and other key regions in the world.

For that reason the HLG recommends the establishment of an European observatory monitoring mechanism. It should aim at providing relevant information / data on KETs to enable better development and implementation of policies regarding the deployment of KETs by European decision-makers, including Member States, regional authorities and industry. It should analyse the situation with regard to KETs deployment by establishing a methodology to assess the situation in the EU and applying it to benchmark the EU with regard to the rest of the world. The follow-up of EU and international policies (trade, regulation, subsidies and fiscal policy) in the area of KETs should be included. This monitoring mechanism could sound the alarm if the situation is deteriorating and be used as a tool to identify complementary policy measures. A report should be published by the Monitoring Mechanism on a regular basis to assess the situation.

The HLG also considers that the Commission should consult the main stakeholders on a regular basis in order to constantly interact and receive feedback on the development and implementation of the EU KETs policy.

Recommendation n°11: A European KETs observatory and consultative body

The High Level Group recommends that the European Commission establishes a European KETs Observatory Monitoring Mechanism tasked with the mission of performing analysis and a "KETs Consultative Body" comprised of stakeholders across the entire innovation chain to advise and monitor the progress in Europe of the HLG KET recommendations towards the development and deployment of KETs for a competitive Europe this should include all relevant data regarding policies and strategies evolution outside EU.



APPENDICES

1. EUROPEAN COMMISSION TERMS OF REFERENCE SUGGESTED GENERAL WORKING METHODS HIGH-LEVEL EXPERT GROUP ON KEY ENABLING TECHNOLOGIES (HLG KETS)

o General Remarks on the High-Level Group

As foreseen in the Communication from September 2009, the aim of the HLG is to assess the competitive situation and existing public and private R&D capacities of the relevant technologies, develop a detailed strategy and recommend appropriate policy measures with an associated roadmap for a more effective deployment of KETs in Europe. As such, the KETs form part of the new EU2020 strategy and are highlighted under two EU flagship initiatives, namely the "Innovation Union" and "An industrial policy for the globalisation area".
The creation of the HLG has generated a high level of interest and is expected to deliver solid results. The members of the HLG have been chosen primarily from among those nominated by industry and research associations in close cooperation with other Commission services. In doing so the European Commission sought to achieve a balanced overall composition based on broad representation, knowledge and the experience of the candidates while keeping the size of the HLG to a manageable level.
The HLG will closely follow existing EU policies in the related field and cooperate with other bodies dealing with innovation and technology such as the European Institute of Innovation and Technology (EIT), European Technology Platforms and Joint Technology Initiatives.
The HLG will ensure that the positions of all the different stakeholders are duly taken into account and work towards a consensus around a supportive environment for KETs.

o Tasks of the HLG

The HLG is tasked with proposing a long-term strategy and concrete actions to improve deployment of KETs in the EU and to strengthen Europe's industrial competitiveness. It will evaluate current difficulties, strengths and weaknesses as well as the potential for deployment. It will focus its work on the KETs identified in the Commission communication, i.e. nanotechnology, micro- and nano-electronics, advanced materials, biotechnology and photonics along with advanced manufacturing technologies as a cross-cutting KET, to be discussed at the HLG. However, this selection is not necessarily final, the HLG will also assess KETs to address societal challenges such as Climate change (Carbon Capture and Storage).
The measures recommended by the HLG are expected to address the policy issues identified in Chapter 4 of the Communication, namely innovation, technology transfer, joint programming, state aid, climate change, public procurement, international cooperation, trade policy, financing and skills. In concrete terms the Communication asks the HLG to:

- Assess the competitive situation of the relevant technologies in the EU with a particular focus on industrial deployment and their contribution to address major societal challenges;
- Analyse in depth the available public and private R&D capacities for KETs in the EU (on all levels); and
- Propose specific policy recommendations for a more effective industrial deployment of KETs in the EU.

o Working Methods and Structures

The High Level Group

The HLG should hold its meetings in Brussels. The meetings will be opened by the European Commissioner responsible for Enterprise and Industry in cooperation with the Commissioners in charge of the European Digital Agenda as well as Research. Up to three meetings are anticipated – kick-off, mid-term and final.
The HLG will deliver a mid-term report six months after its first meeting. A final report will be delivered to the Commission no more than six months later.

The detailed working arrangements and the creation of ad hoc sub-groups will be prepared by a Sherpa group and decided by the HLG itself. The Commission staff will provide the secretariat and logistical support as appropriate. Use of teleconferencing and email is encouraged.

The Sherpa Group

Each member of the HLG will nominate a personal representative to the Sherpa Group.

Representatives are expected to be of a high level, able to represent individual stakeholders, national authorities, industry associations, etc. Acting under the HLG's strategic direction and the overall coordination of its own Chairman, the Sherpa Group will focus on the effective preparation of the specific tasks laid down in the Communication.

In particular, the 'Sherpa' Group's job will be the hands-on preparation of the detailed assessments, analyses and policy recommendations as foreseen in the Communication. This includes agreeing on the operational mandate of the HLG, drawing up a Work Programme and ensuring the set-up and the proper functioning of the technology-specific working groups.
The Sherpa group will meet once per month in Brussels.

The Working Groups

Vertical analysis (phase 1):
It is expected that the detailed work input of the HLG will initially be carried out during the initial six months in ad hoc thematic working groups on each of the 5 identified key enabling technologies.
For the advanced manufacturing systems, the analysis will be carried out in a two step process:

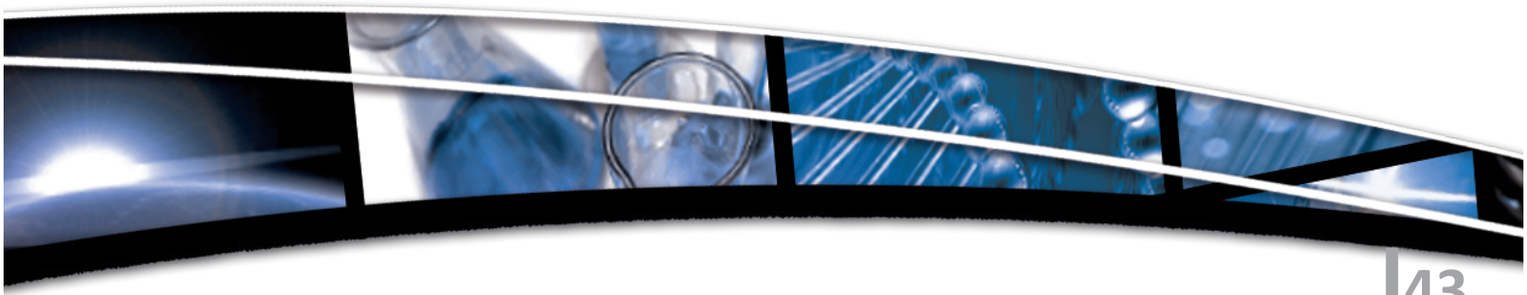
- Firstly, each vertical working group will analyse advanced manufacturing as a specific item in their working group meetings and appoint a specific liaison on the topic to an Advanced Manufacturing analysis team.
- Subsequently, subject to agreement by the Sherpa group, and based on the analysis of the first three months in the vertical thematic groups, an advanced manufacturing systems working group will be established.

The working groups will launch broad based consultations of the relevant European stakeholders through the organization of KET Open Days and a KET Internet Forum.
These analyses should provide detailed 'bottom-up' information on the competitiveness situation in terms of potential, challenges, maturity levels, etc.
Subsequently, after the mid-term report, new ad hoc working groups based on transversal and cross-cutting issues (trade policy, legal market and public procurement, etc.) will be set up. Where appropriate, specific workshops on key policy areas will be organized with external experts.

Transversal analysis (phase 2):
For the transversal analysis scheduled for the second period of the HLG KET work, new working groups will be settled on specific policy areas, agreed by the HLG KET. KET Expert workshops will be organised with relevant external (Industry, Associations, Academia, RTOs, etc.) and EC experts.

The Scope of Work of the High Level Group

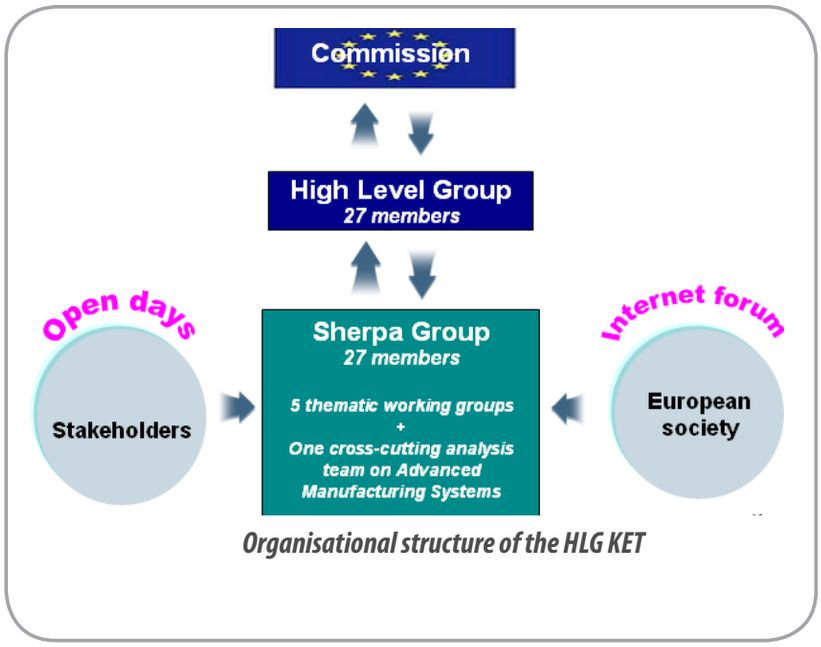
The HLG is expected to provide policy recommendations for further enabling the wide deployment of the most promising KETs in the EU. Policy recommendations using existing instruments for short term implementation as well as recommendations of a more long term nature taking into account the EU 2020. Recommendations for new activities as well as reinforcing existing initiatives are aimed at. Given the different characteristics of the KETs, it can be expected that the HLG recommendation could include a set of horizontal policies applicable to all or most of KETs and a set of specific policies related to the individual KETs unique requirements.



The Commission is particularly interested in concrete recommendations related to innovation and competitiveness policies aiming to improve conditions for industrial deployment in the EU, such as:

i. Identification of the potential scope for closer collaboration between governments, industry and researchers for the wide deployment and commercialisation of KETs, defining and stimulating lead markets, pre-commercial procurement, stimulating public private partnerships.
ii. Identification of promising potential pilot and demonstration projects, first applications and replication projects, with illustrative budgets.
iii. Review of the availability of appropriate financing instruments for the development and industrial deployment of KETs, including direct and indirect state incentives, taxation regimes.
iv. The extent to which appropriate regulatory framework conditions exist to secure an EU-wide Single Market, including health, safety and environmental legislation and technical standards.
v. Identification of potential gaps in terms of skills, higher education and training.
vi. Identification of the scope for potential demand side measures to improve market take-up, including public authorities and SMEs.
vii. Potential for co-operation outside EU, international standard setting, and potential trade policy issues (where relevant).

It is expected that the HLG group promotes and creates a shared long term vision on KETs, creates a sense of partnership, can put KETs high on the political agenda and can gather support for their recommendations for concrete recommendations for policy actions.



Organisational structure of the HLG KET

2. MEMBERSHIP OF THE HLG KET

President

Mr Jean THERME (Director for Technological Research, Director of CEA Grenoble, Director Delegate for New Technologies for Energy CEA, French Atomic Energy Commission)

Members

Prof. Luigi AMBROSIO (President, European Society for Biomaterials)

Mr Giorgio ANANIA (Chairman, Cube Optics)

Dr André-Jacques AUBERTON-HERVE (CEO, SOITEC)

Mr Peter BAUER (President, European Semiconductor Industry Association, CEO, Infineon Technologies)

Mr Andrea BENASSI (Secretary-General, European Association of Craft, Small and Medium-Sized Enterprises)

Dr Daniel BERNARD (Scientific Vice-President, ARKEMA)

Mr Carlo BOZOTTI (CEO, STMicroelectronics)

Prof. Hans-Jörg BULLINGER (President, Fraunhofer-Gesellschaft)

Ms Anne DE GUIBERT (Research Director, Saft Group)

Dr Spase DRAKUL (CEO, THYIA Tehnologije)

Mr. David WILLETS (Minister for Science and Innovation, United Kingdom)

Mr Javier EGUREN (CEO, NICOLAS-CORREA)

Dr Winfried HOFFMANN (President, European Photovoltaic Industry Assoc.)

Mr Jochen HOMANN, (Secretary of State, German Federal Ministry of Economics)

Dr Andre KOLTERMANN (Group Vice-President, Süd-Chemie)

Prof. Erkki LEPPÄVUORI (President, VTT Technical Research Centre, Finland).

Mr Jan MENGELERS (President, Netherlands Applied Scientific Research Org., TNO)

Mr J Richard PARKER (Director, Rolls Royce)

Mr Richard PELLY (Chief Executive, European Investment Fund)

Dr Wolfgang PLISCHKE (Board Member, BAYER AG)

Mr Luc ROUSSEAU (General Director, Ministry for Economy, Industry and Employment, France)

Mr Frank ROZELAAR (Non-executive Chairman, QinetiQ)

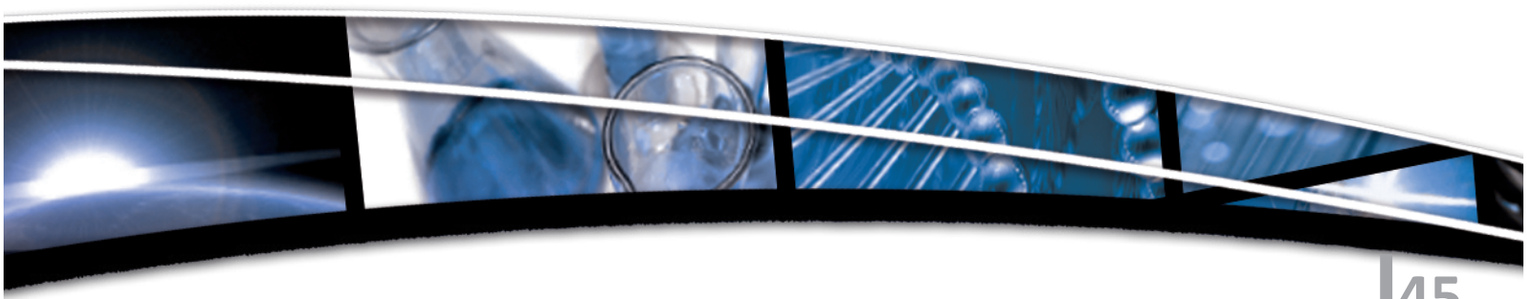
Mr Gerald SCHOTMAN (Chief Technology Officer, Royal Dutch Shell)

Mr Eamonn SINNOTT (General Manager, Intel Ireland)

Dr Lars STRÖMBERG (Vice-President, Vattenfall AB)

Mr Marc VAN SANDE (Chief Technology Officer and Vice-President, UMICORE).

Mr. David WILLETTS (Minister for Universities and Science, UK)



3. MEMBERSHIP OF THE SHERPA GROUP

Chairman

Prof. Gabriel CREAN, Vice-President, CEA Technologies, CEA France

Members

Dr Patrick BERNARD (SAFT, Research Group Manager)

Dr. Patrick BRESSLER (Fraunhofer Institut, Head of Fraunhofer Office)

Mr. Brendan CANNON (Intel Ireland, Corporate Affairs Director)

Mr. Filip GEERTS (CECIMO a.i.s.b.l, Director General)

Mr. Dirk CARREZ (EuropaBio Director, Industrial Biotechnology)

Mr. Wolfgang CRASEMANN (Federal Ministry of Economics and Technology, Germany)

Ms. Ilka Von DALWIGK (Vattenfall, Group Function R&D)

Mr. Filip GEERTS (Director General, CECIMO)

Mr. Sebastian GOEKE (Applied Materials GmbH & Co. KG, Governmental Affairs Energy & Environmental Solutions)

Mr. Teun GRAAFLAND (Shell International, Manager European Science & Education Programmes)

Dr. Harald GRUBER (European Investment Bank, Head of Division, ICT and e-Economy)

Mr. Fergus HARRADENCE (Dept Business Innovation & Skills, Deputy Director of Innovation Policy)

Mr. Laurens HOEDEMAKER (TNO EU Office Director)

Dr. Alfred HOFFMANN (Infineon Technologies AG, Corporate Vice President Public Authorities and Associations)

Dr. Gernot KLOTZ (CEFIC AISBL, Executive Director of Research and Innovation)

Ms. Nelly KERNEVEZ (Soitec, Director of Partnership)

Mr. Laurentino LAVEZZI (Office of Coordination of European policies, Ministry for Economy, Industry and Employment, Deputy Head of office, France).

Dr. Rudolf LICHTMANNEGER (Economic Policy Department of Austrian Federal Economic Chamber, Deputy Head)

Dr. Gordana MIJIC (Thyia, Chief Technology Officer)

Dr. Paul MIJLEMANS (Umicore, Director Technology Scouting)

Prof. Josep A. PLANELL (Institute for Bioengineering of Catalonia – IBEC, Universitat Politècnica de Catalunya – BarcelonaTech, Director)

Mr. Adriano PULISCIANO (Rolls-Royce, Principal Technologist)

Dr. Leena SARVARANTA (VTT Technical Research Centre of Finland, Head of EU Initiatives)

Dr. Enrico VILLA (STMicroelectronics, Senior advisor to the CEO and COO)

Mr Markus WILKENS (VDI Technologiezentrum, Düsseldorf)

HLG KET Secretariat:

CEA:

Ms Katia DIDAOUI (European Policies Officer, Technological Research Division, CEA)

European Commission, DG Enterprise:

Mr. Michel CATINAT (Head of unit ICT for Competitiveness and Industrial Innovation, DG Enterprise)

Ms. Sophie MUELLER (Project Manager, EU Policies, unit ICT for Competitiveness and Industrial Innovation, DG Enterprise)

4. KETS OPEN DAYS (2010) – SECTORIAL ANALYSIS –

KETs Open Days gathered 845 participants from across Europe and were organised by the HLG KET thematic working groups:

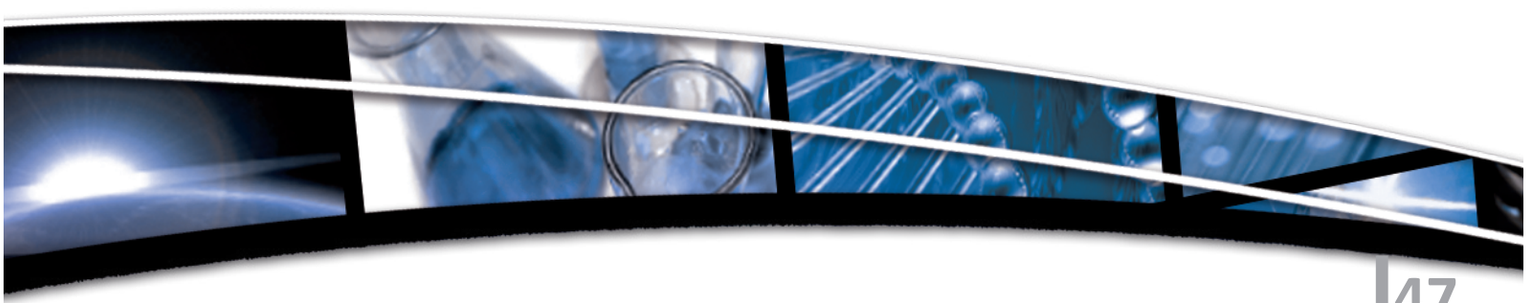
- Open day on Nanotechnologies, 27 October 2010, Charlemagne Conference Center
- Open day on Micro nanoelectronics, "Mastering Innovation and Shaping Europe's future", 18 October 2010, Borschette Center, Brussels
- Open day on Advanced materials, 25 October 2010, Madou Auditorium, Brussels.
- Open day on Photonics, 10 November, Madou Auditorium, Brussels
- Open day on Industrial Biotechnologies, 5 November 2010, , Center Borschette, Brussels
- Open day on Advanced manufacturing systems, 15 November 2010.

HLG KET speakers:

- M. Auberton-Hervé (CEO, SOITEC)
- M. O'Hara (GM, Intel Ireland)
- Dr. Van Sande (Executive VP, Umicore)
- Ms De Guibert (Research Director, Saft Group)
- Dr. Kolterman (Group VP of Corporate Research and Development at Süd-Chemie AG)
- Prof. Ambrosio (President, European Society for Biomaterials)
- Dr Hoffmann (President, European Photovoltaics Industry Association, EPIA)
- Dr. Erguren (Vice-President CECIMO)

European Commission speakers:

- M. Catinat (Head of Unit ICT for Competitiveness and Industrial Innovation, DG ENTR)
- Mrs. Del Brenna, Head of Unit Competitiveness of the pharmaceuticals industry and biotechnology, DG ENTR)
- Mrs Lalis (Director Industrial Innovation and Mobility Industries, DG ENTR)
- M. Tokamanis (Head of Unit Nanotechnologies, DG RTD, Directorate Industrial technologies)
- M. Tomellini (Head of Unit "Value-added materials" , DG RTD, Directorate Industrial technologies)
- M. Van der Pyl (Director Components and Systems, DG INFSO)



5. KET EXPERT WORKSHOPS (2011) – TRANSVERSAL ANALYSIS –

During the HLG KET Phase 2 transversal analysis (2011), the following KET expert workshops were organised with different external (Academia, RTOs, Industry, etc.) and EC experts on the following topics:

- Transdisciplinarity and societal acceptance, 14 April 2011, Breydel building, DG ENTR, Brussels.
- Value chain integration, 12 April 2011, Breydel building, DG ENTR, Brussels.
- Technological research and Eurocentric IP (Pillar 1), 8 April 2011, Breydel building, DG ENTR, Brussels.
- Product development (Pillar 2), 7 April 2011, Breydel building, DG ENTR, Brussels.
- Globally competitive manufacturing (Pillar 3), 4 April 2011, Breydel building, DG ENTR, Brussels.
- Policy options, 25 March 2011, Breydel building, DG ENTR, Brussels.
- Financial instruments, 23 March 2011, Breydel building, DG ENTR, Brussels.

European Commission experts:

DG RTD	- Lorenzo Valles (head of unit, New production processes) - Jean-David Malo (Head of Unit Financial Engineering) - B. Robertson (Programme Manager, Adaptive production systems)
DG ENTR	- Nikos Pantalos (EU Cluster Policy) - Anne- Marie Wyss (EU State Aid Regime) - Peter Droell (Head of Unit, Industrial Innovation) - Vesa Vanhanen (deputy head of unit, Financing of Innovation and SMEs)
DG REGIO	- Claus Schultze (Smart Specialisation)
DG TAXUD	- Uwe Ihli, (head of section CCCTB, Unit D1)DG COMP)
DG COMP	- Carlos Tenreiro (Deputy Head of unit, R&D, innovation, Venture capital)
DG TRADE	- Peter Klein (head of unit, Industrial sectors)
DG MARKT	- M Gattinara (Unit C 3 - Formulation and enforcement of public procurement law III)
DG ECFIN	- Thomas Gerassimos (Director, Finance, coordination wit EIB group, EBRD and IFIs)
DG EAC	- Peter Baur (Deputy Head of unit EIT, Partnership with economic actors)
JRC	- Pascal Colpo
EIF	- Richard Pelly (HLG Member, President EIF) - Marc Schublin (Head of Mandate Management and Product Development) - Shiva Dustar (EIB)
COMMITTEE OF THE REGIONS	- M. Markkku Markkula

6. INDUSTRY PILOT LINE CRITERIA AND STAKEHOLDERS COMMITMENTS

Industry pilot line criteria

- **Status of industrial asking for public support**

The company should be a manufacturing enterprise with at least one significant production site in the EU. Criterion has to be fulfilled, unless the company is a start up.

- **Check of market distortion of the KET pilot line**

Volume of expected output of the KET pilot line in the next three years. If already a market exists, the market share should be small in comparison to world market.
Criterion has to be fulfilled unless the market is in a small early stage condition

- **Technology leadership**

Existing R&D results should be leading edge compared to competition. Description should give evidence about competitive technological advantage as a consequence of the pilot plant. Criterion has to be assessed case by case.

- **Impact on societal challenges**

Typical examples are benefit to the environment like energy saving or waste recycling, benefit for aging populations like easier production processes, healthier working conditions.

- **EU added value**

Benefit for other EU member states outside the location of pilot line: suppliers, customers, RTOs, or
Convergence or phasing-out region, or
Environmental impact.

- **Potential for creating manufacturing jobs in Europe**

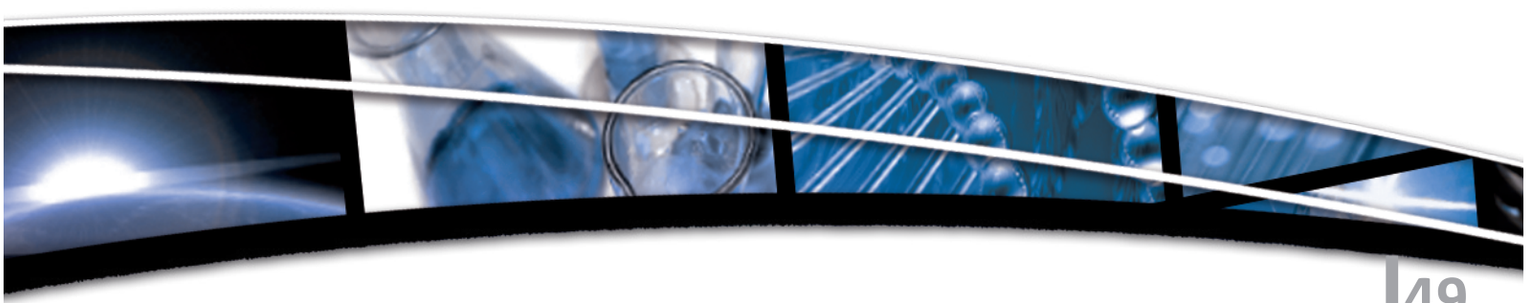
Direct sustainable jobs to be generated or safeguarded.

- **Commitment from industry**

First exploitation of generated IP and technology in Europe. Involvement of industry partners along the value chain. For projects with larger public funding (e.g.> € 10 mil), company receiving public funding should involve EU lead customers and/or suppliers (preferentially SMEs)
This involvement should reinforce the EU competitiveness on KET : opportunity for suppliers to demonstrate advanced materials and technologies on the upstream value chain, opportunity for end users on the upstream value chain to foster the innovation of final products on the market. (Benefit for EU local ecosystem or EU supplier network Criterion.

- **Criteria for success: description of critical success factors and objectives to be achieved.**

- **Skills and education: use of pilot line for appropriate skills / education training.**




Máire Geoghegan-Quinn
Antonio Tajani