



High-Level Expert Group on Key Enabling Technologies

Final Report

KETs: TIME TO ACT



EUROPEAN
COMMISSION



HIGH-LEVEL EXPERT GROUP ON
KEY ENABLING TECHNOLOGIES

KETs: Time to act

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EXECUTIVE SUMMARY

KEY ENABLING TECHNOLOGIES: AN ENGINE FOR THE REINDUSTRIALISATION OF EUROPE

The High Level Expert Group on Key Enabling Technologies (HLG-KET) reaffirms the vast potential the development and use of KETs hold for Europe. It concurs with the European Commission (EC) on its insistence on the potential of KETs to drive innovation and to stimulate Europe's competitiveness and manufacturing renaissance. In his political guideline document for the new European Commission, President Juncker said that “[...] we need to maintain a strong and high performing industrial base [...]. To achieve this we need to stimulate investment in new technologies [...]”. Commissioner Bieńkowska, in charge of Internal Market, Industry, Entrepreneurship and SMEs, in her hearing at the European Parliament stated *“Together with the Commissioner for Research, Science and Innovation, I want to use the Horizon 2020 Programme and other EU policy instruments in order to support close to market industrial innovation and key enabling technologies”*. Commissioner Moedas, in charge of Research, Science and Innovation, stated *“We must prioritise commercialisation. Turning science into technology. Bringing technology to market”*.

KETs (advanced manufacturing technologies, advanced materials, industrial biotechnology, micro- and nanoelectronics, nanotechnologies and photonics) are indispensable technology building blocks, with the potential – especially in combination – of unlocking innovation, providing added value and underpinning a wide range of product applications in strategic European value chains. KETs therefore largely influence economic conditions, employment and the quality of life of European citizens.

Europe derives competitive advantages in many products and services and in multiple domains; many of them are driven by KETs, for example in automotive, aeronautics, engineering, space, chemicals, textiles, building and infrastructures, agriculture and healthcare. KETs can further revolutionise processes and help modernise manufacturing, reducing costs of production, our reliance on finite materials, energy consumption, waste and pollution. KETs offer exceptional prospects to transform and modernise economies and help confront daunting challenges for instance in energy, climate change and ultimately societal welfare.

ADVANCED MANUFACTURING: A BACKBONE FOR A GLOBAL EUROPEAN ECONOMY

Manufacturing is recognised as the backbone of advanced economies, largely driving economic growth, employment and innovation.

Manufacturing contributes disproportionately to exports (80%), productivity growth (60%) as well as to innovation, accounting for 77% of the total investment in research and development. Manufacturing firms are almost three times more likely than service businesses to introduce not only innovative products but also new services. In 2012, manufacturing companies in the EU generated €1760 bn of value added and employed 32 million employees directly and approximately twice that much indirectly, mainly in small and medium-sized enterprises (SMEs). Building and maintaining a strong manufacturing base is therefore essential for Europe's economic sustainability in raising incomes and providing the machinery, tools and materials to build modern infrastructures and housing, to manufacture innovative products and to modernise industrial processes.

Europe is confronted with a structural erosion of its manufacturing base and risks losing its competitive manufacturing capacity. As a result of economic and financial crisis and rapid geopolitical trends, Europe's manufacturing position is changing. Europe is experienced a significant de-industrialisation and a progressive dismantling of its manufacturing sector, both in terms of contribution to Gross Domestic Product (GDP) (which decreased from 18.5% in 2000 down to 15% in 2012) and employment (with a total loss of 3.8 million jobs over the period 2008-2012). Symptoms include relatively high manufacturing costs as well as a lack of a coordinated Innovation and Industrial policies across the European Union.

The global manufacturing map has been swiftly redrawn and Europe is losing ground. The rise of Asian economies, including China, Japan, South Korea and India is confirmed all along strategic industrial value chains. In the U.S., manufacturing is being reinforced to regain competitive advantage and this appears to be helping productivity and related employment. Significant investment programmes are profoundly altering economies, especially in Asia. European growth and jobs are already affected and Europe needs to react by recognising this metamorphosis and by developing appropriate strategies.

TO COMPETE GLOBALLY IN MANUFACTURING, SUPPORT TO KEY ENABLING TECHNOLOGIES IS VITAL

Use of KETs will be influential in creating a competitive European economy. To support this, Europe needs improved and more proficient policies on innovation, if businesses are to succeed in deploying KETs quickly and effectively.

Globally the KETs market is estimated to be worth more than €1 tn but Europe cannot afford to be complacent. Other world regions are aggressively investing in KETs and although supply chains are increasingly global, the nations and regions that adopt these technologies and embed them into innovative products, processes and services will be the main beneficiaries in terms of growth, sustainability and jobs.

Europe is a global leader in the development of KETs, but has been weak in translating this capacity into marketable products and services. Member States and regional instruments, in addition to the European Horizon 2020 programme are now directing more innovation support towards closer to market activities, but these are insufficient to leverage private investment and are not achieving critical mass and impact. Moreover, it is recognised that compared to competitor regions, the *“EU is less focused on strategic areas and tends to scatter its efforts on a wider range of scientific fields and technologies, with the risk of dominating none.”* [Innovation Union Competitiveness Report. 2013, EC]

Asian economies, on the other hand, have stepped up efforts to attract investment in KETs development and deployment. Asia’s patent share in KETs was 26% in 2000, but rose to 44% in 2011, compared to 27% for Europe and 23% for North America. There is a similar picture with regard to performance in trade: Asia now holds a share in total export related to KETs of about 57%, compared to 23% for Europe and 20% for North America.

Although Europe has succeeded in holding its share in patent and trade relatively constant over the past decade, there is a clear need to adjust to the new global environment and to intensify efforts to support the development and industrial deployment of KETs. Massive and strategic investment will be needed to foster industrial innovation in order to restore industrial competitiveness and ensure a strong industrial base for Europe.

IMPLEMENTATION OF THE EUROPEAN STRATEGY FOR KETs: MUCH PROGRESS BUT FULL POTENTIAL UNEXPLOITED

Throughout its mandate, the High Level Expert Group on KETs (HLG-KET) has continuously advised and informed public authorities and private stakeholders, in its reports, on the urgency of taking action toward the full implementation of the European Strategy for KETs. Significant steps in the implementation of this strategy have been achieved, building on the proposals of the New European Industrial Policy and aligning different policy instruments to support industrial deployment of KETs.

KETs are now a priority for the new framework programme for Research and Innovation (Horizon 2020), one of the investment priorities in the European Structural and Investment Funds and also in the European Investment Bank. The new state aid rules give more flexibility to Member States to support KETs-investments.

However, there is clear room for improvement. In view of the unexploited potential, the HLG-KET has assessed the implementation of its mid-term recommendations set out in the Status Implementation Report of July 2013 acknowledging the progress made to date and putting emphasis on where further actions are still needed.

Significant actions and investment are required to put Europe back on track and ensure that we preserve competitiveness and secure a sustainable European economy. In the coming years, our capability to innovate in KETs will certainly be one of the most important factors for the success of the European manufacturing industry; a path that has already been taken by competitor economies. The HLG-KET is presenting a set of new recommendations as an integrated approach to ensure the full implementation of the European Strategy for KETs. This is a blueprint for public authorities as well as private stakeholders to act quickly, efficiently and collectively in order to tackle the challenges ahead.

BLUEPRINT FOR FULL THE EUROPEAN

Building a strong integrated approach to cross the European KETs “valley of death”

Full deployment of KETs into EU industries calls for an integrated approach that provides increased and adequate support for each of the three pillars of the bridge to cross the KETs “valley of death”: (1) from the development of technologies with transformative potential (KETs) in appropriate technology infrastructures, (2) through their implementation in industrial pilot lines for prototyping, testing and validating products, (3) until the launch of KETs-based manufacturing projects essential to deploy technology-based products, processes and services.

Unleashing the market potential of KETs by better integrating the KETs strategy across EU initiatives

To unleash market opportunities for KETs, the European Strategy for KETs needs to be better integrated across different EU policies and initiatives. Many EU objectives cannot be met without significant investment in KETs development and their industrial deployment. KETs are the technology blocks embedded in applications needed to solve societal challenges and will play a key role to achieve initiatives such as a digital single market, a circular economy or EU global technology leadership in climate and energy solutions. Moreover, modernisation of European policies to cope with global competition and the adaptation of skills policies to respond to the needs of industry will be essential to capture the benefit of KETs for the whole European economy. Adoption by Member States and Regions of the KETs strategy and taking the appropriate course of action is also crucial in obtaining the expected outcome. This will require appropriate investment, intelligent regulation and smooth integration into all key European policies.

IMPLEMENTATION OF STRATEGY FOR KETs

HLG-KET 8 RECOMMENDATIONS

- | | |
|--|-------------|
| 1 Boost European technology infrastructures to support industry | P.60 |
| 2 Strengthen KETs pilot lines and demonstration activities | P.61 |
| 3 Unleash significant investment into manufacturing through new EU tools | P.62 |
| 4 Escalate regional Smart Specialisation Strategies to a European level | P.65 |
| 5 Establish bonding between KETs and societal challenges for a sustainable and competitive Europe | P.66 |
| 6 Ensure European interests are met in trade and investment agreements | P.67 |
| 7 Fully exploit the dual-use potential of KETs | P.69 |
| 8 Invest in KETs-related skills to ensure Europe's innovation potential | P.70 |

INTRODUCTION:

KEY ENABLING TECHNOLOGIES

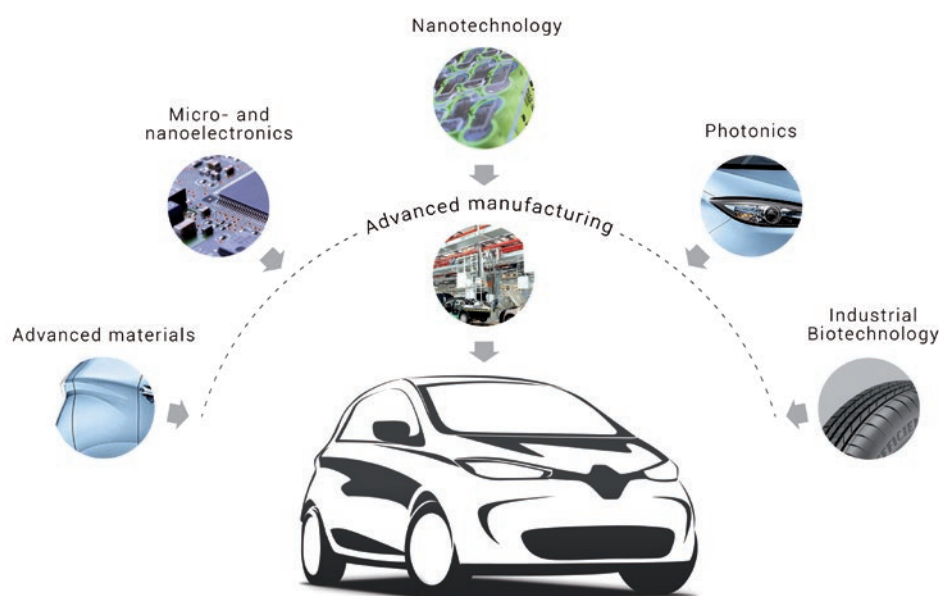
Over the years, many technologies have been successfully developed. However, a clear strategy as to how these technologies could be deployed to meet the innovation and industrial agendas at the European level has often been lacking and as a consequence these technologies were not exploited to their full potential.

In 2009, the European Commission stressed in its Communication¹ *“Preparing for our future: Developing a Common Strategy for Key Enabling Technologies in the EU”* the need to launch a process of identifying, for the first time, key technologies that would have the potential of strengthening the EU’s industrial and innovation capacity to address the societal challenges. Six Key Enabling Technologies (KETs) have been identified: **advanced manufacturing, advanced materials, industrial biotechnology, micro- and nanoelectronics, nanotechnology and photonics**. This communication also proposed a set of measures to improve the related framework conditions and put into place a coherent strategy at the European level that would allow the KETs to be brought more efficiently to industrial deployment.

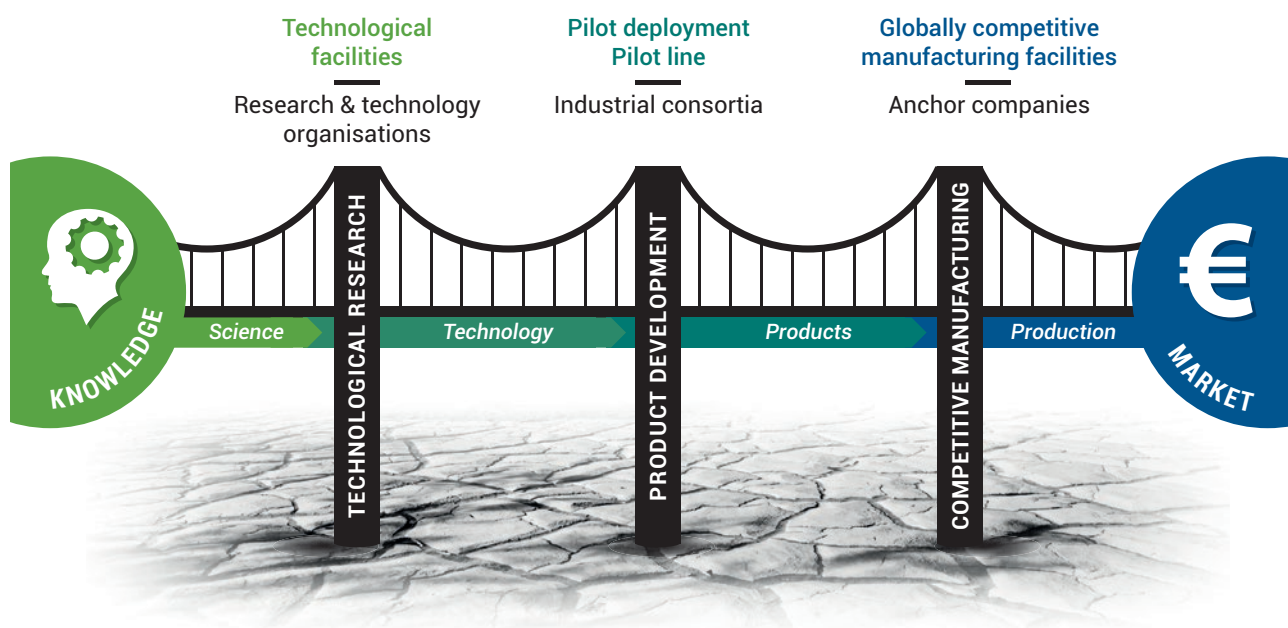
KETs are indispensable technology building blocks, which – especially when combined – offer the potential

of unlocking innovation, providing added value and underpinning a wide range of product applications in strategic European value chains. KETs increasingly have an impact on the quality of life of European citizens, on the competitiveness of European economies and on the creation of sustainable jobs.

Indeed, KETs are at the heart of game-changing processes, products and services in multiple application areas such as automotive, aeronautics, engineering, space, chemicals, textiles, building and infrastructures, agriculture and healthcare, where the European industry holds a competitive advantage. In addition, KETs are also expected to modernise the manufacturing processes by reducing the cost of production, the reliance on raw materials and the consumption of energy, while at the same time diminishing the adverse impact on the environment by reducing the generation of waste and pollution. Moreover, it is recognised that some of the European Commission priorities and targets such as Growth and Jobs in Industrial Policy, Energy Union package, Digital Single Market, Resource Efficiency, Circular Economy, Smart Cities, Clean Tech and Bioeconomy cannot be met and implemented without KETs being mastered and deployed. KETs can therefore simultaneously



1. Communication from the Commission “Preparing our future: Developing a common strategy for key enabling technologies in the EU”. COM (2009) 512 final.



Crossing the KETs “valley of death”

contribute to realising the reindustrialisation and meeting the societal challenges, making them compatible and reinforcing their respective impacts on growth and job creation.

In order to foster the deployment of KETs in Europe and identify obstacles and opportunities in this respect, the European Commission established in July 2010 a High Level Expert Group² on KETs (HLG-KET) with representatives from EU Member States, industry, the European Investment Bank and the research and technology community, tasked with developing a shared longer term strategy and action plan. The group delivered its report³ on June 28th 2011 providing policy recommendations aiming at a coherent long-term strategy to develop KETs and at improved conditions for their deployment in industry. The HLG-KET unveiled one of Europe's major weaknesses with regard to innovation, namely the difficulty of translating its scientific knowledge base into commercial goods and services. This difficulty is creating a gap, commonly referred as “valley of death”. To cross this valley, the HLG-KET provided a coherent strategy consisting of 10 recommendations and a specific action plan based on the “three-pillar bridge” model:

- a pillar representing technological research to support transforming fundamental research into technologies;
- a central pillar representing product demonstration and development to support transforming technologies into product prototypes;

- a pillar representing advanced manufacturing and mass production to support creating production systems to commercially produce the products.

Many recommendations were integrated in the EC's Communication “*A European strategy for Key Enabling Technologies – A Bridge to Growth and Jobs*”. The communication outlines an action plan to foster the industrial deployment of KETs in Europe. It details how the right framework conditions can trigger the deployment of KETs into European industry enhancing its competitiveness, stimulating growth and creation jobs across Europe.

Since the adoption of the European Strategy for KETs, the European Commission has aligned and adapted its instruments in order to reinforce the role of KETs recognising them as one of the crucial elements of the research and innovation (R&I) European policy, namely the Horizon 2020 programme, as well as one of the investment priorities for the European Structural and Investment Funds (ESIF) and a key pillar of the new European industrial policy.

A new European Commission High Level Expert Group on KETs was set up in January 2013 to advise the Commission on the implementation of the European Strategy for KETs and identify a clear scope for future actions in order to further foster the KETs and improve their impact in our economy.

2. http://ec.europa.eu/enterprise/sectors/ict/key_technologies/kets_high_level_group_en.htm

3. http://ec.europa.eu/enterprise/sectors/ict/files/kets/hlg_report_final_en.pdf

CHAPTER 1:
**KETs - PRESSING
NEEDS IN AN
INTERNATIONAL
CONTEXT**

This chapter provides a brief analysis of the importance of manufacturing for the European economy and the outlook of the structural shifts in the European manufacturing sector and the challenges ahead.

- Manufacturing is recognised as essential for European economic, social and environmental sustainability to raise private and public incomes and to provide the machinery, tools, means, and materials to build modern and efficient infrastructures, housing and products.
- Europe has experienced a significant de-industrialisation and a progressive dismantling of its manufacturing sector. Manufacturing contribution to European Gross Domestic Product (GDP) decreased from 18.5% in 2000 to 15% in 2012 and 3.8 million jobs were lost over the period 2008-2012 in the manufacturing sector.
- Europe innovates, but its weakness remains its inability to successfully convert this innovation into products and services. Often, innovative European ideas end up being manufactured elsewhere.
- The U.S. and Asian economies have already engaged significant resources toward the development and deployment of Key Enabling Technologies (KETs), coupled with industrial policies that enhance their attractiveness for industry investment.
- In Europe, KETs development and deployment can deliver both societal and industrial benefits across many areas such as energy, environment and climate, security, communication, mobility and health. To achieve that impact, however, Europe needs a more coherent and enticing innovation and industrial framework for KETs.

1.1. A RAPIDLY CHANGING GLOBAL MANUFACTURING LANDSCAPE

1.1.1. European manufacturing matters

The economic crisis has led to an increased focus on the structure of the future European economy and the role of the manufacturing sector within this¹, owing primarily to a superior productivity compared to other sectors². Recognising the urgency for action, the European Commission highlighted in its communication on an *“Integrated Industrial Policy for the Globalisation Era”*³ the key role of manufacturing in underpinning the recovery of growth and jobs and addressing societal challenges. This emphasis was more pronounced in its communication *“A Stronger European Industry for Growth and Economic Recovery”*⁴ which put a particular emphasis on modernisation of manufacturing as a way to *“contribute to economic recovery in the short- and medium-term and have a significant impact on our longer-term growth”*. Manufacturing is seen as the engine of Europe for future growth and jobs and a vital element of the European industry renaissance⁵. This is also reflected in the report of the European Commission Task Force on advanced manufacturing⁶.

1. EPC Issue paper. “Towards a NEw Industrial Policy for Europe”. N°78, November 2013

2. Manufacturing Europe's future. Bruegel blueprint series. Bruegel 2013.

3. Communication from the European Commission. “An Integrated Industrial Policy for the Globalisation Era. Putting Competitiveness and Sustainability at Centre Stage”. COM (2010) 614 final

4. Communication from the European Commission. “A Stronger European Industry for Growth and Economic Recovery. Industrial Policy Communication Update”. COM (2012) 582 final.

5. Communication from the European Commission. “For a European Industrial Renaissance”. COM (2014) 12 Final.

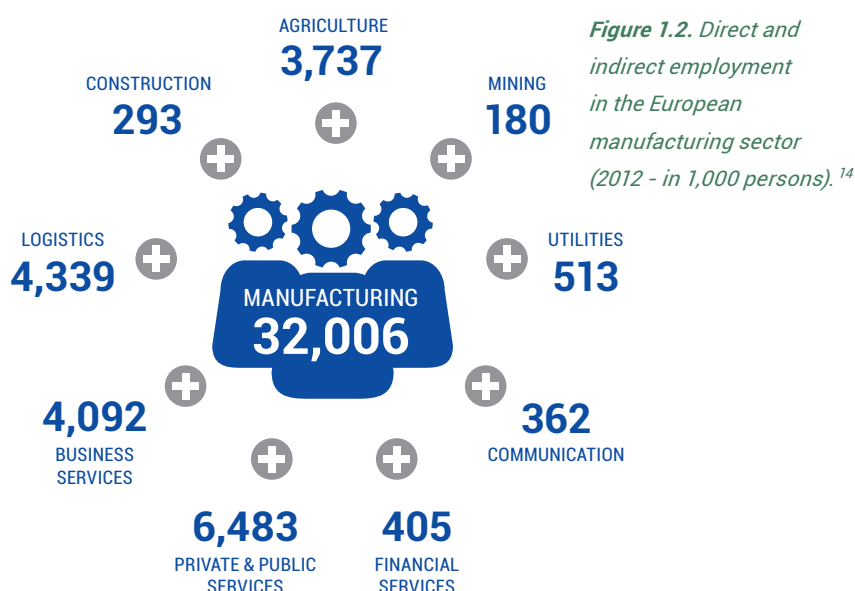
6. Commission Staff Working Document. “Advancing Manufacturing - Advancing Europe”. Report of the Task Force on Advanced Manufacturing for Clean Production. SWD (2014) 120 final.

Indeed manufacturing is a driving force for European industry and contributes significantly to the whole economy. For each 1% increase in the demand for products manufactured in the EU, the average total domestic output of all Member States increases by 1.68%.⁷ In the manufacturing industry, multiplication factors for indirect and induced effects range from 1.88 in production, 2.21 in national added value and up to 2.73 in employment⁸ (and even higher in specific KET-related sectors, such as semiconductors with a factor of 5)⁹. The manufacturing sector is very productive: an hour of work generates nearly €32 of added value. With a share of 15% of value added in the total economy, manufacturing is nevertheless responsible for 77% of private sector research and technological development (R&D) expenditure and for 49% of innovation expenditure (**Figure 1.1**).



Manufacturing is also a main driver for trade including intermediate and consumer products, and related services. In the EU, it is responsible for 80% of total exports¹⁰. Significant numbers of European jobs, directly or indirectly, depend on manufacturing¹¹.

In the context of high unemployment in Europe (11.5% in the EU-28 and more dramatically 21.6% for youth unemployment¹²) reviving the sector could provide tens of millions of new jobs. In 2012, manufacturing directly employed around 32 million people in Europe (accounting for 16% of total employment in the EU-15¹³, down from over 21% in 1995) and indirectly accounted for an additional 20 million jobs in related supply sectors across Europe¹⁴ (**Figure 1.2**).



7. "Industry as a growth engine in the global economy", Institut der deutschen Wirtschaft Köln, IW Consult GmbH, Köln 2013, p.47

8. "Die wirtschaftliche Verflechtung von großen, mittleren und kleinen Unternehmen in der Steiermark Industriewissenschaftliches Institut", Wien 2008, p.36

9. HLG-KET Final report. June 2011.

10. Eurostat. "Extra-EU trade in manufactured goods". May 2014.

11. "European Competitiveness Report 2013. European Commission.

12. Eurostat.Newsrelease. 180/2014 - 28 November 2014

13. The term EU-15 refers to the 15 Member States of the European Union as of December 31, 2003, before the new Member States joined the EU. The 15 Member States are Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, and the United Kingdom.

14. Eurostat (2013), WIOD (2013). European Commission MEMO "Advancing Manufacturing paves way for future of industry in Europe". Brussels, 19 March 2014

European manufacturing activity is increasingly spread through global value chains. Manufacturing companies in 2009 represented around 10% of the 2 million enterprises in the EU-27 non-financial business economy¹⁰. They contribute to 14% of total employment distributed in SMEs and large companies, which contribute along different value chains in creating European industrial ecosystems¹⁵. SMEs are often referred to as the backbone of the European economy because they significantly contribute to industrial value chains¹⁶. In the manufacturing sector, 99.2% of companies in the EU-27 are SMEs. They account for 59% of employees, 45% of value added and 39% of sales in manufacturing. Revitalising European manufacturing will therefore require a specific focus on SMEs.

1.1.2. The global manufacturing map has been swiftly redrawn

Over recent decades, the European manufacturing landscape has changed profoundly. Its contribution to global value added has steadily decreased, while geographic distribution of manufacturers has radically changed as a direct consequence of global competition. Consequently, the manufacturing sector in Europe has come increasingly under pressure as shown by the dynamic shift in global manufacturing cost competitiveness¹⁷. This shift redraws the decades-old assumptions about where to sustain current assets and build future production capacities. This has direct consequences on the attractiveness of Europe for investment decisions. As an example, Europe's share in global inward Foreign Direct Investment (FDI) has declined significantly: from over 50% of the world's FDI in 2002 to 20% in 2013¹⁸. In 2013, 166,343 jobs were created in Europe through FDI, down 2% from 2012; a performance that is still 15% below pre-crisis levels.¹⁹

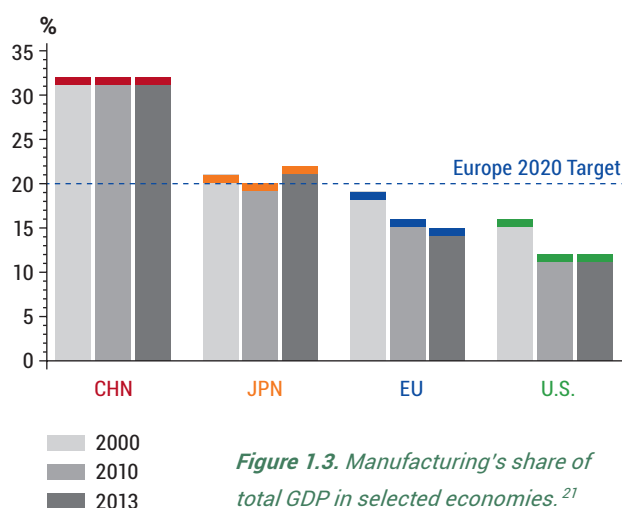


Figure 1.3. Manufacturing's share of total GDP in selected economies.²¹

Despite the fact that manufacturing outperformed other sectors of the economy¹⁷, the share of manufacturing industry in Europe remains below the 20% target of EU GDP set out in the European Commission communication on industrial policy⁴. In fact, the aggregate proportion of manufacturing in GDP fell from 19.1% in 2000 to 16% in 2011²⁰, and continued to fall to just over 15% in 2013, below that of the world average (17% in 2013) as seen in **Figure 1.3**.

15. Status Implementation Report. (KETs SMEs perspective: Interview with Ulrike Rabmer-Koller, Vice-President of the Crafts and Trade Division of the Austrian Chamber of Commerce (WKÖ), Chairman, the European Association of Craft, Small and Medium Sized Enterprises' (UEAPME) Sustainable Development Committee. Page 42. High Level Group on Key Enabling Technologies. 2013.

16. European competitiveness report 2014.

17. "The shifting economics of Global Manufacturing: How cost competitiveness is changing worldwide". The Boston Consulting group. August 2014.

18. EY's attractiveness survey. "Europe 2014 Back in the game". 2014.

19. EY's European Investment Monitor 2014 (EIM). 2014.

20. European Commission MEMO. Brussels. 11 September 2014.

21. Based on the World Bank and OECD.

A very similar development was observed in the U.S. where the share dropped from 15 to around 13% over the same period. These economies have experienced a shift from consumption of goods to consumption of services, and jobs in services replaced those in manufacturing²².

The declines in manufacturing jobs in both the U.S. and in Europe can partially be explained by the shift to services. In the same time frame, manufacturing has been growing in Asia (particularly in China) due to massive investments in improving production capacities²³. Asian emerging markets become resilient and important industrial players, in particular China with its share of manufacturing added value stabilising around 30% in 2013.

China is now the world's largest industrialised country producing an added value of €1.91 tn compared to €1.75 tn in the EU²⁴. According to United Nations estimates, China displaced the U.S. as the largest manufacturing nation in 2012²⁵ (in share of global manufacturing nominal gross value added) as shown in **Figure 1.4** (This Chinese rise was recently confirmed by the International Monetary Fund²⁶, that claimed that China just overtook the U.S. to become the largest world economy). Japan ranked third in manufacturing value added, while South Korea and India are rapidly jumping in the Top 10. In the meantime, a gradual decline of the ranking of EU Member States position is seen, which reflects a global loss in manufacturing competitiveness across Europe for several industrial sectors¹⁷ (see the box: Shift of manufacturing industry away from Europe).

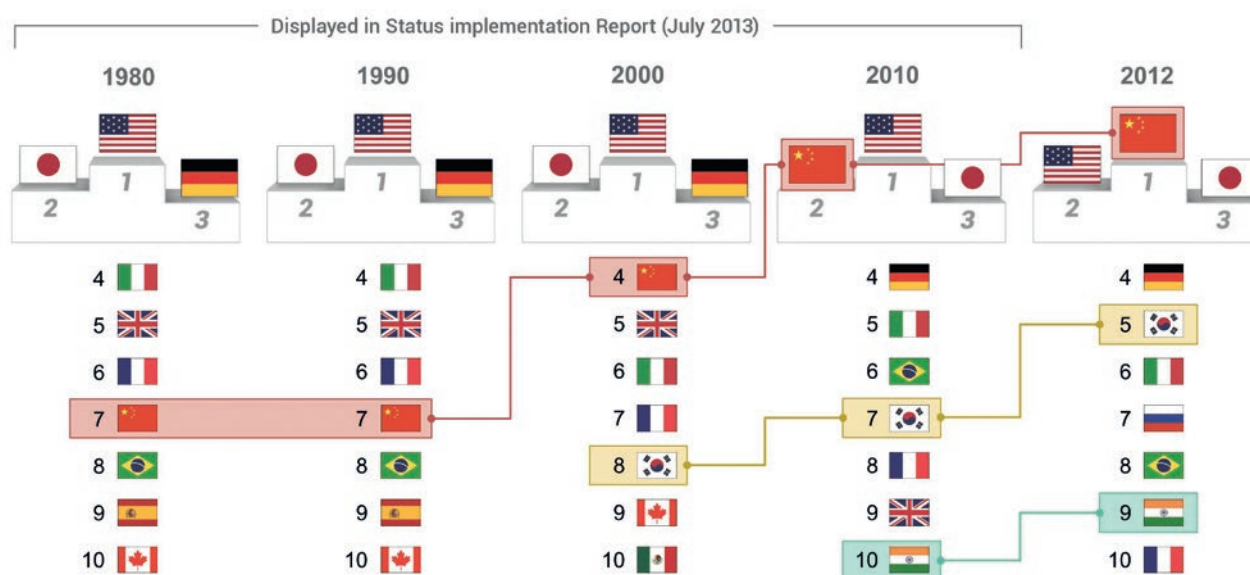


Figure 1.4. Top 10 manufacturers by share of global manufacturing nominal gross value added.^{22,23}

22. "U.S. Manufacturing in International Perspective". Congressional Research Service. January 2014.

23. McKinsey (2012): "Manufacturing the future. The next era of global growth and innovation."

24. UN (2013), OECD (2013), Eurostat (2013).

25. Estimated by United Nations and MAPI Foundation.

26. World Economic Outlook Database. International Monetary Fund. <http://www.imf.org/external/pubs/ft/weo/2014/02/weodata/index.aspx>

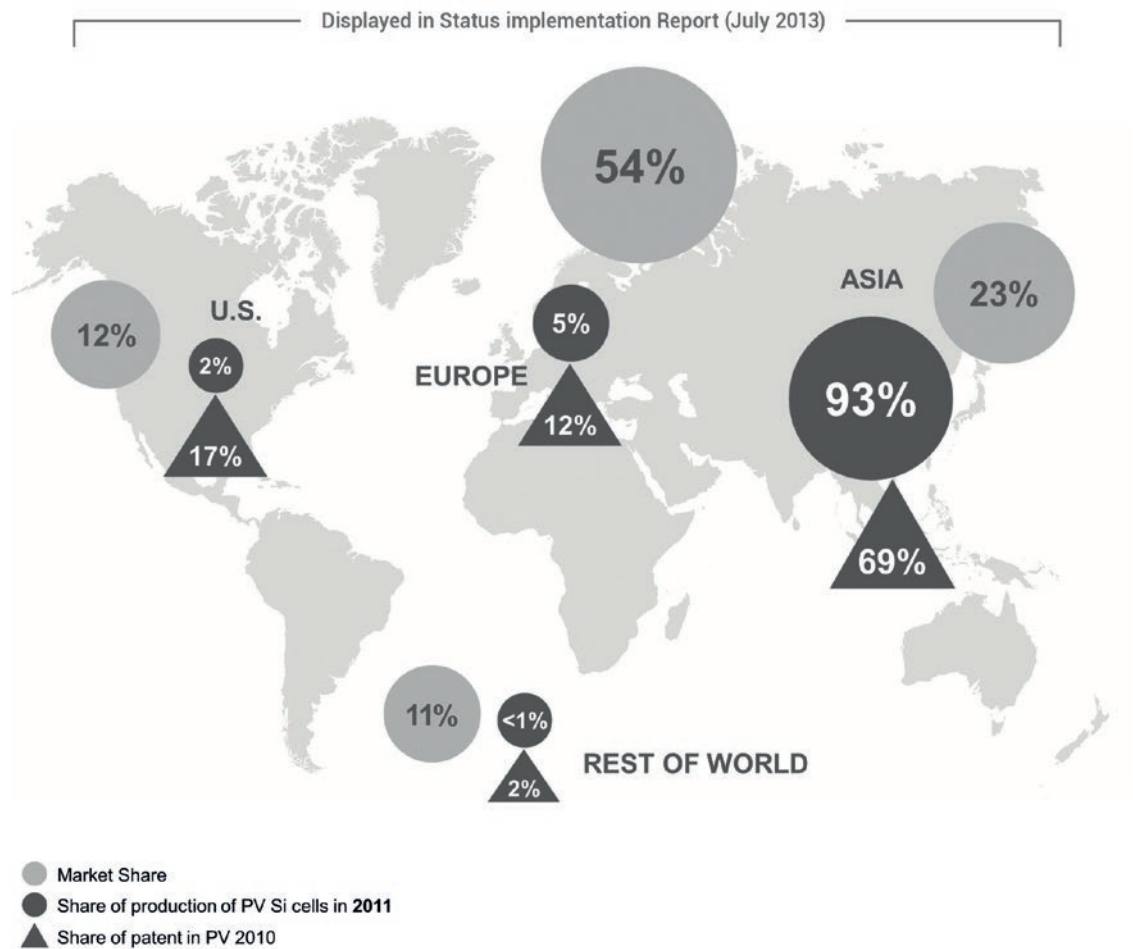


Figure 1.5.
Global patent and
manufacturing share
evolution: case of
photovoltaics.²⁸

2010-2011

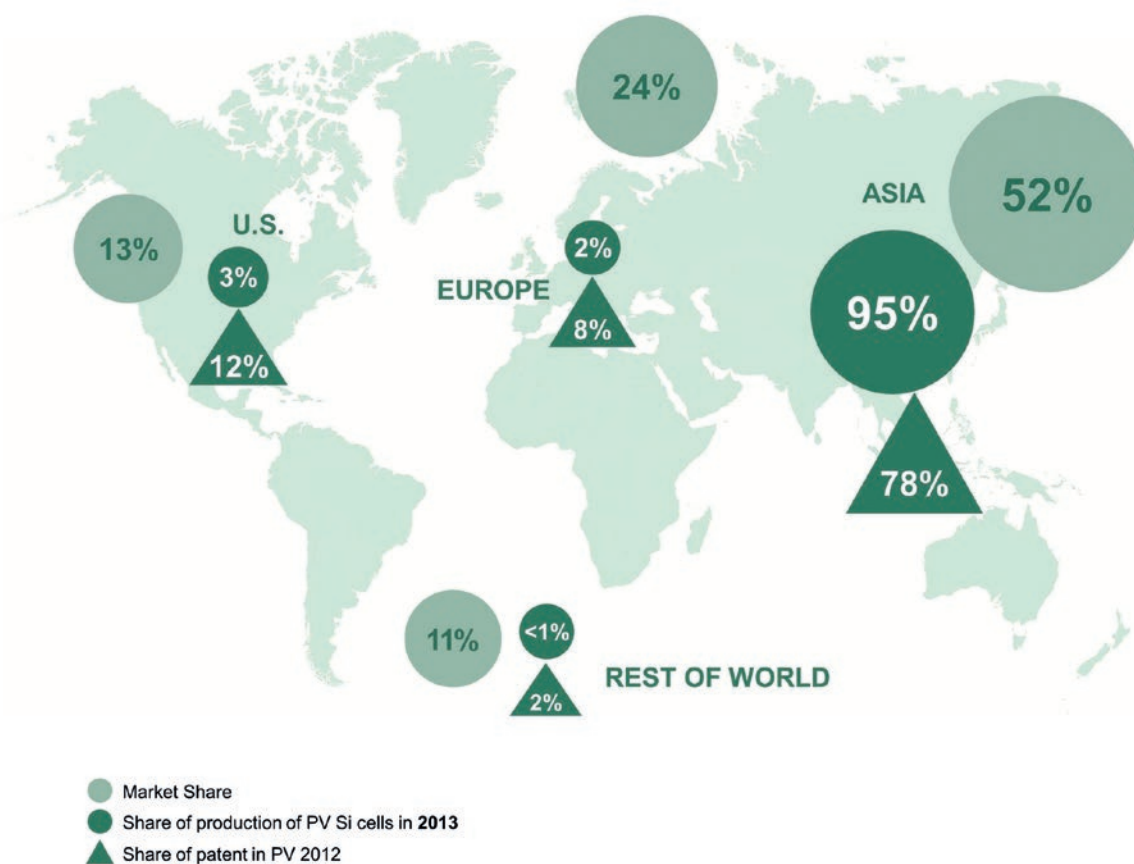
SHIFT OF MANUFACTURING INDUSTRY AWAY FROM EUROPE

The premises of the shift of manufacturing away from Europe is seen with the HLG-KET report of 2011 which highlighted the rapid transfer from Europe of manufacturing activities in two strategic domains: Li-ion batteries and photovoltaics. This was again emphasised in the Status Implementation Report of 2013 and displayed as typical examples in the 2014 KET MANIFESTO document²⁷ (See Appendix 2). The situation worsened dramatically over the past three years (for instance Asia concentrated 95% of world production of photovoltaic cells in 2013, as seen in the **Figure 1.5**) resulting in an almost complete shift of EU photovoltaic manufacturing to Asia.

This trend is also reflected in other industry sectors. For instance smartphone manufacturing activity has completely disappeared from Europe. In just the time period of FP7 (2007-2013) Nokia's smartphone market share was dominant at 49.8% in 2007 (436 million sold), but

27. Final report 2011, Status Implementation report 2013, KETs for a competitive Europe 2014, KETs manifesto 2014
http://ec.europa.eu/enterprise/sectors/ict/key_technologies/kets_high_level_group_en.htm

28. 2010/2012 share of patent applications in photovoltaics by world region of priority. Source: Questel 2014



2012-2013

collapsed to 2.5% in 2013. Nokia's smartphone business, whose market value topped \$250 bn in 2000, was swallowed by the U.S. company Microsoft for only \$7.2 bn in April 2014, marking an end of the last smartphone manufacturer in Europe²⁹.

The European chemical industry is also facing the same trend with progressive shift of manufacturing capacities away from Europe. A clear example is the cost of producing ethylene (which is the foundation in the production of plastics, detergents, coatings and other materials). Making ethylene in Europe is not competitive compared to the U.S. (due to the shale gas boom), or the Middle East. This is boosting profits abroad and attracting massive investment, including from European chemical companies³⁰.

Similar trends are seen across all sectors. They include semiconductor memory devices, flat panel displays, cameras and advanced lighting technologies for instance.

29. Bouwman, Harry et al. "How Nokia failed to nail the Smartphone market". 25th European Regional Conference of the International Telecommunications Society (ITS), Brussels, Belgium, 22-25 June 2014.

30. Competitiveness of the European Chemical Industry. CEFIC. October 2014.

Consequently, the role of manufacturing industry in Europe is progressively declining over the last decades and the economic crisis has made the situation even worse. Employment in EU manufacturing has been declining steadily for several decades. Over 3.8 million jobs have been lost in manufacturing in Europe since the beginning of the crisis³¹ and this trend has not yet been reversed. This represents just over half of total loss in the EU-15 employment in the manufacturing which fell by 17.6% between 2000 and 2012 with different shifts across Member States³¹. One should note that this declining trend was consolidated well before the 2008 crisis.

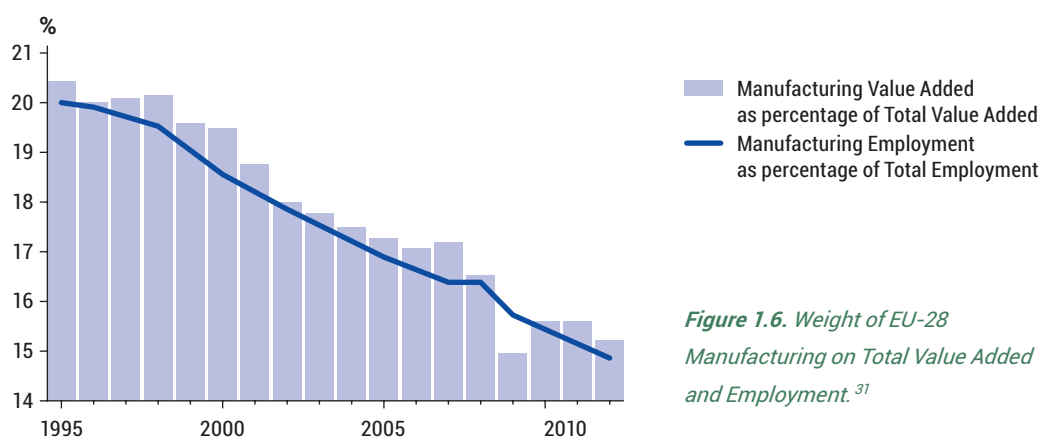
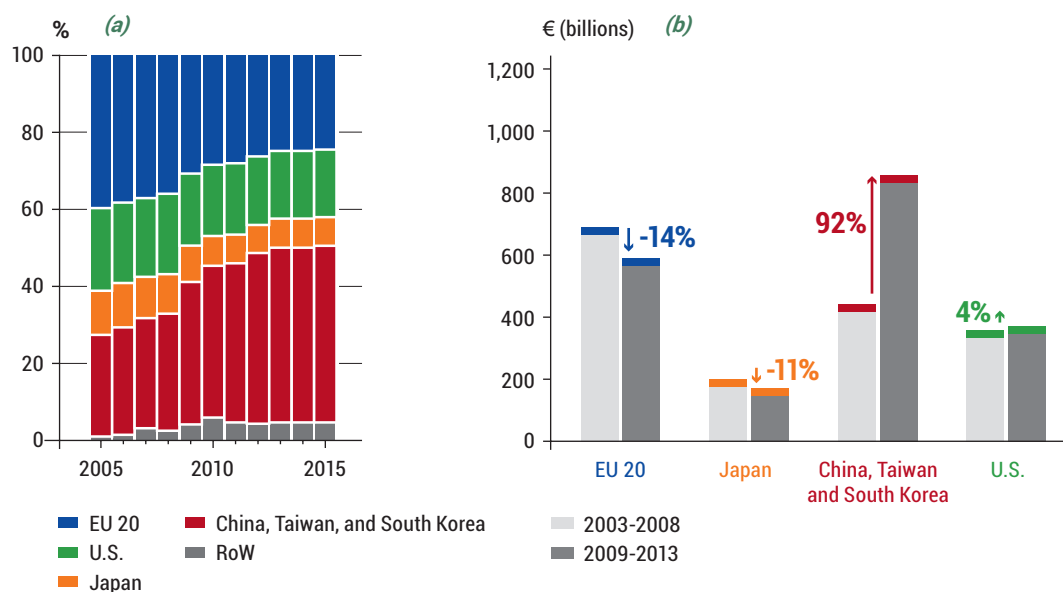


Figure 1.6. Weight of EU-28 Manufacturing on Total Value Added and Employment.³¹

These negative prospects have direct consequences on the private sector's perception of business attractiveness in Europe. The European share of total world investment in manufacturing declined from 40% in 2005 to 25% in 2013 (a 37% reduction)³²; a trend that has also been experienced by other economies because of the global crisis. However, recent analyses have found that China and the U.S. stepped up investment in the wake of the crisis, thanks to aggressive internal policies that improved confidence and raised attractiveness for investment (Figure 1.7).

Figure 1.7. (a) Share of world's total manufacturing investment by regions and (b) Average change in total manufacturing investment by regions between the period 2003-2008 and 2009-2013.³²



31. "Europe's re-industrialisation. The gap between aspiration and reality. Deutsh Bank Research." November 2013. European Member States competitiveness Level.

32. Commission staff working document. "Reindustrialising Europe". Member States' Competitiveness Report 2014. SWD (2014) 278.

The new global manufacturing map is increasingly biased in favour of countries that have engaged significant public-private initiatives to re-invigorate their manufacturing bases and controlled key patterns of change in manufacturing competitiveness, including cost (where Europe is not in a position to compete¹⁷) and innovation (where Europe has some assets but is losing ground).

In this fierce competition, whereas the U.S. and Mexico are thought to have lower average manufacturing costs thanks to low wage growth, sustained productivity gains, stable exchange rates and an energy-cost advantage, it is widely accepted that the future of manufacturing will largely be determined by the extent to which it can take advantage of new key technologies (KETs)³³. Future growth and competitiveness in sustainable and advanced manufacturing will be mainly unlocked by the KETs and innovation. This transition, if managed properly and early enough, could help Europe to retrieve leadership.

Indeed, research, development and innovation efforts are seen as important drivers of non-price competitiveness as they can increase the capacity to create complex sustainable, customised and innovative products leading to a differentiation into the market with embedded services. They would enable Europe to maintain its position in global value chains. The European Commission acknowledged the contribution of KETs to both innovation and productivity with regard to quality, performance and functionality of products and in reducing the costs of the manufacturing processes. KETs can achieve this by, for example, allowing real-time accurate monitoring, increasing speed, decreasing consumption of energy or materials, and improving operating precision, as well as improving environmental performance, such as with regard to waste and pollution³⁴. Investing in advanced manufacturing to respond to major European societal challenges (energy, mobility, health, climate, environment, security...) means investing in KETs¹.

1.2. EUROPEAN R&D INVESTMENTS INADEQUATELY ADDRESS INNOVATION CHALLENGES

The prior HLG-KET final report published in 2011 concluded that the weakness of Europe in efficiently converting its scientific excellence into the marketplace is a major barrier. Europe is good at developing new technologies for many different applications. Very few of them successfully end up in final products and services. Building a strong innovation framework, allowing strategic investment and funding along the whole innovation chain to reverse this situation is crucial. The HLG-KET has, therefore, repeatedly alerted the European Commission and other public authorities of the urgent need to reshuffle European priorities and rebalance European funding toward technological research and product development, including technology infrastructures, industrial pilot lines and demonstrators for prototyping, testing,

33. Georges Tassey. "Competing in Advanced Manufacturing: The Need for Improved Growth Models and Policies". *Journal of Economic Perspectives*—Volume 28, Number 1—winter 2014—Pages 27–48.

34. High Level Group on Key Enabling Technologies. Thematic Report by the Working Team on Advanced Manufacturing Systems. December 2010.

and validating activities, as well as adopting integrated industry-oriented policies in developing and deploying KETs. To do so, creating favorable framework conditions to stimulate innovation and enhance R&D investment in KETs and offering competing capabilities to European innovators is key.

Europe's performance in KETs suffers from both the lack of coherent policy approach and fierce global competition from countries that do understand their systemic importance. (Figure 1.8).

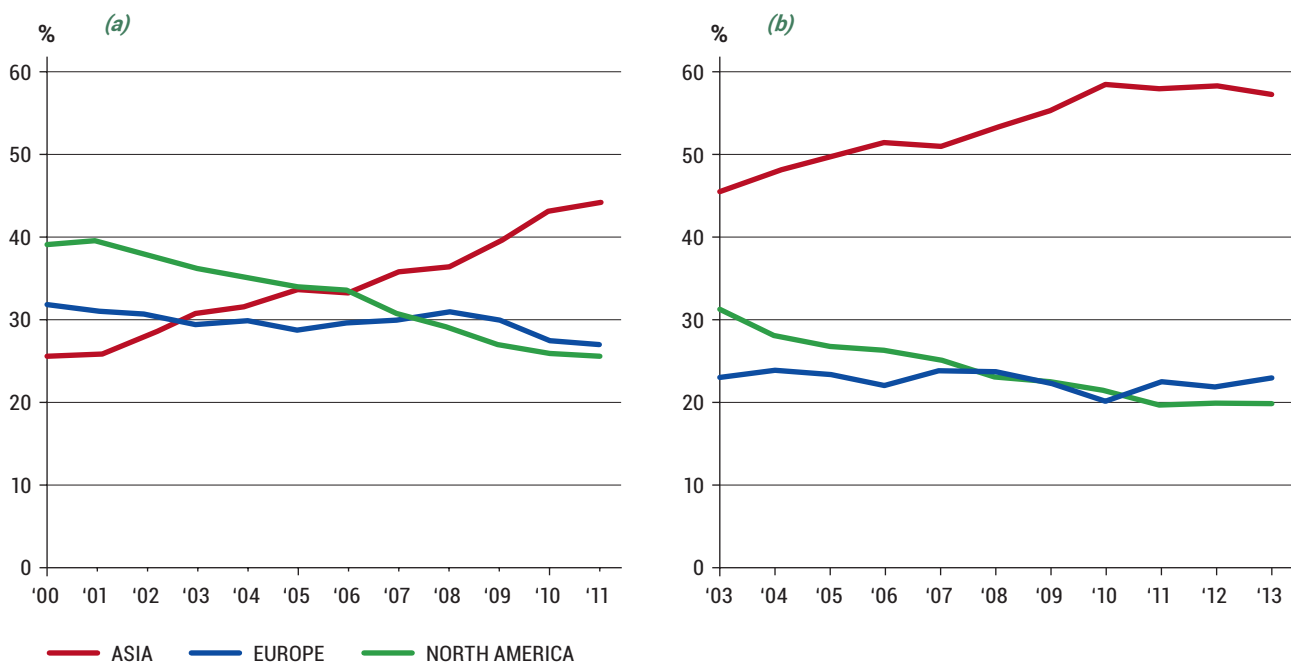


Figure 1.8. (a) Share of EPO/PCT patents by region 2000-2011
(b) export market share by region 2003-2013 (all KETs cumulated)³⁵

For instance, Asia's patent share in KETs was rather low in 2000 (26%), but has continuously increased throughout the 2000s, exceeding the patent share of the EU-28 in 2003 and of North America in 2007 and reaching 44% in 2011. Europe has progressively declined its share in KETs development with around 27% share of patent applications in 2011³⁵ (23% for North America).

Also with regard to performance in trade, Asia experienced an increase of more than 10 percentage points compared to 2003. Asia now holds a share in total export related to KETs of about 57% compared to 23% for the EU-28 and 20% for North America.

Although Europe succeeded in holding its share in total export relatively constant over the past decade, there is a clear need to adjust to the new global environment and to step up efforts to support the development and industrial deployment of KETs.

* Purchasing Power Standards (PPS) - Financial aggregates are sometimes expressed in Purchasing Power Standards (PPS), rather than in euro based on exchange rates. PPS are based on comparisons of the prices of representative and comparable goods or services in different countries in different currencies on a specific date. The calculations on R&D investments in real terms are based on constant 2005 PPS. Source: Eurostat

35. KETs Observatory. First annual report. May 2015. European Commission.

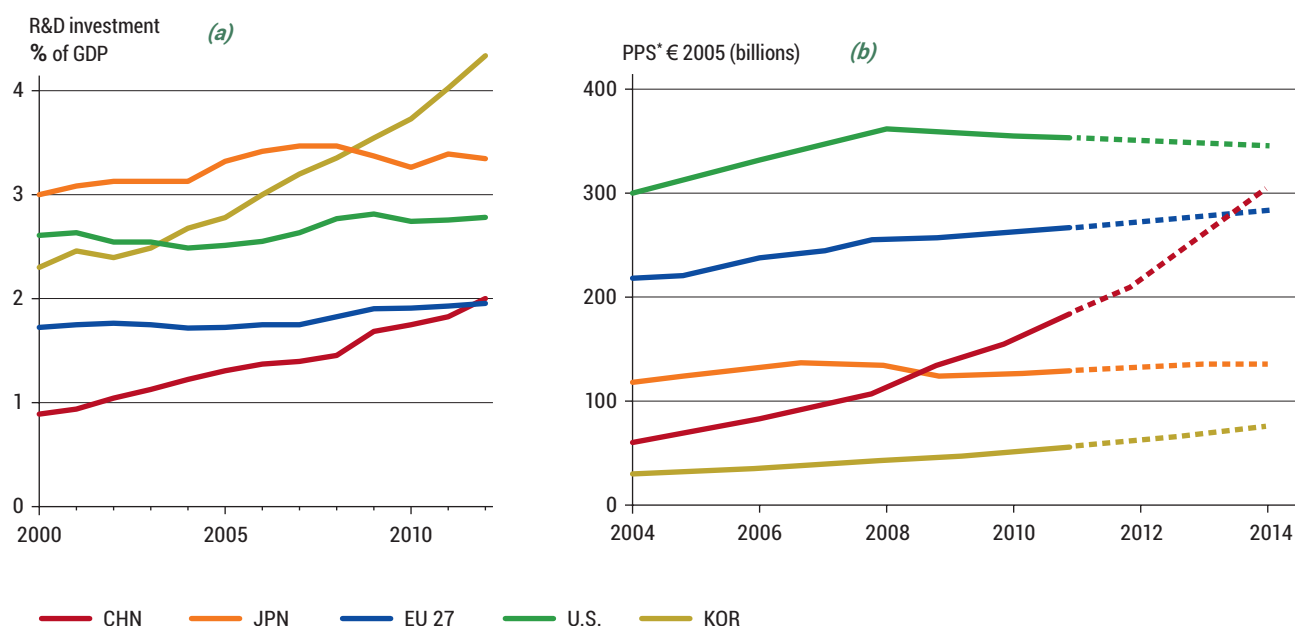


Figure 1.9. (a) Gross domestic expenditure on R&D as % of the GDP in identified regions
(b) Total R&D expenditure in real term and R&D intensity share in identified regions.³⁶

One of the reasons of this decline is the lack of appropriate and strategic use of EU funding in supporting transformative technologies with strong innovative potential and added value for manufactured products and services.

For instance, the EU has recognised research and development as a key part of the Europe 2020 Strategy, which committed to increase the share of R&D in EU GDP to at least 3%³⁶ and reorient efforts toward more effective results in the real economy. However, the EU's share of R&D is on average 2% and lags behind the U.S., Japan and other advanced economies and has been recently overtaken by China (**Figure 1.9(a)**).

In absolute terms, the Member States investment in R&D was more resilient to the economic crisis in comparison to that of the U.S. and Japan. The EU accounted for 23% of total global R&D spending in 2011, down from 27% in 2001^{37,38}. However, China shows fast and consistent growth of R&D. In 2014, China's R&D investment was expected to exceed, in real terms, that of all EU Member States combined (in PPS) (**Figure 1.9(b)**). Indeed, investment in knowledge is increasing faster in the Asian economies than in Europe and the U.S. The economies of East/Southeast and South Asia (including China, India, Japan, Malaysia, Singapore, South Korea, and Taiwan) represented 25% of the global R&D total in 2001, but 34% in 2011.

36. Innovation competitiveness report 2013. European Commission.

37. Communication from the Commission. "Europe 2020. A European strategy for smart, sustainable and inclusive growth". COM (2010) 2020

38. National Science Foundation. Science and engineering indicators 2014. Chapter 4. Research and Development: National Trends and International Comparisons.

The EU's research assets were, until recently, focused on scientific excellence; with little appreciation of economic impact and industrial deployment³⁸ (See Box “Innovation Union Competitiveness report 2013”). This has resulted in weak direct impact on European productive capacity and competitiveness and in declining industrial participation in the EU Framework Programmes (FP), from 39% in FP4 (1994-1998) to 31% in FP6 (2002-2006) and to less than 25% in FP7 (2007-2013)³⁹. To reverse this, the European Commission launched a new framework programme (Horizon 2020) with a significant part of the budget (17.6%) dedicated to promoting leadership in enabling and industrial technologies, including KETs and advanced manufacturing technologies⁴⁰.

INNOVATION UNION COMPETITIVENESS REPORT 2013

“The U.S. and Asian research and Innovation efforts are often more strategically oriented. Science and Technology development in Asia and the United States are more focused on transformative and pervasive technologies and more oriented towards emerging global markets [...]. In comparison, the EU is less focused on strategic areas and tends to scatter its efforts on a wider range of scientific fields and technologies, with the risk of dominating none”. Innovation Union Competitiveness Report 2013. Page 8. EC (2014)



Based on three main pillars, Horizon 2020 funding is expected to provide €29.7 bn for research and innovation actions on the “societal challenges” such as for climate change, renewable energy, food safety and aging. €17 bn are dedicated to industrial leadership. €24.4 bn are focused on basic research (mainly relying on the European Research Council programme) which represents 31% of the Horizon 2020 budget (more than the 26% in FP7). This proportion of upstream research should be appreciated in light of the corresponding public R&D investment that the U.S. and in China dedicate, respectively, 18 and 4.8% of their national budgets for scientific excellence, while the majority of funding is focused on close to market activities (applied research). This emphasis on industry-driven R&D and advanced manufacturing technologies is due to a desire to strengthen innovation capabilities, by accelerating the conversion of a promising idea into a practical product, process and service.

* RTOs are organisations with significant core government funding (25% or greater) which supply services to firms individually or collectively in support of scientific and technological innovation and which devote much of their capability (50% or more of their labour) to remaining integrated with the science base. (EARTO definition)

39. Interim evaluation of the Seven Framework Programme Interim. Report of the Expert group, European Commission.

40. Horizon 2020 funding for “Leadership in enabling and industrial technologies” also includes nanotechnologies, advanced materials, biotechnology, information & communication technologies, cross-cutting KETs and space technologies.

Europe still has more than half of the Top 10 of innovative economies⁴¹. However, at a broader prospect, a different situation is observed⁴². In 2014, for the first time, Asia headed the Top 100 Innovators with 46 companies from the region, comprising 39 from Japan, 4 from South Korea, 2 from Taiwan and also for the first time, 1 from mainland China. North America followed with 36 companies of which 35 were from the U.S., Europe accounted for the remaining 18 honorees.

As an example, from a pure patent application perspective (PCT)⁴³, Europe has 8 companies in the Top 50 (ranking dominated by Asian players) and only 2 Universities in the Top 50 (ranking dominated by U.S. Universities). Europe has its most impressive representation from European Research and Technology Organisations (RTOs)* that lead the first two positions (CEA and Fraunhofer) in the Top 50 world ranking of research and technology centres which is mainly dominated by Asian players (**Figure 1.10**).

This ranking demonstrates that European RTOs that are key innovators as they play an important role in the development and deployment of KETs for European industry.

Appropriate support to European innovators along the innovation chain and to key players along the value chains is crucial. To do this, the current framework and policies should be modernised to link together all development steps from idea to product and from R&D to marketplace. This would provide a coherent and integrated approach to innovation in Europe and avoid fragmentation of initiatives.

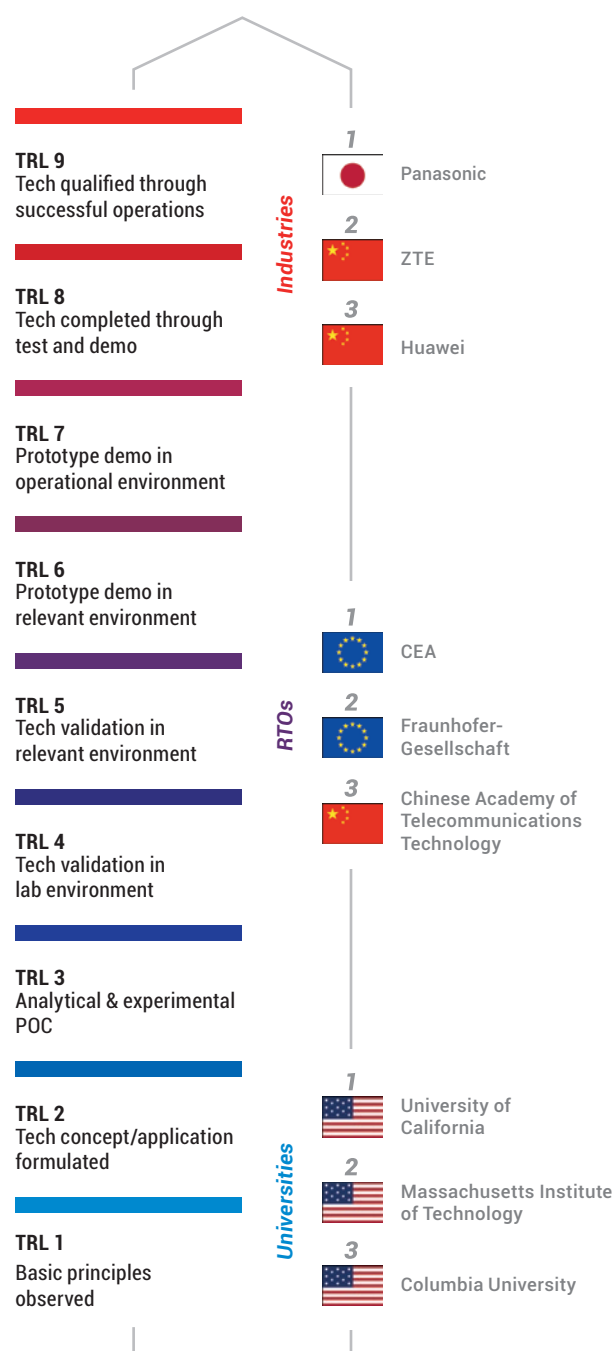


Figure 1.10. Top 3 PCT applicants distributed across TRL.⁴³

1.3. COMPETING ECONOMIES INVEST MASSIVELY IN KETs-BASED MANUFACTURING TO BOOST THEIR INDUSTRIES

European industry is still a world leader in several manufacturing sectors, e.g. mechanical engineering, with a 37% global market share. However, the role of the manufacturing industry in Europe has declined in recent years and the challenges ahead in modernising

41. The Global Innovation Index 2014: The Human Factor in Innovation. Cornell University, INSEAD, World Intellectual Property Organization (WIPO).

42. Thomson Reuters 2014 top 100 global innovators. Honoring the World leaders in Innovation. November 2014.

43. Patent Cooperation Treaty Yearly Review. The International Patent System. WIPO 2014

manufacturing processes and logistics (advanced manufacturing) need significant support and implementation of measures. Competing economies have already engaged specific actions and strengthened their policies in order to modernise their technological and industry infrastructures, stimulate technological innovation and boost their manufacturing bases to be ready for the mid and long term challenges in the manufacturing sector.

In this section we assess the effectiveness and efficiency of public intervention in the U.S. and Asian economies, aimed at supporting industrial competitiveness through advanced manufacturing.

1.3.1. Resurgence of U.S. manufacturing

From 2000 to 2010, U.S. production and investment in new capacity stagnated. Tens of thousands of manufacturing factories closed⁴⁴. The manufacturing sector lost more than 5 million jobs. The challenges faced by manufacturing led to concerns that the engine of U.S. innovation was at risk.

In response, the U.S. has engaged impressive efforts to boost its manufacturing basis that has led to substantial improvements of its manufacturing competitiveness, compared to other economies⁴⁵. Since the end of the recession, manufacturing in the U.S. has added jobs and expanded at a historic rate²⁵. Manufacturing output has increased 30% since the end of the recession, growing at roughly twice the pace of the economy overall. Between February 2010 and June 2014, the U.S. added 646,000 manufacturing jobs⁴⁵, and restored its leadership position in attracting business investment.

This was the result of recent ambitious policies that spur direct public investment (including the establishment of a national network of 45 manufacturing institutes over 10 years⁴⁶) and provide incentives for manufacturing and insourcing to *“make America a magnet for jobs and manufacturing”*⁴⁷.

In addition, this renewed growth in manufacturing has created millions of additional jobs across its supply chain and in the communities where it locates. To do so, the U.S. has managed to reinforce both its technological infrastructures and manufacturing bases, thanks to flagship initiatives such as the Manufacturing Innovation Institutes⁴⁸ and the Reshoring initiative⁴⁹.

44. Bureau of Labor Statistics. U.S. Department of labor.

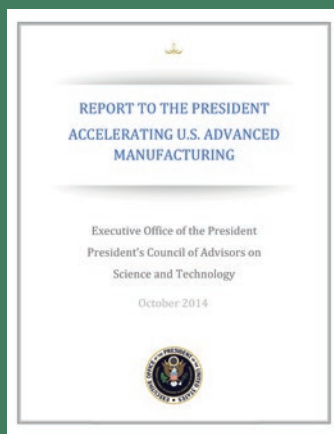
45. Making in America: U.S. manufacturing entrepreneurship and innovation. The Executive Office of the President. June 2014⁵¹.

46. “Opportunity for All: Investing in American Innovation”. The president budgets. Fiscal’s year 2015.

47. Extraction from the State of the Union speech of the President Obama. U.S. Capitol. Washington, D.C. 12 February 2013

48. Report to the president on ensuring American leadership in advanced manufacturing. President’s Council of Advisors on Science and Technology. June 2011.

49. Solving the Reshoring Dilemma. Supply Chain Management Review. January/February 2014.



NATIONAL NETWORK OF MANUFACTURING INNOVATION INSTITUTES: RE-ESTABLISHING THE U.S. AS A GLOBAL POWERHOUSE FOR MANUFACTURING AND INNOVATION

To support investment and accelerate innovation in U.S. manufacturing, the U.S. is creating a national network of manufacturing innovation institutes across the country following the recommendations of the President's Council of Advisors on Science and Technology report. The U.S. plan is to support the development and upscaling of new advanced manufacturing technologies helping smaller manufacturers to adopt new technologies to increase their competitiveness, and accelerating the transfer of new technologies from federal labs to industry.

Leveraging the strengths of a particular region, each institute will bring together companies, universities and community colleges, and Government to co-invest in the development of world-leading manufacturing technologies and capabilities that U.S.-based manufacturers can apply in production. Building on 4 institutes already launched and the 5 additional ones launched in 2014 with available funding of \$1 bn, the initiative aims to create 45 new manufacturing innovation institutes over the next 10 years (**Figure 1.11**).

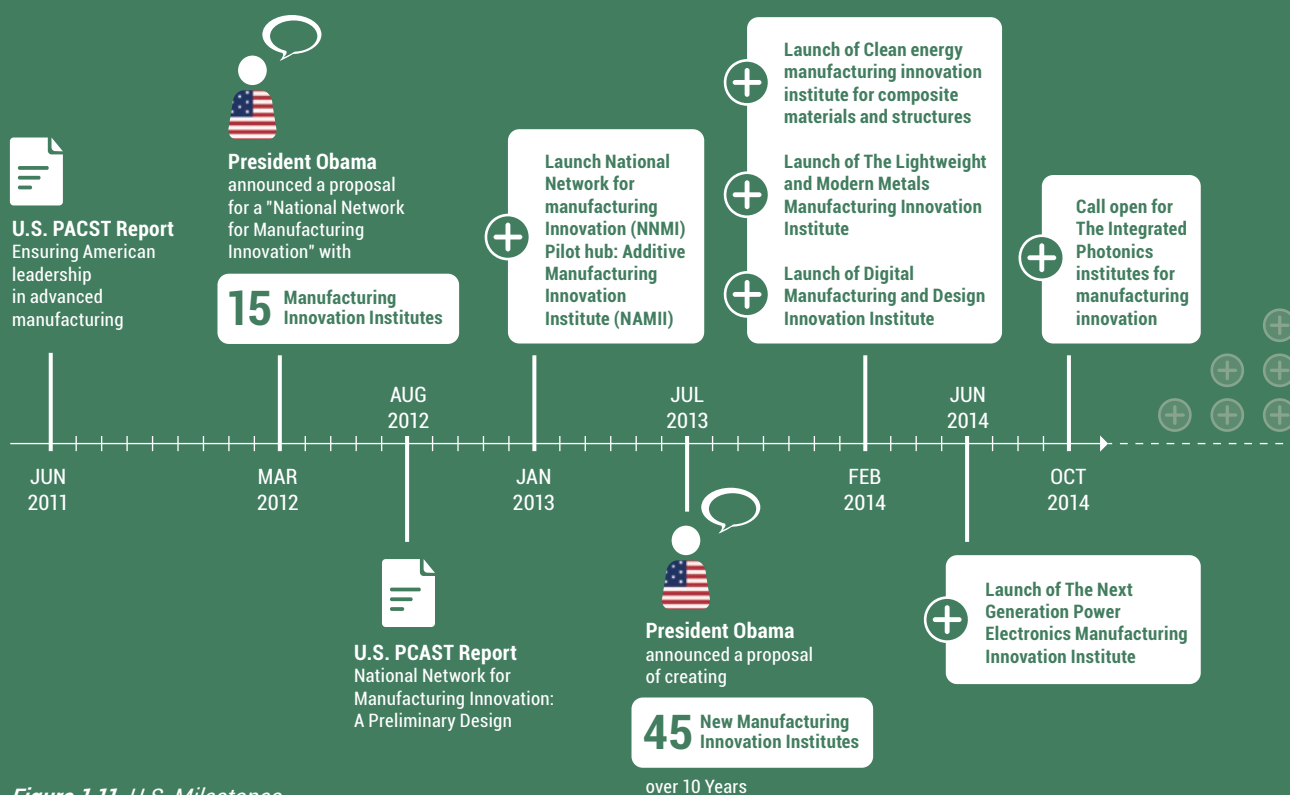


Figure 1.11. U.S. Milestones in deploying the National Network for Manufacturing Innovation.⁵⁰

50. Based on <http://manufacturing.gov/nnmi.html>

RESHORING INITIATIVE: EXPANDING SELECTUSA TO ATTRACT INVESTMENT IN THE U.S.

American manufacturers have accelerated investments in R&D in the U.S. Already the largest source of R&D, the manufacturing sector has continuously intensified private sector R&D in 2013. Moreover, according to AT Kearney's 2014 FDI Confidence Index, the U.S. surged past countries like China, Brazil and India to become the country with the top FDI prospects globally with significant investment in R&D⁵¹.

In addition, recent productivity growth has made the U.S. more competitive in attracting businesses to invest and create jobs by reducing the relative cost of manufacturing and of doing business compared to other countries. The U.S. has created a tax incentive to bring offshore jobs and invest-

ments back into the U.S., and reduced tax benefits in current law for expenses incurred to move U.S. jobs offshore. The U.S. now provides a tax credit for these communities to spur re-investment and economic revitalisation.

As a result of these policy efforts, manufacturers – like General Electric, Google, Apple, Ford, and others are building more capacity and reallocating strategic production back to the U.S. In a survey among U.S. manufacturers with offshore production, the majority of respondents (54%) are looking at reshoring to the U.S., up from 37% in 2012⁵². To expand this, the U.S. launched *SelectUSA* at the Department of Commerce, creating the first Federal action to actively attract business investment.

It is worth noticing that Manufacturing Innovation Institutes launched by the U.S. echo the recommendation of the HLG-KET on the KETs technology platforms (**See recommendation 5 of the Status Implementation Report**)⁵³ and that those institutes are created based on the potential partnership model of European infrastructure facilities for advanced manufacturing, namely European Research and Technology Organisations (RTOs).

1.3.2. Asian economies are reinforcing their capacity in high value-added manufacturing



China has massively invested in manufacturing industries (low, medium and high-tech) as a way to strengthen its economy. Its share of industry contribution to GDP is now 30%, compared to 15% in the EU and 13% in the U.S.⁵⁴. More worrisome is the fact that China is increasingly focused on export specialisation in high-tech sectors⁵⁴ having attained 22% of global share in 2010, compared to Europe's 15% share. China's immense domestic market, its installed base across a range of capital-intensive industries,

51. AT Kearney's 2013 FDI Confidence Index. "Back to business. Optimism amid uncertainty". 2013.

52. Boston Consulting Group Press Release. "Majority of Large Manufacturers Are Now Planning or Considering 'Reshoring' from China to the U.S.". September 2013.

53. Status Implementation Report. HLG-KET. July 2013.

54. The World Bank national accounts data and OECD national accounts data files (2010-2014).

and pool of skilled talent, guarantee that it will be a rising force in many manufacturing sectors. China now has large programmes to catch up in key technologies⁵⁵. Moreover, Chinese companies leverage European public funding to perform their R&D. With 22% of the market share, China is now the world's largest factory for advanced products not just serving "traditional" markets but also leveraging the potential of creating a favourable framework for a healthy internal market. The cases of photovoltaic cells and Li-ion battery sectors are striking. In addition, recent announcements on the first Chinese-built plane⁵⁶ and the merger of Chinese train makers, as part of the strategy to compete more effectively against Canadian, European and Japanese rivals⁵⁷ is in line with the rise of a global giant in advanced manufacturing.



Taiwan. Reshoring initiatives are now expanding beyond the U.S. The increasingly strategic nature of global manufacturing has resulted in key economies actively encouraging re-location of their manufacturing industry and reinforcing their own industry base. Taiwan has recently reshored 44 manufacturing companies from mainland China, potentially creating 32,000 additional jobs. After having invested more than €120

bn in mainland China, since 1990, creating 80,000 factories with more than 80 million jobs, Taiwan has set up a "taskforce" to invest in national capability for "High-Tech and innovative manufacturing companies" with an ambitious national programme to attract highly-skilled competencies and labour. Taiwanese manufacturers in China have become less willing to step up investments in mainland China, with the growth of investments in Taiwan outpacing those in mainland China for the first time in years⁵⁸.



India. "Make in India" is an initiative of the Government of India to encourage companies to manufacture their products in India⁵⁹. It was launched by Prime Minister Narendra MODI on September 25th 2014. The objective is to increase the manufacturing sector growth to 12-14% per year over the medium term and increase the share of manufacturing in India's GDP from 16 to 25% by 2022, creating 100 million

additional jobs by 2022. 8 National Investment and Manufacturing Zones (NIMZ) along the Delhi Mumbai Industrial Corridor (DMIC) have been announced. 9 projects have been approved by the DMIC trust. 3 more Industrial Corridors connecting India's regions are under different stages of development. Additional capacities are being installed in major manufacturing industries. These include an incentive process for the manufacturing industry to access public procurement. NIMZs are conceptualised as integrated industrial townships of at least 50 sq km (5,000 hectares) with world-class infrastructure.

55. China's National High-Tech Research and Development Programme, also known as the 863 Programme. It focuses on the application of cutting-edge technologies in certain key areas in the "National Long-term Scientific and Technological Development Plan (2006-2020)". National Key Technologies R&D Programme mainly supports R&D, application and demonstration in areas like energy, resources, environment, agriculture, material, manufacturing, transportation, information industry and modern service industry, population and health, urbanization and urban development as well as public security.

56. Reuters. "China's homemade regional jet gets licence to fly". 30 December 2014.

57. Financial Times. "Chinese train makers agree \$26bn merger". 31 December 2014.

58. The Taiwan Electrical and Electronic Manufacturers' Association report. "The Investment Environment and Risk Survey of Mainland China". 2014.

59. Boston Consulting Group. "Make in India: Turning vision into reality". November 2014



South Korea recently launched “the Creative Economy Industrial Engine Project and the Manufacturing Industry Innovation 3.0 Strategy”⁶⁰. The public and private sectors are expected to raise €1 bn to set up 10,000 smart factories by 2020 so as to speed up the reform of the manufacturing industry through information technology and software convergence. At the same time, they foster the growth of those segments combining manufacturing with information technology, examples of which include the incorporation of information technology into the energy sector. Also, the core material and component and electronic devices development, engineering, design and software segments are receiving concentrated support for the enhancement of industrial competitiveness. 10 key materials are to be developed by 2019, and the development of engineering, design and embedded software is supported. A public-private committee was set up in order to monitor and assess the implementation of this strategy.

In addition, the Korean government promotes investment and expanded infrastructure support based on “the Three-year Plan for Economic Innovation”. Policy measures to promote investment include reforming regulation, supporting investment for SMEs, expanding investment in safety facilities, boosting ventures and start-ups, investing in activating suspended business projects due to strict regulations, and increasing R&D investment. In order to expand infrastructure investment, the government will spend €70 bn on this plan over 2014-2017, while also promoting large-scale infrastructure projects through PPP.

1.3.3. EUROPE AND RESHORING



After years of shifting production to Asia, European companies are increasingly considering reshoring as a business opportunity. In October 2014, a PricewaterhouseCoopers (PwC) survey of 384 euro zone non-financial companies found almost 60% had reshored some operations, mainly production, over the past year, against 55% which had done the opposite. Italy topped the reshoring list with 44 companies, while Ireland, Germany and Spain also featured prominently. For instance, according to another analysis from PwC, reshoring has the potential to create between around 100,000 and 200,000 extra UK jobs over the next decade in different sectors from textiles and advanced manufacturing to business support services and R&D, and boost annual national output by around £6-12 bn by the mid-2020.⁶¹ The European Parliament has also already highlighted the benefits of “reshoring”⁶². However, no coordinated actions exist (or are expected) within the EU to promote and facilitate European companies return and reinvestment in Europe. The way forward for Europe to remain competitive is to ensure integrated actions, joining the forces of political leaders and private stakeholders to re-industrialise Europe⁶³.

60. <http://english.motie.go.kr/?p=5416>

61. PricewaterhouseCoopers. “UK Economic Outlook”. November 2014.

62. European Parliament research service. Briefing document. “Reshoring of EU manufacturing”. March 2014.

63. HLG-KET document. KETs for a competitive Europe. February 2014.

1.4. CONCLUSION

At present, it is a positive signal that manufacturing is receiving improved recognition from the European Commission as “of key importance for Europe’s economic recovery and competitiveness”⁶⁴ establishing the goal to increase the manufacturing share to 20% of European GDP by 2020. However, according to The Observatory on Europe⁶⁴, to achieve this objective, the European manufacturing sector will have to generate an additional €841 bn in value added by 2020 which corresponds (at current productivity levels) to creating more than 15 million new manufacturing jobs by 2020 (**Figure 1.12**); this last being equivalent to the total of Italian and German manufacturing jobs put together⁶⁵. This is a real challenge which would remain even with “spectacular” productivity growth superior to 3% in the European zone (that currently culminates barely to 0.8%⁶⁶).

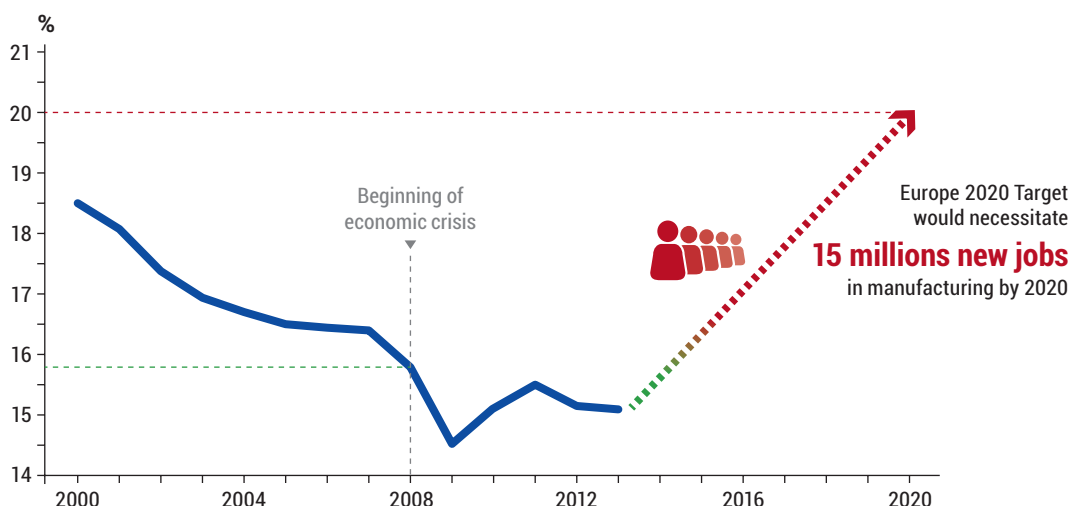


Figure 1.12. Manufacturing share in the total European Gross Domestic Product (GDP) and requirements of the 20% target in terms job creation.²²

Such figures underline the ambition of the target, which is extremely challenging, not to say “unrealistic”. Recovering the pre-crisis level performance seems an “achievable” and more appropriate objective. If so, the EU has to reinstate rapidly to a position where it can effectively compete. To do this, Europe has to engage massive political, financial and industrial efforts toward the development and industrial deployment of KETs. This should include: a rebalancing of public R&D&I funding closer to market activities, assessing the real impact of public R&D funding on the European economy and deploying KETs effectively into capital goods, professional equipment and machinery, consumer’s products and services.

64. Observatory on Europe 2014. “Improving European Integration and Competitiveness”. The European House Ambrosetti. 2014

65. Eurostat

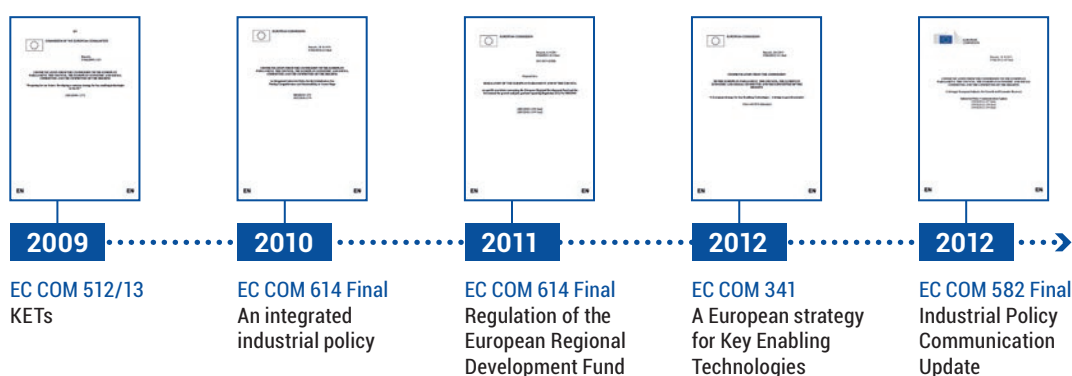
66. The information technology & innovation foundation. “Raising European Productivity Growth Through ICT”. June 2014.

CHAPTER 2:

IMPLEMENTATION OF THE EUROPEAN STRATEGY FOR KETs: STATE OF PLAY

The first High Level Expert Group on Key Enabling Technologies (KETs) in its 2011 report recognised the strategic importance of KETs for the competitiveness of both high-tech and traditional European industry. The European Commission reinforced this by setting out a coordinated European Strategy for KETs¹, recognising them as a crucial elements of the research, development and innovation (R&D&I) within the Horizon 2020 programme², as one of the investment priorities for the European Structural and Investment Funds (ESIF)³ and a key pillar of the new European industrial policy⁴ (See Figure 2.1). The European Strategy for KETs aims to trigger the manufacturing of KETs-based products in the EU and to gain manufacturing industry competitiveness in order to stimulate growth and jobs.

Figure 2.1.
European Support
on KETs policy
Milestones.



2.1. EUROPEAN COMMISSION HIGH LEVEL EXPERT GROUP ON KEY ENABLING TECHNOLOGIES

In its communication of 2012, the European Commission announced the establishment of “an external KETs Issues Group that will advise the Commission on KETs related policy issues”¹ which was launched on February 23rd 2013 in Brussels, in the presence of four former European Commissioners; for Industry and Entrepreneurship, Antonio TAJANI, for the Digital Agenda, Neelie KROES, for Research, Innovation and Science, Maire GEGHEGAN-QUINN, and for Regional Policy, Johannes HAHN. The remit of the group was to:

- discuss and advise the European Commission on any KETs-related policy issues;
- follow up the implementation of the European Strategy for Key Enabling Technologies adopted by the European Commission on June 26th 2012;
- promote the development of KETs policies by European Member States.

This group (See Appendix 1) comprised representatives from key players along strategic European value chains, including technology representatives from each of the six KETs, down-stream industry, cross-cutting KETs, civil society, the European Investment Bank, as

1. Communication from the European Commission. “A European strategy for Key Enabling Technologies – A bridge to growth and jobs”. COM (2012) 341 final.

2. Regulation (EU) No 1291/2013 of the European Parliament and of the Council of 11 December 2013 establishing Horizon 2020 – the Framework Programme for Research and Innovation (2014-2020) and repealing Decision No 1982/2006/EC.

3. Regulation (EU) No 1301/2013 of the European Parliament and of the Council of 17 December 2013 on the European Regional Development Fund and on specific provisions concerning the Investment for growth and jobs goal and repealing Regulation (EC) No 1080/2006.

4. Communication from the European Commission. “For a European Industrial Renaissance”. COM(2014) 14 final.

well as representatives of relevant contractual Public-Private-Partnerships (cPPPs). The European Commission requested an immediate analysis of the bottlenecks and potential solution paths to the rapid implementation of the KETs strategy in Europe. Along with this analysis, the HLG-KET proposed a set of recommendations in its “Status Implementation Report”⁵, identifying critical measures to ensure the effective deployment of the European KETs strategy (**Figure 2.2**).

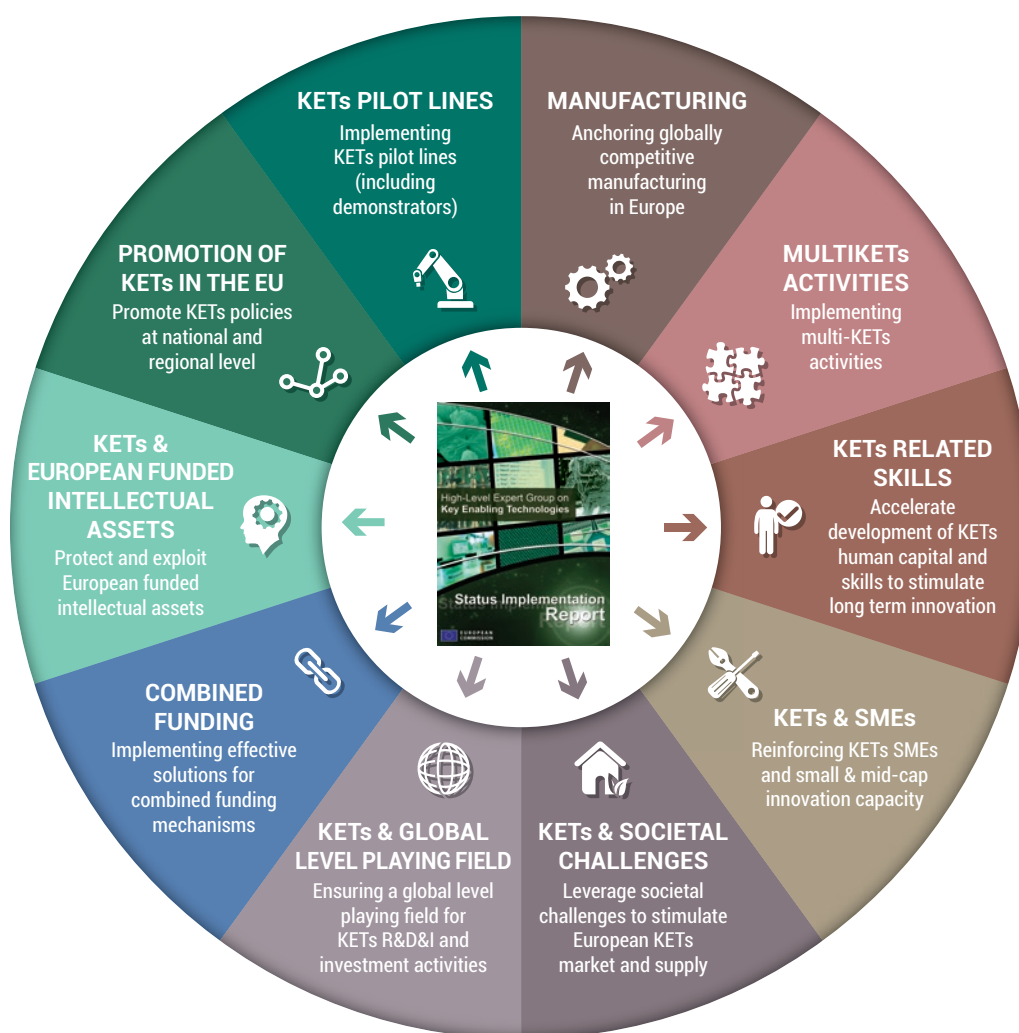


Figure 2.2.
Recommendations
of the HLG-KET,
outlined in the “Status
Implementation
Report”. July 2013.

Throughout its mandate, the HLG-KET has continuously advised and informed public authorities and private stakeholders on the urgency to take actions toward an integrated KET innovation and manufacturing policy (see **Figure 2.3**), through a number of reports and documents.

HLG-KET Document: KETs for a competitive Europe

The HLG-KET has repeatedly informed the European Commission that manufacturing in the European Union has declined over the past decades with Europe facing a “tsunami” of competitive and industrial threats from both Asia and the U.S. In addition, the HLG-KET warned

5. HLG-KET Report. “Status Implementation Report”. July 2013.
See http://ec.europa.eu/enterprise/sectors/ict/key_technologies/kets_high_level_group_en.htm



Figure 2.3. Deliverables of the second European Commission High Level Expert Group on Key Enabling Technologies.

that Europe is also progressively losing ground in the global competition on KETs development and deployment to Asian competitors.

In view of the European Council of March 2014 the HLG-KET issued a document “KETs for a Competitive Europe”⁶ to invite the European Council to:

- acknowledge that KETs-based technologies and products are instrumental to meet the EU Industry policy, and Climate and Energy package targets.
- provide political support to the European Commission in the rapid elaboration of a favorable European KETs innovation landscape along with a competitive European KETs-based manufacturing industrial policy.

The European Council was invited to declare KETs as a key priority of the EU, by launching a political process in connection with relevant stakeholders, to pave the way for a massive integrated action in the EU, and put in place the necessary favorable landscape for a European KET-based innovation and manufacturing policy.

HLG-KET Communication: KET MANIFESTO (See Appendix 2)

A KET Summit was organised on May 19th 2014 in Grenoble-France, in the presence of Michel BARNIER, former European Commissioner for Internal Market and Services and former acting Commissioner for Industry and Entrepreneurship, Geneviève FIORASO, former French Secretary of State of Higher Education and Research, and Jean THERME, President of the European Commission High Level Expert Group on Key Enabling Technologies. The former Commissioner BARNIER addressed the HLG-KET and requested a “KET Manifesto”⁷ as a support document to be conveyed to newly elected Members of the European Parliament, highlighting the importance of KETs to growth and jobs in Europe.

2.2. STATUS OF IMPLEMENTATION OF EUROPEAN KETs STRATEGY

The HLG-KET acknowledges that progress has been made on the implementation of the European KETs strategy (see Figure 2.4). Firstly, the European Commission has adopted some of the recommendations made and aligned several instruments in support of KETs deployment; in particular Horizon 2020, Structural Funds and the European Investment Bank have all identified KETs as a priority. Secondly, new state aid rules introduced in the European Commission communication of May 2014⁸ will allow Member States to better support KETs

6. HLG-KET document addressed to the European Council of March 2014. “KETs for a competitive Europe”. February 2014.

7. KET MANIFESTO. “Key Enabling Technologies. Cornerstone of the European industrial renaissance”. July 2014.

8. Communication from the European Commission. “Framework for state aid for research and development and innovation”. COM (2014) 3282.

investments, notwithstanding, all these actions fall short and are still far from ensuring a level playing field for European industry. Thirdly, other actions are starting to promote the required multidisciplinary skills, as well as to facilitate access of industry to KETs technology infrastructures in order to boost industry innovation capabilities.

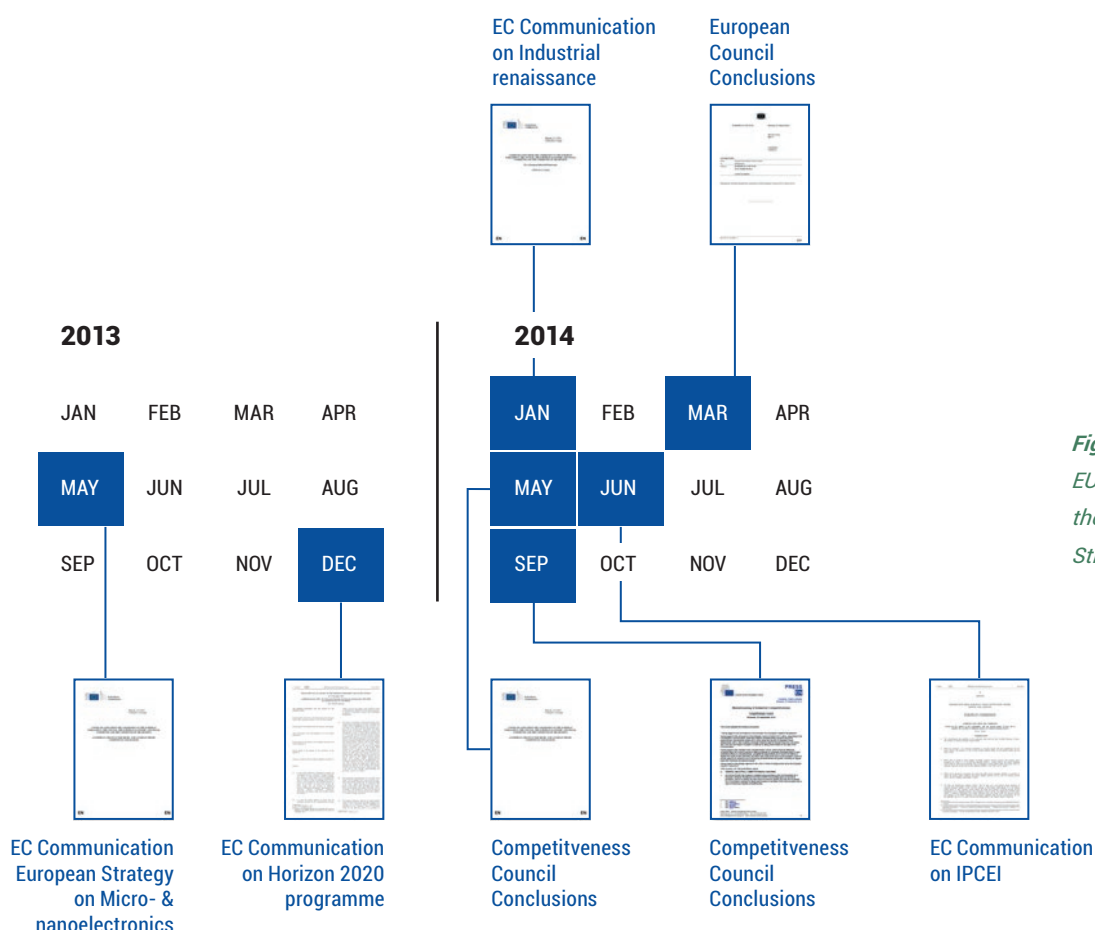


Figure 2.4.
EU milestones of
the European
Strategy for KETs.

As regards governance and involvement of key stakeholders in the KETs strategy implementation, the European Commission established in 2013 a KETs Member States' group to stimulate discussion and exchange of views between the HLG-KET and representatives of the EU Member States and ensure synergies between European and national/regional level. The European Commission also established an interservice group consisting of 15 Directorate Generals to coordinate KETs-related issues under a wide industrial policy umbrella.

As requested in the mandate to the HLG-KET, this chapter provides an assessment of the implementation of the European Strategy for KETs⁹, in order to strengthen and make the most of the unexploited potential of the European policy on KETs, building on the recommendations of the HLG-KET in its "Status Implementation Report". Each issue which was the focus of a recommendation is addressed in this chapter, first by highlighting achievements made to date in the implementation, and then by providing a brief analysis of opportunities that should be pursued to achieve the full potential of the implementation.

9. This assessment is based on the official and public policy documents from the European Commission and the European Council

Implement pilot lines (including demonstrators)



The High Level Group recommends that the European Commission as well as Member States and regions stimulate the reindustrialisation of Europe by accelerating product development and manufacturing capabilities in Europe and, supporting the implementation of industrial pilot lines (including demonstrators), in all KETs strategic industrial sectors and value chains, with the strong commitment of industry.

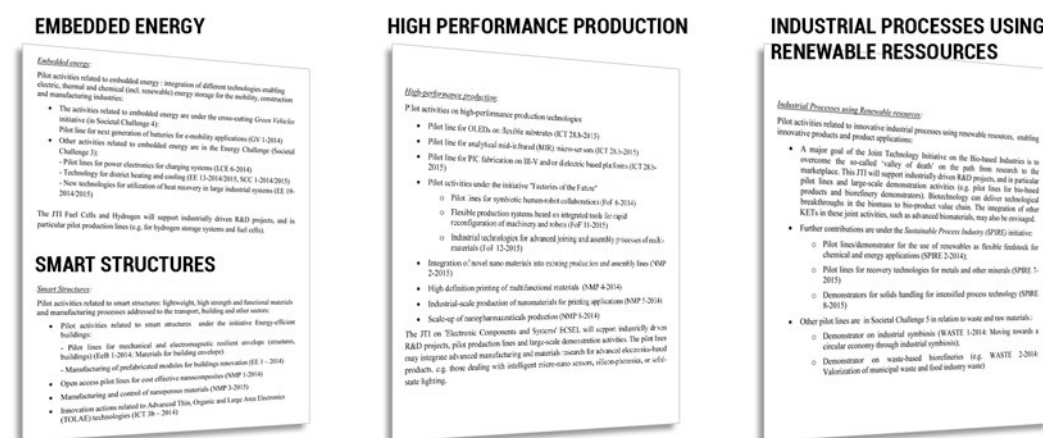
The HLG-KET invited the European Council to provide a political impetus to the implementation of a favourable European KETs innovation landscape [...] and prioritise a KETs innovation [...] and related public investment in the Union.

ACHIEVEMENTS

Horizon 2020 includes initial steps towards closer-to-the-market projects (including pilot lines and demonstrators), a priority for the cross-fertilisation between KETs as well as the inclusion of market-oriented selection criteria in order to increase industry participation along the value chains (business and exploitation plans, commitment to first manufacturing in Europe, introduction of Technology Readiness Levels in topics, etc).

The first Horizon 2020 work programme 2014-2015 called for more than 20 KETs pilot lines in areas of high industrial interest and innovation potential earlier identified by the HLG-KET.

Figure 2.5. KETs pilot lines box in Work Programme 2014-2015 of Horizon 2020.



The ENIAC JU that focused on micro- and nanoelectronics has pioneered in funding 14 KETs pilot lines projects in its calls of 2012 and 2013¹⁰. The strong industrial participation in such projects demonstrated the interest in using innovative technologies (KETs) to develop industrial prototypes products. Indeed, with participation share of 39% of SMEs, 30% of large firms and 31% of RTOs/academia, the selected projects demonstrated the full commitment and integration of key players of European Microelectronics value chains from material and equipment manufacturing to design and volume production of micro- and nanoelectronics components and systems. The strong interest demonstrated by the private stakeholders

10. <http://www.eniac.eu/web/index.php>

and the public authorities to support these pilot lines show their strategic importance. The new JU ECSEL¹¹ operating since 2014 put into effect the new European Electronics strategy that aims to strengthen the competitiveness and growth capacity of the micro- and nanoelectronic industry in Europe by rebalancing appropriate funding toward close to market activities and focusing on high value-added activities. The 2014 ECSEL call resulted in funding a further six pilot lines for future production projects with total European Commission funding approaching €95 M of the total €200 M public funding. Calls for KETs pilot lines are open to link-up European manufacturers with technology companies, chip designers, and researchers at the very earliest stages of product development to give European industry and products a competitive edge. As an example, a leading semiconductor company and its partners piloted breakthrough technologies that resulted in a sizable industrial investment.

In addition, KETs are now one of the investment priorities for the European Structural and Investment Funds (ESIF); the Structural Funds can be used to finance KETs pilot lines that are much closer to the market, even up to the first production stage.

Implement multi-KETs activities



The High Level Group recommends that the European Commission dedicates EC support for multi-KETs to pilot lines (including demonstrators) in the TRL range 5 to 8. The High Level Group identified test cases of multi-KETs pilot lines of high industrial interest and significant capital investment that could be carried out with support of the European Commission, Member States and regions. The High Level Group recommends to strengthen coordination and links, including joint calls to invest in pilot lines, between PPPs and other initiatives of the different pillars of Horizon 2020.

ACHIEVEMENTS

The first Horizon 2020 work programme 2014-2015 called for more than 20 KETs pilot lines in four multi-KETs areas of high industrial interest and innovation potential earlier identified by the HLG-KET (high-performance production, embedded energy, smart structures, and industrial processes using renewable resources). These four areas were integrated in the work programmes of NMP and ICT as well as in 5 contractual PPPs (Factory of the Future (FoF), Energy efficient Building (EeB), Green Vehicle (GV), Photonics and sustainable process industry (SPIRE) and the JTI Bio-Based Industry (BBI)).

Around 30% of the Horizon 2020 budget will be dedicated to activities integrating different KETs. As one of the projects launched by the European Commission, 'RO-cKETs' (Roadmap for cross-cutting KETs) helps the EC to identify promising areas of innovation for cross-cutting KETs that address clear industrial and market needs in a broad number of industrial sectors. The multi-KETs pilot lines project helps to foster a common understanding and consensus for future actions in Europe by focusing on multi-KETs pilot lines.

11. Communication from the European Commission. "A European strategy for micro- and nanoelectronic components and systems". COM(2013) 298 final.

Implement effective solutions for combined funding mechanisms



The High Level Group recommends the European Commission, Member States and regions to ensure that their funding instruments provide a workable solution allowing to cumulate different funding sources (H2020, ESIF, COSME, EIB, ESF, etc.) via combined funding mechanisms, in line with the short competitive and industrial timeframe constraints. In particular industrial pilot line projects with significant capital investment, require exploiting the possibilities offered by Articles 55, 60, 87 of the proposed Common Provisions Regulation for Cohesion Policy, in the context of the Smart Specialisation strategy.

ACHIEVEMENTS

The rules for participation and dissemination in the Framework Programme for Research and Innovation (2014-2020) Horizon 2020 (Art. 37) and the rules of Cohesion policy (Art. 65 (11)) of Common Provision Regulation have been changed to make it possible to give two EU grants to the same beneficiary for the same project (subject to the absence of double financing of the same cost item). A guide on good practices to establish synergies (including the combination of funding) between ESIF and other EU instruments has been published. The first Horizon 2020 calls in the work programme 2014-2015 encouraged synergies between Horizon 2020 and national/regional R&D&I programmes (including ESIF).

ADDITIONAL OBJECTIVES TO BE PURSUED

KETs pilot line is the central pillar of the “three-pillar bridge” model recommended by the HLG-KET and at the core of the European Strategy for KETs adopted by the European Commission. It was identified as the missing link in the innovation chain, between technological research and competitive large-scale manufacturing. To do so, appropriate KETs technology pilot prototyping facilities* are crucial to both demonstrate and deploy operations at real scale of relevance in terms of user performances.

Beyond the positive steps undertaken by the European Commission in launching KETs pilot lines, a number of issues remain:

- Calls for pilot lines projects in Horizon 2020 were very broad in scope in order to maximise participation which resulted in a very large number of participants at the expense of the real potential of applicants in creating value and manufacturing jobs in Europe. For instance, the 4 published calls on Nanotechnologies, Advanced Materials, Biotechnology and Advanced Manufacturing and Processing programme (NMPB) received 90 eligible proposals, among which only 10 were selected for funding (with a success rate down to 11.1%)¹². Whilst this success rate might be appropriate for up-stream research, it is singularly unattractive for major European KETs industry. The European Commission should ensure that its public funding is allocated to projects that create value and avoid refinancing projects that have underperformed.

* The main purpose of a pilot line is to enable industry to fabricate a significant quantity of innovative product prototypes arising from internal or external KETs development and allow industrial prototype product development, test, qualification and validation.

12. Source: European Commission.

- The funding available for pilot lines in Horizon 2020 (WP 2014-2015) does not meet the ambition of industrial pilot line projects which are capital-intensive and close to market. For example, €66 M was provisioned by the European Commission as grants to fund the ten selected projects under NMPB programme, which represents an average of only €6.6 M per project. In addition, the available public funding is too weak to be consistent with the necessary scale of private funding (ex. EIB lending), which constrained the ambition of Horizon 2020 calls to only small scale projects.
- The impact of the pilot line concept could be considerably increased by making a better use of the leverage available in Joint Undertakings such as ECSEL that demonstrated the capability to fund KETs industrial pilot line projects of adequate size by combining European Commission and Member States contributions.
- Though a guideline has been published by the European Commission to ensure synergies between ESIF and other EU instruments, to date there is no workable and effective solution to cumulate funding in a single project. In addition, this synergy should not target only cumulative funding but should go beyond purely financial topics. For instance, R&D&I projects funded under Horizon 2020 and cumulating funds from ESIF, require more common planning and coordination between instruments and between public authorities to facilitate the evaluation, selection, launch and execution of projects. Further progress is needed.
- Contractual Public-Private Partnerships (cPPPs) are R&D&I initiatives primarily led by industry. During the Framework Programme (FP7), these acted already as pioneers by often funding demonstration projects close to the market. Within the framework of Horizon 2020, the execution of calls and project reviews should therefore maintain and reinforce its focus on implementation, taking into account the potential impact in creating business opportunities, growth and jobs. The European Commission should be encouraged to raise its support to those priorities of the PPPs that fund close to market activities. At the same time, the Commission should also provide sufficient funding to achieve a significant positive industrial impact.

Ensure a global level playing field for KETs R&D&I and investment activities



The High Level Group, in the context of the ongoing modernisation process for state aid, recommends that for KETs-related projects the European Commission accelerates the notification procedure, proactively facilitates that relevant KETs-related initiatives qualify as Project of Common European Interest, and renders the matching clause under R&D&I Framework operational. The High Level Group recommends that bilateral and multilateral trade negotiations should be used by the EU and Member States to address the transparency of third countries state aid.



The HLG-KET invited the European Council to modernise European Commission state aid policy and promote and accelerate the execution of “Important Projects of Common European Interest” in strategic KETs related industrial sectors.

ACHIEVEMENTS

State aid has been modernised and thus allows Member States to better support KETs investments, notably by reforming the R&D&I guidelines, the General Block Exemption Regulation and the Risk Finance Guidelines (e.g. doubled notification thresholds, increased maximum aid intensities, global competitiveness taken into account in the assessment by the EC, state aid to support pilot lines and demonstrators, etc). A communication on Important Projects of Common European Interest (IPCEI) has been adopted by the European Commission in June 2014, highlighting the importance of this instrument for the KETs strategy and allowing flexibility in funding capital intensive costs¹³. In response, four areas (high-performance production, embedded energy, smart structures, and industrial processes using renewable resources) identified by the HLG-KET were mentioned in the European Council Conclusions of March 2014 as of high industrial interest with significant potential to be investigated as IPCEIs. Additional proposals issued from the Electronic Leaders group (ELG) are also being discussed under the microelectronic topic (Fully Depleted Silicon-On-Insulator (FDSOI), Power electronic devices and integrated circuits, MEMS and Sensors for Internet of Things (IoT), advanced equipment and advanced CMOS technologies). The European Road Transport Research Advisory Council (ERTRAC) is also discussing an IPCEI on Connected & Automated Driving as an opportunity to further leverage the substantial private investments in this topic. IPCEI on transforming CO₂ into value for a rejuvenated European economy is also considered.

ADDITIONAL OBJECTIVES TO BE PURSUED

Concerning the provisions of the Commission guideline on regional state aid 2014-2020, the HLG-KET observed consistency with a former guideline. The HLG-KET fully acknowledged the objective of the guideline to implement the EU internal market and to create a level playing field within the EU.

On the other hand, the HLG-KET observed that the guideline is the strictest regulation on state aid fostering large investment worldwide. In most regions, no aid regulation exists at all.

Moreover, the HLG-KET observed that neither WTO provisions nor Bilateral Trade Agreements enabled the European Commission Directorate General for Trade (DG Trade) to really ensure a global level playing field for large investments. This is especially true since some WTO rules on subsidies and countervailing measures had been phased out in the year 2000. This change of the game motivated other regions to implement attractive investment aid. Only the EU kept strict regional aid provisions.

The HLG-KET observes that the communication on IPCEI and the provisions of the Investment Plan for Europe (called the “Juncker Investment Package”) represents early steps towards meeting that concern. In view of the strong and justified political will for more investment that generates growth and jobs in Europe, the HLG-KET observed that preliminary proposals insufficiently address manufacturing-related projects that are a main source of growth and job creation.

13. Communication from the European Commission. “Criteria for the analysis of the compatibility with the internal market of state aid to promote the execution of important projects of common European interest”. (2014/C 188/02)

Reinforce the KETs innovation capacity of SMEs



Considering the vital role of SMEs in job creation and innovation in the European Union, and their difficulties to install or have access to pilot line or early stage prototyping facilities, due to limited resources, business size and financial capacities, the High Level Group recommends the European Commission to proactively support specific actions to promote and enable pan-European access to a set of European KETs technology platforms, to accelerate the entry to the market of early-stage KET-based prototypes, enabled by SMEs, in coordination with EU value chains.

ACHIEVEMENTS

The SME instrument under Horizon 2020 was launched to support close-to-market activities, with the aim to give a strong boost to breakthrough innovation enabled by SMEs. This instrument provides grants for SMEs across two main phases of development: “feasibility assessment stage”, and “innovation development & demonstration purposes”. Even if calls are dedicated only to SMEs, cooperation between SMEs and other “bodies” (that could include KET technology infrastructures) is made possible by subcontracting.

The European Commission has implemented in Horizon 2020 the Fast Track to Innovation (FTI) pilot to promote close-to-the-market innovation activities, in any area of technology or application. This programme will offer the possibility for all kinds of innovation actors (including SMEs) to work together and deliver innovation onto the market and/or into society. Based on preliminary experience and the good fit with future needs FTI should be continued beyond 2016.

The European Commission ICT programme has launched:

- The “I4MS Initiative” (ICT for Manufacturing SMEs) to help SMEs develop and deliver highly innovative products that are produced economically and at high quality, taking advantage from the newest advances in ICT. Experiments are implemented with the help of pan-European networks of competence centres.
- The “Smart Anything Everywhere” (SAE) initiative which supports product and service innovation through digital technologies. Clustered in four initial projects that started in January 2015 this initiative is based on networking of 23 of Europe’s leading competence centres in the components and systems value chain across 11 Member States aiming to support 100 user-supplier experiments with 200 SMEs and mid-caps.
- The “ACTPHAST” project that supports and accelerates the innovation capacity of European companies by providing them with direct access to the expertise and state-of-the-art facilities of Europe’s leading photonics technology platforms (23 partners). The ACTPHAST innovation service approach provides a single contact point for SMEs and is reaching out to companies by teaming up with regional competence clusters.

A tender project “European Tender-Support to the KETs Action Plan with a focus on promoting cooperation between EU KETs Technology Platforms” was also launched by the European Commission with the aim to explore best practices and to provide recommendations for helping SMEs, including facilitating their access to KETs technology infrastructures.

ADDITIONAL OBJECTIVES TO BE PURSUED

The HLG-KET has stressed the strategic importance of providing manufacturers SMEs with the capabilities to access KETs-related infrastructures (private or public). This was the basis of recommendations set out in the HLG-KET Status Implementation report of 2013 requesting support for Pan-European access of SMEs to a set of KETs technology infrastructures to accelerate time to market. Indeed, most SMEs cannot afford the investment needed to operate a pilot line (capital-intensive) even if a public grant is provided. A number of SMEs are also located far from existing KETs technology infrastructures and are even not usually aware of the quality of facilities they can access. They also evolve in a particular business, usually “mono-product” requiring primarily low scale production. Some innovative SMEs have cutting-edge technology in-house, but often no pilot lines or/and manufacturing infrastructure to turn the technology into consumer goods and services.

The SME instrument launched by the European Commission is very competitive, business-oriented and focused on creating impact, bringing high-potential innovations closer to the market, but not covering all applications fields; nor providing support to link SMEs with suppliers of the technology.

Consequently, the HLG-KET has repeatedly stressed the urgency to earmark and support manufacturing SMEs with appropriate R&D and manufacturing capacities to assist them to accelerate development and fabrication of the early series of product prototypes. Technology and validation infrastructures could be public (mainly provided by Research and Technology Organisations (RTOs)) or private (large firms), and allow:

- Cooperation between SMEs and RTOs which provide technology and validation infrastructures as well as high-skilled staff and suitable know-how is particularly relevant in the KETs area. The European Commission should ensure access of SMEs to technology infrastructures and know-how available in Europe, speeding up KETs development and ensuring first mover benefits: patents, early investment in plants and production, early market penetration, gaining manufacturing know-how, pulling ahead of the competition. The European Commission should support such cooperation and access of SMEs to top-notch technology and validation infrastructures by identifying and supporting cooperative calls of capable SMEs and suitable RTOs. This can be done with existing instruments in calls focusing on KETs under the industrial competitiveness and the societal challenges pillars of Horizon 2020, the SME instrument, and the Fast-Track-to-Innovation instrument.
- The cooperation of SMEs and larger firms and RTOs is equally important since it is the fundamental basis of a strong ecosystem offering a fertile environment for SMEs to innovate and develop new regional competitive advantages, speeding up the scale-up of businesses, creating jobs and thereby contributing to growth and prosperity. This cooperation covers development, scale-up, technology insertion and global roll-out/marketing of new technologies. It can therefore provide speed and lift to European KETs and should be supported by special calls focusing on this kind of cooperation under the industrial competitiveness and the societal challenges pillars of Horizon 2020 and the Fast-Track-to-Innovation instrument.

Anchor globally competitive manufacturing in Europe



The High Level Group recommends that the European Commission puts in place the appropriate political, financial and regulatory environment which will allow the European Union to both attract and maintain globally competitive manufacturing activities in Europe. The EIB should continue to exploit the possibilities of the Memorandum of Understanding signed with the European Commission, as well as of the increased funding volume for KETs related projects, resulting from the EIB capital increase of €10 bn.

ACHIEVEMENTS

KETs have been identified as a priority by the European Investment Bank (EIB). Following the Memorandum of Understanding¹⁴ signed in February 2013 between the European Commission and the EIB, the EIB lending to KETs projects has increased by 60% (from €2.7 bn in 2012 to €4.4 bn in 2013), some of them being supported by the FP7 Risk-Sharing Finance Facility (RSFF), a joint EC/EIB debt financial instrument that will be continued under Horizon 2020.

In 2014, the lending volumes amounted to €2.2 bn (due to fewer operations with large technology companies) benefitting altogether 22 projects, a larger number than in 2013.¹⁵

KETs are recognised as one the investment priorities in the European Structural and Investment Funds (ESIF); these Funds can be used to support technological and applied research, pilot lines, early product validation actions, advanced manufacturing capabilities and first production.

The European Commission has clarified¹³ the criteria under which Member States (in line with EU state aid rules) can support transnational projects of strategic significance for the EU, namely the Important Projects of Common European Interest (IPCEIs). The new provisions are neutral as to the sector where the IPCEI project is realised. This will make it much easier to support important projects with a clear European dimension in areas such as R&D, cross-border transport, or energy that would otherwise have needed to be assessed under several different sets of rules. In that regard, Member States may grant repayable advances, loans, guarantees or grants to IPCEIs and the public support may cover up to 100% of the funding gap on the basis of a large set of eligible costs for close to market projects (allowing aid for the first industrial deployment of an R&D project, i.e. during the up-scaling of the pilot facilities and the testing phase).

ADDITIONAL OBJECTIVES TO BE PURSUED

IPCEI instrument will open new opportunities to fund innovation-related manufacturing activities. This includes industrial deployment due to the development of new products or services with high research and innovation content and/or the deployment of a fundamentally innovative production process. Several industry-led initiatives are considering to launch IPCEIs, e.g. in the field of Micro- and Nanoelectronics, Energy efficient Buildings, Connected & Automated Driving and CO₂ Reuse.

14. Memorandum of Understanding between the European commission and the European investment bank in respect of their cooperation in key enabling technologies (KETs) according to communication com (2012) 341 Final. Ref. Ares(2013)290897 - 05/03/2013

15. Source: European Investment Bank

In order to facilitate effective and rapid execution, the notification process, operated by the European Commission DG Competition should be simplified to accelerate the launch of such projects. A fast decision-making process is necessary to raise Europe's attractiveness for manufacturing investments. To achieve this objective, the European Commission has considered its early participation in the design of such projects as “general positive indicator”. If so, this involvement should focus (i) on the one hand, on improving the mutual understanding of all involved parties regarding the required information and (ii) on the other hand, identification at an early stage of the data needed, the purpose of their use and the rationale of the compatibility assessment. This could be facilitated through regular meetings organised by the European Commission along with Member States representatives and private stakeholders in order to accelerate the design, review, notification and the launch of IPCEI projects.

The European investment plan, launched by the new European Commission has a threefold objective: it aims at mobilising finance for investment, providing an improved investment environment and making the finance reach the real economy. Manufacturing is one priority of the EU that should make use of this plan to leverage investment in the advanced manufacturing enabled by the KETs. As it involves capital-intensive activities, it would have to mobilise significant investments not only from the Member States and Regions, but also from the European Commission to reach the expected impact on the European economy. In that regard, the Member States and European Commission are invited to identify relevant manufacturing projects eligible for funding in the frame of the European Investment Plan and provide provisions on same.

Most of the Smart Specialisation Strategies from European regions have so far been officially delivered and will soon make use of the ERDF funds in KETs related projects (as one of the priorities for investment in research and innovation). However, defining a strategy is only the first step. Smart Specialisation priorities need to be translated now into concrete investments and tangible economic results. In that regard, better coordination between public authorities (European Commission/Regions) and industry is needed.

Accelerate development of KETs human capital and skills to stimulate long term innovation

The High Level Group recommends that the European Commission, Member States and regions, address the current KET skills deficit in a comprehensive and integrated manner across all technical levels and in the different KETs domains. A Europe wide education and training plan should be put in place. The weak support of individual excellence in KETs related technological research should be addressed by increasing up to 15% the share of ERC budget dedicated on this thematic. A KIC on Advanced KETs-enabled Manufacturing should be launched in 2014. The European Social Fund should be mobilised to improve KETs employment and job opportunities in European regions, in particular amongst Europe's young talent pool. Finally, it should ensure a pool of skilled technologists on strategic multi-KETs fields through its Future and Emerging Technologies Programme (FET).





The HLG-KET invited the European Council to address the current KET skills deficit by taking advantage of existing instruments (mentioned in the status Implementation report) to increase the talent pool and skills supply in KETs-related sectors.

ACHIEVEMENTS

The Knowledge Innovation Community (KIC) on Added-Value Manufacturing, proposed by the European Commission for the EIT's Strategic Innovation Agenda will be launched in 2016 (instead of 2018) in more coherence with the European Industrial Policy ambition and will respond to the urgent need to boost the manufacturing sector in Europe, including the promotion of KETs-based trans-disciplinary skills and competences.

In 2014, the European Commission launched a tender aiming to address the skills requirements for KETs. This project focuses on the current and anticipated needs of employers and the ways to best satisfy those needs. It aims to develop a shared international multilevel vision on how to address the skills requirements for KETs. The project will produce specific recommendations and a European action plan, including a roadmap for 2016-2020.

ADDITIONAL OBJECTIVES TO BE PURSUED

A “skills gap” is the perceived mismatch between (i) the specific needs of employers for talent and (ii) the skills possessed by the available workforce (either employees or job candidates). It thus refers to qualitative challenges in matching supply and demand, whereas a “skills shortage” refers to the quantitative challenge of finding sufficient candidates.

The specificity of KETs jobs is that these (i) involve working across borders of disciplines, hence require technical multidisciplinary; and (ii) rely on a balance of technical and non-technical skills.

The primary concerns with respect to KETs workers, are (i) a shrinking work force; (ii) a decreasing inflow and (iii) lacking and/or deteriorating skills. The latter is not only due to an ineffective alignment between educational programmes and industrial needs, but more generally also to the fact that all technology, especially KETs, changes at a rapidly increasing pace, which has a positive impact on innovation and growth, but poses a real challenge for the existing and potential workforce and for the education and training systems.

It should be noted that apart from a genuine skills gap in KETs sectors there is also an employment gap, caused by the current severe underinvestment in industry.

Since 2011, the HLG-KET has repeatedly requested the European Commission to support individual excellence in KETs related technological research by increasing the support dedicated to this thematic to a 15% share of the ERC budget. The ERC represents 17% of the overall Horizon 2020 budget (€13.1 bn out of €79 bn) primarily dedicated to scientific excellence (representing twice the budget of KETs in Horizon 2020).

Protect and exploit European funded intellectual assets



The High Level Group recommends that the European Commission develops and includes provisions in grant agreements for European innovation projects closer to the market, requiring an exploitation plan demonstrating a clear return on investment for the European economy. In the case of technological transfer, first exploitation (under reasonable circumstances) of IP arising from European public funded R&D&I should be made in Europe. The High Level Group also recommends the European Commission to ensure that technology transfer of European Commission public funded Intellectual assets receives specific attention in bilateral trade agreements in a spirit of reciprocity.

ACHIEVEMENTS

The proposals submitted under the Horizon 2020 programme are evaluated on the basis of identified criteria: excellence; impact; quality and efficiency of the implementation. In the case of close to market activities, it is requested in the call for proposals to establish a specific business and exploitation plan, with a commitment to conduct the first manufacturing deployment in Europe in the case of pilot lines/demonstrator projects.

ADDITIONAL OBJECTIVES TO BE PURSUED

The spillover effect of KETs on the whole economy is well recognised. Their strong contribution to the competitiveness of economies has led to focused national integrated strategies and policies by competing economies (notably the U.S. and Asia) based on direct public support which has impacted the global level playing field and created competitive disadvantages for EU companies and in certain cases market distortion¹⁶. The HLG-KET acknowledged the clarification made by the European Commission in the execution of IPCEIs requesting to make the matching clause under R&D&I Framework operational. This should be performed in light of several ongoing initiatives to launch IPCEI projects such as in the area of Micro- and Nanoelectronics, Energy efficient Buildings, Connected & Automated Driving and the CO₂ Reuse.

In parallel, competition-distorting incentives must primarily be addressed in the international context of the WTO framework, other international institutions such as the OECD and G20 as well as in the context of bilateral free-trade agreements.

Global competition in KETs-based advanced manufacturing is on-going and will intensify during the next decades. It is well established that no one economy will likely dominate an entire supply chain which becomes too vast. Thus, value chains will increasingly spread out across the global marketplace where each global challenger will focus investment on higher value-added activities that build on unique capabilities and strengths. Consequently, trade

of KETs-based products and notably international transfer of innovation will become a key element of the global supply chain management; hence it is crucial to ensure an international competitive trade environment for European KETs-based goods (in term of products, services and innovation).

Leverage societal challenges to stimulate European KETs market and supply



Policies on European Societal Challenges, in particular, in pillar 3 of Horizon2020, should address the development and use of European KETs building blocks as an integral part of the product solutions. The High Level Group recommends the European Commission to ensure strong engagement of KETs industries/value chains in implementation and in relevant advisory groups dealing with societal challenges programmes. Benefit-risk approaches based on dedicated applications/uses of technologies must be an integral element in the Societal Challenges programme to bridge the public request for innovative and at the same time safe processes and products.



The HLG-KET invited the European Council to:

- » ensure an integrated approach on the benefits and risks of new technologies in order to bring innovation to the market with the speed needed in a global competition.*
- » recognise and promote pre-commercial procurement and procurement of European innovative technologies as a strategic tool to stimulate demand and markets for innovation in the Union.*
- » ask the European Commission to create market pull for KETs by systematically integrating the manufacturing policy with other EU policies.*

ACHIEVEMENTS

The first Horizon 2020 work programme 2014-2015 issued a number of calls in the pillar 3 (Societal challenges) seeking technology-based solutions. More specifically, it called for more than 20 KETs pilot lines in four multi-KETs areas of high industrial interest and innovation potential identified by the HLG-KET (high-performance production, embedded energy, smart structures, and industrial processes using renewable resources), including 3 in pillar 3 of Horizon 2020, under the societal challenge 2: “Food security, sustainable agriculture, marine and maritime research and the bio-economy.” and the societal challenge 3: “Secure, clean and efficient energy and the societal challenges.”

ADDITIONAL OBJECTIVES TO BE PURSUED

The primary objective of the EU 2020 Strategy is to create sustainable growth and jobs in Europe. To achieve that target and ensure both individual and collective benefit, support to industrial value chains, from upstream to downstream, and tackling societal challenges for European citizens, should go hand in hand. Therefore, when addressing and discussing measures to tackle societal challenges, a wide range of stakeholders are needed from the demand and supply side.

- Societal challenges are defined by very complex layers of interests of stakeholders, often requesting a combination of answers from social, cultural, political, and also economic and innovation issues. As a potential lever for growth and jobs creation, it is essential to strike a balance between complexity and diversity of societal requests and responses with the structured coordinated approach needed by business. An integrated process is needed that includes key stakeholders from key European value chains, European Innovation Partnerships, SET-Plan, Smart Specialisation Strategies of Regions, Horizon 2020 and Member States, and involves them in the scoping and implementation of decision and monitoring processes.
- Decision making structures and criteria for work development towards societal challenges need to guarantee transparent framing and evaluation, and seamless collaboration with the other pillars of Horizon 2020. This has to be promoted by defining dedicated areas for large-scale and real environment demonstration of technologies in all European programmes. These programmes have to be assessed by their impact on jobs and growth, as ultimate objectives and should ensure replication at pan-European (local/regional/national) level, in order to make a sustainable impact.
- Societies around the globe tend to have different behaviours in accepting integration of new innovative technologies into manufacturing and products. For some new technologies including KETs, Europeans tend to take a more cautious approach as regards the rightful demand for a balance between risks and benefits. Moreover, the European debates on innovation opportunities and safety issues take place in separate fora. The long-lasting discussions and delayed decisions from this disconnection and the resulting uncertainty are still a major barrier to bring innovation to the market with the speed needed in a global competition. This situation dramatically hampers the capacities of Europe to develop technologies needed to address its societal challenges and holds Europe back in its race towards competitiveness and growth.
- Security is a main pillar of European societal challenges. The importance of KETs for security of supply in several strategic areas including defense and security has been recently acknowledged by the European Council in its conclusions of 19 December 2013 on Common Security and Defense Policy (CSDP) (Part 1.18) *“Civilian and Defense research reinforce each other, including in Key Enabling Technologies [...]”*. In particular, it requested the development of a proposal to stimulate dual-use research based on KETs. *“The European Council invites the Commission and the European Defense Agency to work closely with Member States to develop proposals to stimulate further dual use research.”*¹⁷

Dual-use products, services and technologies can address the needs of both civilian and defence communities. Dual-use technology transfer is the ability to adapt a technology developed in one sector for use in the other. KETs as building block technologies embedded in the most advanced products have high dual use potential. Advanced materials, nanoelectronics, Information and Communication Technologies (ICT), photonics, and unmanned systems and automation are just a few examples of fields in which research, technology development and manufacturing can be used for multiple applications.

Dual-use would have a positive impact on European companies because maximising the dual-use potential of their technology or their KETs-based products should increase turnover through diversification or upscaling of their product range, addressing markets (in both sectors civil and defence) with the highest potential such as transport, healthcare, edutainment, security, textiles, chemicals and materials, energy and electronics.

Promote KETs policies at national and regional level



The High Level Group recommends that the European Commission makes full use of Smart Specialisation to promote KETs in EU Member States and regions and to monitor the uptake of KETs in connection with their research and innovation strategies. In this context, the European Commission is invited to prepare an annual report mapping the regional and national development and deployment of KETs, including across the full TRL scale. The Member States and regions are asked to provide relevant data to facilitate this task. The High Level Group also recommends Managing Authorities in charge of operational programmes to fully exploit the opportunities offered by KETs in the policy mixes implemented to attain the objectives set out in their Smart Specialisation strategies.

ACHIEVEMENTS

KETs are recognised as one of the investment priorities for the European Structural and Investment Funds (ESIF). The Eye@RIS3 database hosted by the JRC-S3 Platform shows that over 60% of EU Member States and Regions registered in the Smart Specialisation Platform have indicated at least one KETs-related priority (14 EU countries and 111 EU regions) in their Smart Specialisation priorities. More detailed information is given in **Appendix 3**.

A KETs Observatory has been launched (www.KETsObservatory.eu) providing EU and national policymakers and business stakeholders with quantitative and qualitative information

on the performance of EU Member States and other competing economies regarding the deployment of Key Enabling Technologies (KETs).

The Vanguard Regions Initiative of more than 20 European industrial regions (<http://www.s3vanguardinitiative.eu>) launched at the European Commission's High-Level Conference on Smart Specialisation in 2013 has developed and tested promising new methodologies for developing and implementing roadmaps for co-investment in European priority areas, including three pilots in the field of advanced manufacturing. These include value chain analysis and mapping and matching of regional capacities and actors from research and industry in specific areas related to the region's smart specialisation strategies, with the goal to facilitate industry-led roadmaps for co-investment into joint demonstrators.

ADDITIONAL OBJECTIVES TO BE PURSUED

In order to ensure translation of KETs-related smart specialisation priorities into targeted support measures and smart investments, better information exchange between regional authorities and business is crucial.

Throughout the three-year mandate of the HLG-KET, its reports have highlighted the crucial need for different stakeholders (private and public) to have access to relevant information and data on KETs development and deployment to inform strategists and decision-makers. Several reports and documents have been released:

- The HLG-KET has continuously informed via presentations and documents^{5,6,7} with relevant figures to raise awareness on KETs and display the KETs-related manufacturing perspectives in the European and global landscapes.
- The European Commission has released a number of communications and reports related to the industrial policy in Europe, where KETs have been acknowledged as an important pillar. In addition the European Commission's Joint Research Centre (JRC) monitored information on KETs priorities declared by regions in the context of its work with the S3 Platform on their research and innovation strategies for smart specialisation (RIS3).
- The KETs Observatory, launched in 2013, has released three newsletters (January and July 2014 and February 2015) and an annual report in May 2015 aiming to provide public and private stakeholders with information on the performance of EU Member States and other competing economies regarding the deployment of KETs.
- More recently, some Member States have separately published reports on performances and national strategies either on KETs or related to research and Innovation.

This fragmentation of reports and analyses across Europe and public institutions in assessing and evaluating progress does not make consolidation of data feasible and does not facilitate an integrated and coordinated strategy on KETs at EU level.

In this respect, it is crucial to ensure:

- A follow up on the implementation of national and regional strategies and KETs-related innovation goals.
- Providing support in establishing progress made, milestones achieved and accessible technology infrastructures established in the European Research and Innovation Area.
- Providing support for the exchange of experiences and good practices.

2.3. CONCLUSION

The HLG-KET acknowledges that significant steps in the implementation of the European Strategy for KETs have been achieved, building on the proposals of the New European Industrial Policy and implemented mainly through Horizon 2020 and other European programmes and instruments (ESIF, EIB...). However, there is additional potential that remains unexploited. Therefore the HLG-KET recommends that the implementation of the European Strategy for KETs should be accelerated, reinforced and coordinated in an appropriate manner across policy instruments of the European Commission. There is also additional effort to be engaged to better deploy and implement this strategy by the Member States (by aligning national priorities) and European regions (by targeting synergies between ERDF and Horizon 2020 funds). Indeed, it is crucial that the Smart Specialisation Strategy concept goes beyond individual regions by better exploiting cooperation and co-investment opportunities across borders. These opportunities should be identified in a coordinated way between managing authorities and industry. When implementing their Smart Specialisation Strategies and ERDF Operational Programmes, Regions and Member States should also focus on links and synergies with other European and transnational initiatives to maximise the impact of their Smart Specialisation investments and to contribute to Europe's growth agenda.

The HLG-KET also recommends that the scope of this strategy is broadened beyond research and innovation activities, and points at a series of EU objectives where full potential cannot be met without significant investment in KET development and deployment (Growth and Jobs in Industrial Policy, Energy Union package, Environment and Climate, Digital Single Market, Resource Efficiency, Circular Economy, Smart Cities, Clean Tech, Bioeconomy, Education, Trade,...).

CHAPTER 3:
**THE WAY FORWARD
- FROM KETs
INNOVATION TO
SOCIETAL AND
ECONOMIC BENEFIT
FOR EUROPE**

3.1. KETs AND INDUSTRIAL MANUFACTURING AT THE CORE OF THE NEW EUROPEAN COMMISSION, COUNCIL AND PARLIAMENT AGENDAS

The policy debate on the future of industry and manufacturing in the EU has intensified over the last decades, but gained even more significance since the economic and financial crisis struck Europe. Today, the challenge is to arrest and reverse Europe's long-term industrial decline, via new and more comprehensive solutions involving public as well as private actors.

In this context, Key Enabling Technologies (KETs) are at the core of political agendas and recognised by policy makers as strategic for the competitiveness of European industry, as well as for the growth of our economy and job creation. This was reflected in the European Strategy for KETs as well as in the updated European industrial policy (integrating KETs into three priority areas), in the European Regional Development Fund (ERDF) (recognition of KETs as one of the investment priorities), and also in the growing support from the European Council and the European Parliament.

The newly European Parliament and the European Commission should seize the opportunity to energise the policies set out in this and the previous HLG-KET reports to implement the measures necessary in response to the key challenges ahead for our economy and society. Revitalising manufacturing and ensuring appropriate impetus for KETs is vital to support European economic growth, attract and retain production facilities, raise investment, enhance exports, improve employment for citizens and set the course for Europe's future in a global economy.

In that regard, the High Level Expert Group on Key Enabling Technologies (HLG-KET) welcomes the consensus that has grown and the support expressed by the European Commission, the European Parliament, the European Council, and the Council of the European Union, which highlighted the systemic importance of KETs for a competitive European economy.

European Commission



European industry is at the heart of the new agenda of the European Commission, recognising its major contribution to the European economy as the basis for prosperity and employment. President JUNCKER stated: *"I firmly believe that we need to maintain and reinforce a strong and high-performing industrial base for our internal market [...]. This should ensure that Europe maintains its global leadership in strategic sectors with high-value jobs such as the automotive, aeronautics, engineering, space, chemicals and pharmaceutical industries. To achieve this, we need to stimulate investment in new technologies, improve the business environment, ease access to markets and to finance, particularly for SMEs, and ensure that workers have the skills industry needs"*.¹

1. "A New Start for Europe: My agenda for Jobs, Growth, Fairness and Democratic Change" Opening Statement in the European Parliament. Plenary Session. Jean-Claude Juncker, Strasbourg, 15 July 2014.

Mrs. BIENKOWSKA, Commissioner for Internal Market, Industry, Entrepreneurship and SMEs in her written answers to the European Parliament hearing said *“My [...] priority will be to strengthen the EU’s industrial base. Europe cannot prosper without industry, and must therefore preserve and strengthen its industrial base”*. She also insisted *“Together with the Commissioner for Research, Science and Innovation, I want to use the Horizon 2020 Programme and other EU policy instruments in order to support close-to-market industrial innovation and key enabling technologies”*.²

Mr. MOEDAS, Commissioner for Research, Science and Innovation made a similar statement in his hearing: *“As regards future initiatives, I will certainly reflect on possible new initiatives that could be developed to support President JUNCKER’s agenda, [...] increasing the manufacturing capabilities of Europe, energy efficiency and competitive low-carbon energy, particularly on renewables, which I know are also important to the Parliament”*.³

European Council



The European Council evoked the *“systemic importance of industry for the whole of the European economy”*. It dedicated, for the first time, an entire section of its March 2014 Council conclusions to it, stressing that *“Europe needs a strong and competitive industrial base, in terms of both production and investment, as a key driver for economic growth and jobs. [...] The overall framework at European and national levels must be made more conducive to investment and innovation and the reshoring of manufacturing jobs”*⁴. Further below in its Conclusions, the European Council recalled that *“...key enabling technologies (KETs) are of crucial importance for industrial competitiveness”*.

Council of the European Union



More recently, the Competitiveness Council acknowledged *“the impetus to industrial policy provided by the Communication for a European Industrial Renaissance and welcomes the emphasis given by the March European Council to industry as a key driver for economic growth and jobs”* and requested *“...a Commission roadmap for taking work forward on the basis of the Communication with a view to enhancing industrial competitiveness”*⁵. Further it welcomed *“...the Commission’s approach to promote optimal framework conditions for industrial competitiveness, giving due importance to sectors, and [recommended] that sector-specific and value-chain analyses should underpin Smart Specialisation, key enabling technologies, clusters and innovation-promoting strategies”*.

2. Answers to the European parliament questionnaire to the commissioner-designate Elżbieta BIENKOWSKA Internal Market, Industry, Entrepreneurship and SMEs

3. Answers to the European parliament questionnaire to the commissioner-designate Carlos MOEDAS Research, Science & Innovation

4. Conclusions of the European Council, 20 and 21 March 2014, Point 5, “Industrial competitiveness and policy”, p4.

5. Conclusions of the Competitiveness Council, 25 September 2014, Point 1, “General Industrial Competitiveness concerns”, p1.

European Parliament



The European Parliament has clearly and unequivocally identified KETs as a key priority for the reindustrialisation of Europe. On October 2nd 2013, at the 5th European Innovation Summit, former European Parliament President BUZEK, asserted *“innovation is one of only three key leverages of growth in the EU, along with the single market and cheaper energy. The four priority areas in innovation being: development of Key Enabling Technologies, increasing the importance of industry in defining research co-funded by the EU, reshaping of the education systems and harmonisation of the EU approach to transport”*.

Indeed the European Technology Congress organised at Wroclaw on June 12th and 13th 2014, under the chairmanship of Professor BUZEK, focused exclusively on *“Leadership in Enabling and Industrial Technologies”*. Professor BUZEK stated that *“KETs perfectly responds to the ambitious objectives of European industries: to accelerate the recovery of economic growth and jobs, propel Europe to global leadership and competitiveness and move to a low-carbon economy. KETs-based technologies and products are instrumental to achieve these targets”*. Most recently, on December 3rd 2014, Professor BUZEK, Chairman of the European Parliament ITRE (Industry, Research and Energy) committee has stated that *“Reindustrialization of the economy is the only way to empty the overflowing labour offices in Europe”* after a joint meeting of Parliament's Committee Chairs and the College of Commissioners.

3.2. BLUEPRINT FOR THE IMPLEMENTATION OF THE EUROPEAN STRATEGY FOR KETs

Chapter 1 showed that Europe is a leader in many technological fields but overall its leadership is under threat from competitors, who benefit from more aggressive policy measures in investment, innovation and complimentary value chains. The HLG-KET exposed flaws in unfavourable framework conditions in Europe, which hinder innovation and its deployment to markets. The HLG-KET made recommendations in the “Status Implementation Report” targeting the full implementation of the European Strategy for KETs (**detailed in Chapter 2**), acknowledging some progress, but also highlighting clear room for improvement. In that regard, the HLG-KET requests the European Commission, along with Member States and Regions to ensure full implementation of the European Strategy for KETs through additional actions.

Europe is now at a stage where significant actions and investment are required to get competitiveness back on track and make the European economy healthy and sustainable again. In the coming years, our capability to innovate in KETs will be one of the most important factors determining the success of our manufacturing industry, especially in comparison to competitor nations and regions. The HLG-KET is presenting a set of new recommenda-

tions as an integrated approach to ensure the full implementation of the European Strategy for KETs. This is a blueprint for public authorities (European, national and regional) as well as private stakeholders to act quickly, efficiently and collectively in order to tackle the challenges ahead. These recommendations are twofold:

■ **Building a strong integrated approach to cross the European KETs valley of death**

Full deployment of KETs into EU industries calls for an integrated approach that provides increased and adequate support for each of the three pillars of the bridge to cross the KETs “valley of death”: (1) from the development of technologies with transformative potential (KETs) in appropriate technology infrastructures, (2) through their implementation in industrial pilot lines for prototyping, testing and validating products, (3) up to the launch of KETs-based manufacturing projects essential to deploy technology-based products, processes and services.

■ **Unleashing the market potential of KETs by better integrating the KETs strategy across EU initiatives**

To unleash market opportunities for KETs, the European Strategy for KETs needs to be better integrated across different EU policies and initiatives. Many EU objectives cannot be met without significant investment in KETs development and their industrial deployment. KETs are the technology blocks embedded in applications needed to solve societal challenges and will play a key role to achieve initiatives such as a digital single market, a circular economy or EU global technology leadership in climate and energy solutions. Moreover, modernisation of European policies to cope with global competition and the adaptation of skills policies to respond to the needs of industry will be essential to capture the benefit of KETs for the whole European economy. Adoption by Member States and Regions of the KETs strategy and taking the appropriate course of action is also crucial in obtaining the expected outcome. This will require appropriate investment, intelligent regulation and smooth integration into all key European policies.

EUROPEAN TECHNOLOGY INFRASTRUCTURES

Many firms excel in exploiting tools and technologies which yield constant improvements for example in rapid prototyping, small batch manufacturing, customisation and inventory management. By broadening access to such tools and technologies, European technology infrastructures greatly increase the scope of innovation activities and accelerate the pace of innovation. They comprise both public and private infrastructures mainly managed by research and technology organisations (RTOs) offering to industry the access to cutting-edge development, in premier class technology environment, and in an industrial-friendly relevant way across a number of sectors. They provide access to highly-skilled resources, methods and expertise, tools and equipment, scientific and engineering know-how, intellectual property, quality control and test techniques, design capabilities, and the necessary process flow to develop KETs building blocks, KETs-based products and services.

In order for European technology infrastructures to deliver greater benefits and become much more effective, the following issues need to be solved:

- Pan-European access of companies to European world-class technology infrastructures needs to be promoted. KETs technology infrastructures are primarily used at the local or near local level, and the main beneficiaries are usually local industries belonging to the industrial ecosystems that host the infrastructure.
- Cooperation between technology infrastructures and industry occurs across all stages of development up to fabrication of pre-series, but the capital intensive investment expenditures is a barrier at the later stages of development. There is a conflict in investment between infrastructure owners i.e. research and technology organisations and industry.
- Amid economic uncertainty across Europe, a number of technology infrastructures are facing a significant reduction in national/regional support which affects their capacities to invest and upgrade their facilities and constitutes, in the medium term (5 to 10 years), a significant risk of Europe losing the competitive advantage offered by European RTOs.

RECOMMENDATION 1 BOOST EUROPEAN TECHNOLOGY INFRASTRUCTURES TO SUPPORT INDUSTRY

In order to ensure a European framework for technology infrastructures, the High Level Group on KETs recommends the European Commission, Member States and Regions to take immediate action by supporting technology infrastructures networks which provide access to industry to share their expertise, cooperation and business practices, develop common projects, build up shared vision and common roadmaps in strategic areas. This framework should:

- Ensure Pan-European access of industry to a set of KETs technology infrastructures (public and private). The EU should support cooperation and access of industry to premier-class research and technology validation infrastructures by identifying and supporting cooperative KETs projects of innovative industries and capable RTOs.
- Facilitate a workable funding mechanism supporting capital-intensive expenditures as initial investment for cooperation activities between KETs technology infrastructures and industry. This can rely on specific support mechanism for European technology infrastructures using European, national and/or regional funds.
- Develop a EU strategy on European technology infrastructures, which anticipates industrial needs, gaps and related opportunities, for market uptake in cooperation with industry to support new technological infrastructures offering capabilities for the most pressing technological challenges that merit focused attention, demand-side measures and appropriate support.

KETs PILOT LINES AND DEMONSTRATION ACTIVITIES

Pilot line projects are defined as a set of activities linked to each other in a coherent way with the objective of the development of technologies and their translation into manufacturing goods and services. They bring tools and means to develop and prototype, test, and validate the innovative product in users' standards and performances. They gather a number of actors across the value chain, cooperating within a specific organisation to deliver and produce a first series of pre-commercial products prototypes. Complexity of development and fabrication activities of a pilot line project requires high-capital expenditure and risks. Support by a pool of public and private resources with critical mass is necessary to achieve standards in performance and quality of a given product.

Horizon 2020 has implemented and funded a first series of pilot line projects providing opportunities to industry in prototyping, testing and validating products. However, the funding available for KETs-based pilot lines in the Horizon 2020 (WP 2014-2015) does not meet the ambition of industrial scale projects. This is mainly due to the scattering of support over a broad number of calls and topics, in a large range of scientific fields and technologies. Supporting pilot line projects needs adequate instruments.

For example, the success of the industrial pilot line projects funded in 2012 and the 2013 calls of the JTI ENIAC as well as the strategic shift of funding toward close to market activities driven by the new JTI ECSEL, clearly demonstrated the importance of a coherent approach to strengthen innovation and manufacturing capabilities of European industry on microelectronics (one of the six KETs). This emphasizes the positive impact and the efficiency of the JTI instrument in mobilising the European electronics value chain (from academia to industry) along with the European Commission and Member States in committing on industry-driven common projects aiming to reinvigorate manufacturing sectors, creating jobs and business in and for Europe. A significant challenge exists to replicate this coordinated effort and success to other KETs-based industrial value chains to deliver the desired effect.

RECOMMENDATION 2

STRENGTHEN KETs PILOT LINES AND DEMONSTRATION ACTIVITIES

In order to strengthen industrial pilot lines and demonstration activities in the EU, the European Commission, Member States and/or Regions and industry are requested to:

- Ensure adequate public funding of R&I over the whole innovation chain, from supporting the initial stages of development of new technologies (TRL 2-3) up to strengthening their deployment into industrial pilot lines and large-scale demonstration activities (TRL 5 to 8), in order to speed up the commercialisation of EU innovation.
- Set specific evaluation criteria for high TRL activities (e.g. KET pilot lines and large-scale demonstrators) to ensure more emphasis on industrial exploitation and project's impact on manufacturing and creating value and jobs in Europe.
- Fully incorporate in the review made by the European Commission of contractual Public-Private Partnerships (cPPPs), Joint Technology Initiatives (JTIs) and European Innovation Partnerships (EIP), the implementation of industrial pilot lines and demonstrators activities based on common criteria defined by the HLG-KET in its final report (2011).
- Set up dedicated initiatives on KETs pilot lines and demonstration activities in the innovation programmes of European Commission, Member States and Regions.
- Support a simple and more attractive funding mechanism exploiting multi-funding sources involving the European Commission, Member States and/or Regions and industry.

KETs-BASED MANUFACTURING PROJECTS

To ensure a highly competitive manufacturing sector in Europe, a successful strategy must build on Europe's existing strengths and assets in strategic value chains and make these more robust. The globalisation of whole value chains has further increased the level of technology-based competition, which makes it less likely that even an advanced region such as Europe can master and dominate entire value chains in one sector. Against this background, strategies such as "vertical targeting", e.g. towards more skill-intensive sectors or towards sectors with a higher degree of product market competition that build on Europe's unique capabilities and strengths, would be more likely to spur growth and highly-skilled employment. With a view to productivity growth and competitiveness, the main challenge for Europe is to select the "right" target sectors. Retaining and further developing these target sectors means that public and key industrial stakeholders work closely together and this is the aim of the newly created instrument called Important Projects of Common European Interest (IPCEI). It is designed for strategic industrial projects, promoting cooperation across industry value chains at an international level. A number of IPCEIs are already in preparation across European industry (**see Box: Examples of Important Projects of Common European Interest in progress**). The IPCEI will, if successful, boost Smart Specialisation Strategies of European regions.

An Investment Plan for Europe is a comprehensive EU response to the current problems confronting the European economy such as weak economic growth, high unemployment, deflationary tendencies, uncertain prospects for long-term growth and competitiveness. To do so, the plan is built on three main strands, including the creation of a new European Fund for Strategic Investments (EFSI), guaranteed with public money, to mobilise additional investment over the next three years (2015-2017) and establishing a roadmap to make Europe more attractive for investment and remove regulatory bottlenecks.

The proposed European Fund for Strategic Investments could be an important tool to support growth-enhancing investments in the area of KETs, in particular in industrial innovation and manufacturing

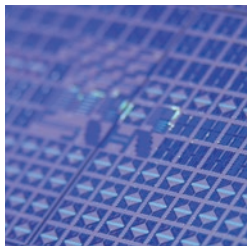
activities. Therefore, the European Fund for Strategic Investments should allow to attract manufacturing investment back into the EU, thereby effectively contributing to the reindustrialisation of the EU. In addition, businesses in KETs-related sectors should actively be involved in designing the roadmap in order to concretely identify business investment opportunities in the Union in order to create growth and employment.

RECOMMENDATION 3 UNLEASH SIGNIFICANT INVESTMENT INTO MANUFACTURING THROUGH NEW EU TOOLS

Considering the vital role of manufacturing for the European economic performances and sustainability, the High Level Group on KETs recommends that European public authorities (European Council, European Commission and European Parliament, Member States, Regions), the European Investment Bank and industry together ensure appropriate support to European manufacturing which include:

- Support and facilitate the design, preparation and execution of Important Projects of Common European Interest (IPCEIs) in KETs-related industrial sectors.
- Support large-scale KETs-based industrial projects including IPCEIs through the European Fund for Strategic Investment (EFSI) of the European Investment Plan.
- For EU initiatives (such as the European Investment Plan), establish an inclusive governance structure involving public authorities and private stakeholders to identify and prioritise large-scale industrial projects and monitor their progress.

EXAMPLES OF IMPORTANT PROJECTS OF COMMON EUROPEAN INTEREST IN PROGRESS



IPCEI for the Manufacturing of Micro- and Nanoelectronic Components

Micro- and nanoelectronics impact all industrial branches, most aspects of our daily life and many societal issues and as such are a major source of economic growth and employment. Europe is a large market for those technologies, but also hosts a world-class semiconductor industry developing and manufacturing a multitude of key elements of the electronic value chain, from equipment and materials over semiconductor technologies like FDSOI, power-semiconductors and sensors/MEMS-technologies to complex designs for important application areas like automotive, security, energy, healthcare and aerospace.

In view of the large investment in new semiconductor fabs in other regions, the European semiconductor industry is facing an increasing threat from a world-wide competition. On the other hand emerging areas such as IoT, digital manufacturing, automated cars, smart cities,... offer huge opportunities for growth for our entire digital ecosystem. In this context former EC Vice President N. Kroes set an ambitious goal of *“doubling the economic value of semiconductor production in Europe by 2020-2025”*. In June 2014, the Electronics Leaders Group (ELG) presented an implementation plan to reach this goal, which will necessitate a multi-billion investment in manufacturing at various European production sites. A consortium of semiconductor stakeholders from Austria, Belgium, France, Germany, Hungary, Ireland, Italy, the Netherlands and the UK is preparing a proposal for an IPCEI for the “Manufacturing of Micro- and Nanoelectronic Components” - a first phase of which involves an investment of about €3 bn.



IPCEI for Connected & Automated Driving

These are crucial times for the automotive sector. Pure hardware and classic steel are no longer sufficient to maintain global leadership of Europe's car industry. Connected highly automated driving is key to that and realises tremendous societal benefits in e.g. safety, fuel reduction and traffic efficiency. KETs are at the very heart of the automotive industry: photonic sensors, nanoelectronic devices like MEMS, or sophisticated production are just some building blocks.

The dominance of Silicon Valley in data-based products is unbroken and challenging Europe's backbone industry – the automotive sector. The entire EU automotive industry invests per year €42 bn in R&D whereas just the five firms Apple, Microsoft, Google, Cisco Systems and Oracle had cash reserves of nearly €400 bn together. Of course, this would be an unprecedented joint effort of all the stakeholders to invest together in innovation with unforeseeable benefits in other economic branches. A combined large-scale effort like IPCEI leverages the competences of leading European players, accelerates time to market and positions Europe as the significant high-tech player in tomorrow's automotive industry.



IPCEI on Advanced Materials and Processes for the built Environment

Deeply anchored in the circular economy approach, the objective of the IPCEI on Advanced Materials and Processes for the built Environment is to work on the life cycle of buildings by optimising “energy efficiency” from materials production all the way to deconstruction. The energy challenge is coupled to the waste management challenge by improving recyclability and reuse of building materials. This will be implemented by boosting KET deployment, with a special focus on advanced materials and related processes. The accelerated industrial production of these innovative advanced materials and processes will reinforce the competitiveness of all related enterprises and amplify the EU capacity to retrofit existing buildings and build more energy-efficient new ones. The objective is to involve at least 15 European projects around KETs-based products and processes, and to work simultaneously with skills adaptation through new educational programmes.



IPCEI PHOENIX - Transforming CO₂ into Value for a rejuvenated European Economy

The chemical valorisation of CO₂ will contribute to the development of a sustainable circular economy, and leadership of Europe in clean technologies. CO₂ is the only carbon resource that is available in abundance in Europe and it can be used to produce more sustainable chemicals, materials, fuels and enable large-scale storage for renewable energy.

The IPCEI “PHOENIX” targets the successful deployment of CO₂ conversion technologies in Europe in an integrated approach across public and private sectors and various R&I programmes through a dedicated initiative, to get a critical mass and speed for progress in the “global race” as U.S. and Asian countries are striving to gain leadership in this area. Such a dedicated public-private partnership as an umbrella, would address both the financial support for technology development, as well as the non-technological barriers through an appropriate and stable policy framework (e.g. recognition of CO₂ as a renewable resource) combined with streamlining decision making between the partners. It will unlock significant investments needed by improving investor confidence. This project has been put forward as a contribution into the “Juncker Investment Package”.

Both industries and the public sectors across Europe (e.g. Member States) have a major interest as publicly voiced in a major starting event in March 2015 with participation of more than 20 companies from various sectors (chemicals, cement, steel, engineering, automotive, high-tech manufacturing, energy and gas), and representatives from 6 Member States (+ Norway). Based on the identified key priorities, a joint approach is currently developed.

FULL IMPLEMENTATION OF THE EUROPEAN STRATEGY FOR KETs

Considering the importance of innovation in the reformed Cohesion Policy and the enabling role of KETs for regional economic transformation, further actions are needed to help Regions translating KETs-related Smart Specialisation priorities into smart investments. The Smart Specialisation Strategy is intrinsically linked to a strategic cluster policy encouraging the bottom-up development of new value chains in such ecosystems or regional clusters. But at the same time, these regional clusters need to provide solutions for global challenges (beyond the mere need of a single region) and to upgrade into world-class clusters of critical dimension in order to boost competitiveness of the Regions and Europe. To do so, creating and making use of innovation requires open borders and also implies inter-regional, nationwide and international

export of products and services. The knowledge available within a single region is insufficient to come to solutions, due to the European distribution of value chains and the crucial need for cooperation. Cross-border cooperation plays an important role in this respect.

In addition, there is a strong need of coordinated approach between public authorities as well as with industry, and this impedes cooperation and the effectiveness of Smart Specialisation Strategies. As active players in shaping innovation ecosystems, managing authorities should be considered, beyond their regulatory, policy and financial roles, as full partners, along with industry and research and technology community in defining priorities and executing related innovation activities.

RECOMMENDATION 4

ESCALATE REGIONAL SMART SPECIALISATION STRATEGIES TO A EUROPEAN LEVEL

In order to ensure full exploitation of the Smart Specialisation Strategies at the European level, the High Level Group on KETs recommends to:

- Make full use of Smart Specialisation Strategies by identifying, selecting and implementing high-quality projects for applications and development of KETs leveraging as much as possible EU funds in terms of financing and strategy and exploiting the potential for synergies with other funds and instruments. The combination of instruments and the integration of cohesion, research and industrial policies at all government levels should be reflected in selection criteria for supporting projects.
- Promote cooperation between Regions (by benchmarking their KETs capacities within a wider macro-region, Europe and the global scene), and between different actors along the value chain (industry and research actors) to stimulate industrial projects with European added value.
- Implement a workable financing mechanism allowing to effectively aggregate different public instruments (Horizon 2020, regional funds including European Structural and Investment Fund (ESIF), national funds, European Investment Bank (EIB), etc.) in line with operational procedures and constraints of the different managing authorities.
- Link the Smart Specialisation priorities with business opportunities by fostering structured information exchange between regional authorities and industry.
- Ensure public authorities (European Commission, Member States and Regions) align their priorities for maximum impact and establish a monitoring mechanism to adapt KETs strategies accordingly.

MEETING SOCIETAL CHALLENGES THROUGH KETs

In an increasingly innovation-driven economy, the use and acceptance of new technologies (including KETs) will not only affect the quality of life for European citizens but also accelerate EU industrial innovation and global competitiveness. Two critical challenges need to be addressed:

- The European innovation landscape remains fragmented and lacking in coherency. This is particularly evident in the dedicated programme called “Societal Challenges”, which suffers from disjointed and isolated policy areas. For example, benefits and uncertainty about risks for consumers and the environment are discussed and decided in separate communities, each adhering to their own policies, criteria and drivers. Clearly some choices are complex and difficult to

reconcile, but it is essential to improve coherency in innovation, and foolhardy to ignore the role of technology in societal challenges. A more integrated process in innovation support, incorporating technological aspects, is essential to revitalise innovation and reduce uncertainty among consumers as well as investors.

- European innovation and industrial policies should establish a balanced market-pull/technology-push along the value chain to create jobs and growth. This is needed not only in consumer products but also in the manufacturing chain and can be achieved by better interlinking the areas of societal challenges with technology innovation. The current “technology agnostic” approach in tackling societal challenges is hindering the exploitation of the full potential of European value chains.

RECOMMENDATION 5

ESTABLISH BONDING BETWEEN KETs AND SOCIETAL CHALLENGES FOR A SUSTAINABLE AND COMPETITIVE EUROPE

It is essential to develop a European approach to link EU policies on societal challenges for instance Energy, Health, Climate and Environment, Resource Efficiency, Security, and Transport with KETs. The High Level Group on KETs recommends that the European Commission launches such an integrated process at EU level, and assign clear mandate and ownership within the European Commission. Better coordination could function via a number of measures:

- Establish a clear integrated decision, implementation and monitoring process at the EU level that ensures representation of KETs stakeholders from European value chains in European Commission policies and initiatives on societal challenges (ex. European Innovation Partnerships (EIPs), Pillar 3 in Horizon 2020), with clear mandates and accountability.
- Define inclusive (public and private) governance and dialogue schemes that provide the basis for a robust decision-making process on new technologies bridging the currently sepa-

rated policy strands, aiming to balance benefits and risks. Such an approach will allow timely integration and promotion of new technological solutions to solve European challenges and overcome barriers to capture innovation benefit for EU industries.

- Use the mid-term review of Horizon 2020 to reassess the equilibrium of funding between different pillars of Horizon 2020 allowing the Industrial Leadership Programme to meet its policy targets defined by the EU Institutions.
- Establish new formal and practical linkages so that conceptions of societal challenges concur with the other technology pillars along KETs value chains. The practical links can be strengthened by defining criteria for societal challenges projects that should create improved added value for Europe through market pull, leveraging for additional private investments, and timely delivery of solutions from policies.
- Target public procurement in the EU in order to stimulate the demand and accelerate market uptake of innovative products and services built from European KETs building blocks.

KETs IN TRADE AND INVESTMENT AGREEMENTS

Economic growth and the positive impact of public investment on innovation should be a focus objective of trade and investment policy. In the case of KETs, this could be achieved by ensuring that project results are commercially exploited for the benefit of European industry, triggering its competitiveness and creating jobs. To this end it is important to ensure substantial recovery in innovation investments that will secure growth and jobs in the EU, as well as commercial opportunities for imports and exports in goods and services on one side and business opportunities through a better access to foreign markets on the other. Ambitious trade agreements with strategic partner countries are therefore essential for ensuring sustainable growth in the EU.

Furthermore, Europe's competitors, particularly the U.S. and Asian countries, have adopted targeted policies, specifically "tailored" to attract foreign investment in KETs (amongst which European investors). Their efforts, in some cases, result in the distortion of the international market for KETs-related industries by creating incentives that Europe often finds difficult to match, due to EU regulations.

The EU must therefore negotiate and conclude international trade agreements on the basis of its own policies and of Europe's strengths and assets across industrial value chains, to ensure balanced mutual benefits between the parties, to promote investment-friendly environments and to improve access to foreign markets in a spirit of reciprocity. As innovation is considered the engine of future economic growth and sustainability, international trade agreements should take into account European innovation policies and related priorities. These include accelerated procedures to allow timely responses to trade abuses and the need to ensure appropriate conditions for a mutually balanced transfer of technology.

RECOMMENDATION 6 ENSURE EUROPEAN INTERESTS ARE MET IN TRADE AND INVESTMENT AGREEMENTS

Considering the important role of a more favorable trade environment in shaping and balancing global competition, the High Level Group on KETs recommends the European Commission to ensure that bilateral/multilateral trade agreements:

- Ensure free and fair market access which facilitates investment opportunities.
- Improve intellectual property rights protection as a key matter.
- Promote reciprocity in the access to public procurement.
- Consider EU policies and priorities across EU strategic innovation sectors in ongoing and future trade agreement negotiations with the view to ensuring coherence, reciprocity and precedence of EU interest.
- Leverage existing trade instruments and modernise trade defence rules in order to secure an international level playing field.
- Take action to reduce or eliminate investment restrictions in third countries, such as the request of strategic technologies transfer as precondition for business.

DUAL-USE OF KETs TO INCREASE SECURITY AND ECONOMIC POTENTIAL

There are potential opportunities in considering the ability to adapt KETs developed in one sector for use in another one. This is the objective of dual-use. Indeed, KETs are the fundamental technology blocks that lie at the heart of an increasingly wide range of goods and services, both in the civilian and the defence sector. The economic impact of KETs is substantial and their role as an innovation accelerator for downstream industries is of key importance. The EU has a strong knowledge base but is not capitalising enough on its R&D potentials in terms of marketable goods and services. Furthermore, there is a well-identified risk of technology dependence in strategic areas, including defence, space, security and areas of high economic importance.

The focus on dual-use research reflects the increasing relationship between the civilian and defence areas. The defence industry's dependence on technologies with a civilian origin is increasing, as is the tendency of technologies with civilian origin to diversify into defence applications. Meanwhile, civilian companies are consumers of technologies which are also of interest to defence firms, such as for example technologies in the fields of robotics and photonics. It is clear that research and essential technologies, such as those relating to KETs, big data, synthetic biology, and 3D printing, will become an important source of innovation for both defence and civilian industries.

Due to both their criticality and potential, KETs are one of the key areas of focus related to the dual-use potential of the research in the context of the actions of the Commission for enhancing

the defence sector in the EU. The Commission's communication *"Towards a more competitive and efficient defence and security sector"* states: *"Within Horizon 2020, the areas of Leadership in Enabling and Industrial Technologies" including the "Key Enabling Technologies" (KETs) and "Secure Societies" (Societal Challenge), "offer prospects of technological advances that can trigger innovation not only for civil applications, but also have a dual-use potential"*.

The European Council of 19/20 December 2013, in accordance with this view, underlined the dual-use potential of KETs and welcomed in its conclusions the intention of the Commission to take further action *"Civilian and defence research reinforce each other, including in key enabling technologies and on energy efficiency technology. The European Council therefore welcomes the Commission's intention to evaluate how the results under Horizon 2020 could also benefit defence and security industrial capabilities"*.

In line with this development, the HLG-KET has set up a specific Working Group on the acceleration of dual-use potential of KETs. This group produced proposals and guidance for the Commission with respect to the dual-use applications of KETs, synthesised in the following recommendation.

RECOMMENDATION 7

FULLY EXPLOIT THE DUAL-USE POTENTIAL OF KETs

In order to ensure the security of supply and increase economic potential in the area of KETs with dual-use applications the High Level Group on KETs recommends the European Commission to:

- Set up an expert group to define research areas, where there is potential for dual-use activities using KETs. To do so, the European Commission along with Member States and private stakeholders should consider the implementation of some criteria related to potential dual-use of KETs and other technologies in order to prioritise them taking benefits of processes already initiated in some Member States. Such criteria definition could be carried out by a dual-use technology matrix, considering transversal or crosscutting aspects, and a related SWOT analysis. Such an analysis might produce different priority levels, indicate different funding solutions and appropriate levels and ways of action.
- Boost potential dual-use application of KETs in future Horizon 2020 work programmes. In that regard, the European Commission along with Member States are requested to start a process to increase the visibility of dual-use themes in future work programmes. The Commission should establish an inventory of Horizon 2020 work programme parts with dual-use potential. A study could also provide an ex-post analysis of Horizon 2020 or/and ESIF projects with dual-use potential that could be further exploited.
- Use Joint Undertaking initiatives for implementation of dual-use projects. A specific process to foster the synergies between defence, space and civilian needs should be put in place and be addressed through specific work packages to be evaluated and potentially supported by the European Defence Agency, the European Space Agency, and other public or private entities.
- Implement workable and effective solutions through combined funding mechanisms for dual-use projects. This should associate different funding sources and ensure coordination across EU instruments (Horizon 2020, ESIF, EIB) and associate different stakeholders (European Defence Agency, the European Space Agency and Regions (through Smart Specialisation Strategy) in the selection process.
- Consider the Preparatory Action on Common Security and Defence Policy (CSDP) related research activities based on KET-based projects already funded under Horizon 2020 or other instruments. Such actions should be in conformity with the Preparatory Action objectives and the need to effectively increase the synergies between civilian and defence research.

KETs RELATED SKILLS

One of the global challenges that European manufacturing will have to face is the shortage of specific skills, especially in KETs, which are needed for innovative goods and related services. This shortage exists even though there is mass unemployment in many countries, and is more striking where labour and education markets are hardly flexible. Consequently, access to specific skills is acknowledged as the pivotal factor in the location of industrial activities. Strategies and policies that support the development of a larger workforce with KET-specific skills across Europe are needed, to ensure the future of manufacturing in Europe. This was clearly stated in the conclusions of the European Council, 20/21 March 2014: “Fostering the Union’s industrial

growth requires the right skills. The European Council urges the Commission and the Member States to address shortages in the area of science, technology, engineering and mathematics (STEM skills) as a matter of priority, with increased involvement of industry. Further efforts by the public and private sectors should be directed to promoting mobility, education and vocational training. All available instruments should be used to this end, such as the European Structural and Investment Funds (ESIF), the new generation of Erasmus+, the Grand Coalition for Digital Jobs, the European Alliance for Apprenticeships or the Youth Employment Initiative and the Youth Guarantee. Industry should be more involved in forecasting future skills needs.”

RECOMMENDATION 8

INVEST IN KETs-RELATED SKILLS TO ENSURE EUROPE'S INNOVATION POTENTIAL

In order for Europe to be able to respond to the needs of industry for a workforce with the appropriate skills, the High Level Group on KETs makes the following recommendations.

Recommendations to the European Commission

Several existing EC-initiatives address the various challenges related to the supply and demand of KETs skills in Europe, but as most of these focus on highly-skilled workers and university graduate, additional actions are needed to:

- Establish close synergy with initiatives at national and regional levels, putting more emphasis on professionals with intermediate-level skills, given their importance in manufacturing and high-tech industries.
- Stimulate and fund partnerships between companies and education providers through EC programmes in efficient combination with national and regional funding schemes and incentivise “Excellence in Teaching”.
- Provide seed funding and guidance based on best practices for Member States and Regions to establish (or reform) apprenticeships and dual-learning systems providing hands-on experience in manufacturing jobs.

- Raise awareness of relevance of KETs for society in order to attract and maintain the right workforce: together with the national/regional stakeholders, the EC needs to communicate that an interdisciplinary approach involving KETs can make a difference in addressing our societal challenges.
- Integrate skills development and training activities in the exploitation strategy of the KETs innovation actions projects under Horizon 2020, including the development of innovative learning resources for the undergraduate and lifelong learning levels.

Recommendations to Member States and Regions and their education providers

Education and training providers will need to be ready to:

- Adapt the curricula with the aim of (i) embedding technical multi-disciplinarity; and (ii) embedding non-technical subjects in KETs-related curricula.
- Regularly update the knowledge and skills of the teaching staff with the active support of industry.
- Change the learning environments and promote innovation in the way KETs subjects are taught e.g. by emphasizing practical applications in mathematics and physics classes; setting up experimental learning projects that enable students to see themselves as innovators and entrepreneurs.
- Rethink the workers' lifetime education and complement it systematically with new knowledge and skills as they progress through a sequence of jobs.
- Encourage and support the dialogue with youngsters concerning (i) societal challenges, such as sustainability, energy, climate, food supplies, safety and security; and (ii) the importance of KETs jobs to tackle these challenges.

Recommendations to Industry

The industry as the stakeholder on the “demand-side” for skills should play an active role and:

- Engage in more effective partnerships with the education providers (universities, technical colleges, vocational schools) in order to generate insight in future jobs and skills requirements and establish a “market for talent” with outcome-based performance measurement.
- Invest more vigorously in learning programmes and review hiring practices in combination with (re)training strategies.
- At the same time, industry should help education providers think “beyond the classroom”: partnerships between companies and vocational schools e.g. can create efficient hands-on pathways into manufacturing jobs.
- Develop transferable talents (e.g. adaptability, problem-solving skills, interpersonal interaction), especially of the workforce segment with intermediate-level skills as these skills will reinforce the durability of this workforce segment, which is threatened - more than the other segments - by automation.

3.3. CONCLUSION

Key Enabling Technologies (KETs) are widely recognised as having a significant impact on how Europeans will live and work, and on how European companies and economies will grow to provide sustainable employment for the citizens. Consequently, the full potential of the different EU objectives and policies - such as Growth and Jobs in Industrial Policy, Energy Union package, Climate and Environment, Digital Single Market, Resource Efficiency, Circular Economy, Smart Cities, Clean Tech, Bioeconomy, Education and Trade - cannot be met without a significant investment in KETs development and deployment.

In addition, KETs are indispensable technology building blocks underpinning a wide range of product applications in strategic European value chains, and increasing the competitiveness of European industries in sectors like automotive, aeronautics, engineering, space, chemicals, building and infrastructures, and pharmaceuticals, where European industry is a world-leader. This industry is challenged today by a new trend in the advanced manufacturing processes, the so-called “Industry 4.0” that aims to create network-centric production, using new manufacturing technologies and cyber-physical systems and increase participation in the value chain and decentralised production. In that regard, devices and embedded computing sensors (integrating KETs) will be communicating, delivering real-time responses in order to speed up monitoring and fabrication processes. Therefore, KETs are also an indispensable driver for the “Industry 4.0” which will both contribute in increasing competitiveness and accelerating the reindustrialisation of Europe.

In that regard, support of KETs should be considered as a crucial element of the political agenda of the new European Commission addressing the creation of growth and jobs and hence should be fully implemented in the Jobs, Growth and Investment Package.

The HLG-KET therefore requests that all public authorities (European Institutions, Member States and Regions) accelerate the implementation of the European Strategy for Key Enabling Technologies, relying on the recommendations set out in this report, which should be considered as an integrated approach to meet the full exploitation potential.

Considering the spillover effect of KETs-based innovation and manufacturing across all EU policies and the urgency to take actions, it is crucial to ensure a high-level structured approach dealing with innovation and competitiveness within the EU, targeting the assessment of societal and business opportunities for EU, the layout of guidance for public authorities, industry and the research community regarding innovation investment needs and opportunities and the follow-up in the implementation of actions. This approach should ensure inclusive engagement of public and private stakeholders in dedicated governance structure and based on an integrated commitment from industry and research communities along with policy makers across different portfolios with high-level leadership within the European Commission.

Finally, and beyond practical measures that should be implemented, EU has to act collectively, with consistency, and more strategically. Other regions of the world are challenging EU industry competitiveness, by implementing strong and integrated initiatives, built on strong public support leveraging massive private investments that serve their economy and strategic interests. If Europe does not commit with similar momentum, there is a dramatic risk for additional erosion of the EU industrial and technology base with related consequences for growth and employment.

APPENDIX 1:
**MEMBERSHIP
OF THE HLG-KET
AND OF THE
SHERPA GROUP**



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APPENDIX 2: **KET MANIFESTO**

MANIFESTO

High-Level Expert Group on
Key Enabling Technologies

KEY ENABLING TECHNOLOGIES

*CORNERSTONE OF THE EUROPEAN
INDUSTRIAL RENAISSANCE*

July 2014



EUROPEAN
COMMISSION

To reindustrialize Europe we need...


... an integrated KETs-based industrial policy

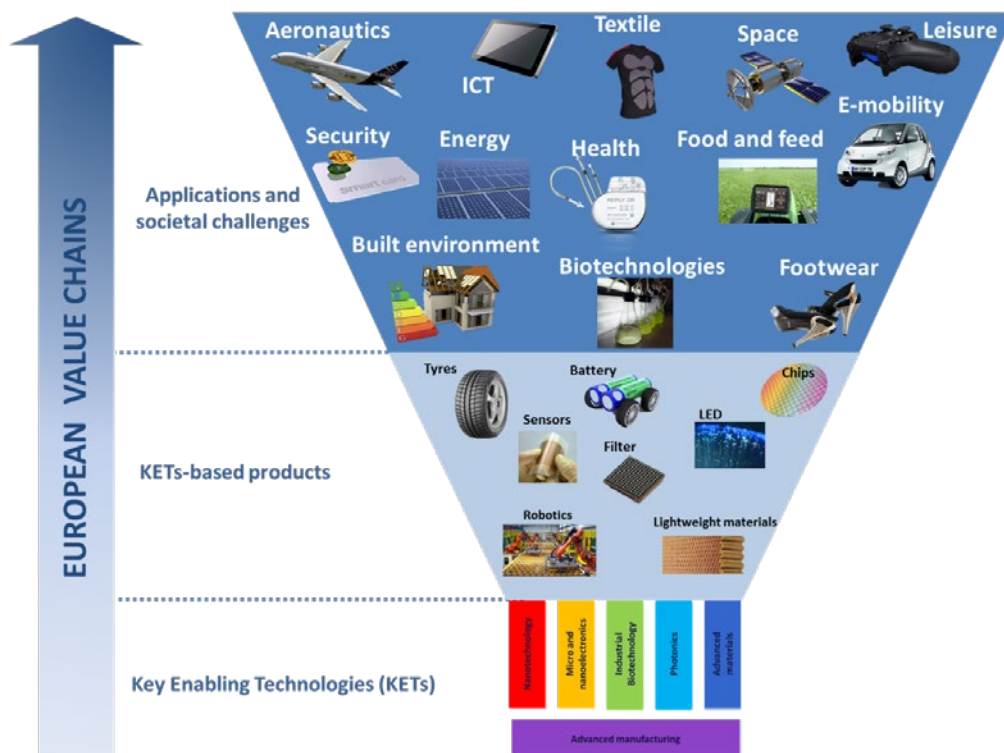
We request the European Parliament to provide support and political leadership to:

- ◇ Give a **high political priority** to an integrated KETs innovation and manufacturing policy and stimulate all types of investment for growth and jobs in the European Union.
- ◇ Create **market pull** by ensuring the systematic use of European KETs to meet European's societal challenges.
- ◇ Use **public procurement** to accelerate market uptake of European KETs-based products and services across the European Union.
- ◇ Increase investor and public **confidence** in new technologies and address barriers to investment.
- ◇ Support policies to reduce the **skills** gap in KETs-related industrial sectors.
- ◇ Support large-scale manufacturing initiatives in **strategic European industrial domains**, using instruments such as important projects of common European interest.

THE EUROPEAN PARLIAMENT IS REQUESTED TO GIVE ITS FULL SUPPORT TO ENSURE THE SUCCESS OF EUROPE'S INDUSTRY, TODAY AND TOMORROW.

KEY ENABLING TECHNOLOGIES (KETs) DRIVE EU INDUSTRIAL COMPETITIVENESS

- ◇ KETs consist of six technologies: Advanced Manufacturing, Advanced Materials, Industrial Biotechnology, Micro-Nanoelectronics, Nanotechnology and Photonics. 
- ◇ KETs are the « technology building blocks » of advanced products and their manufacture.
- ◇ KETs underpin a wide range of products in strategic European value chains and provide innovative solutions to societal challenges.



KEY ENABLING TECHNOLOGIES SUPPORT EUROPEAN GROWTH AND JOBS

- ◇ The global market volume in KETs-based products is expected to be worth almost € 1000 bn* by 2015 and...



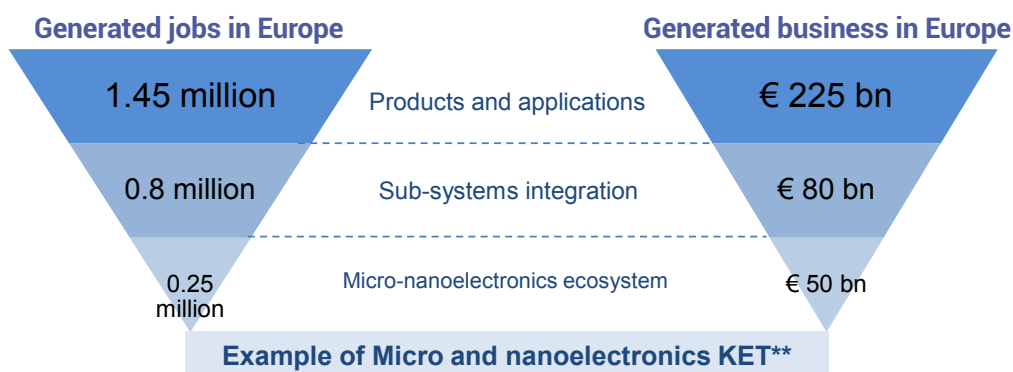
...is expected to grow from 10 to 20% in the coming years.

- ◇ The EU28 export of KETs-based products currently represents

23%
of its global exports*



- ◇ KETs directly and indirectly boost competitiveness and generate jobs all along strategic European value chains, creating growth and wealth in the whole economy.



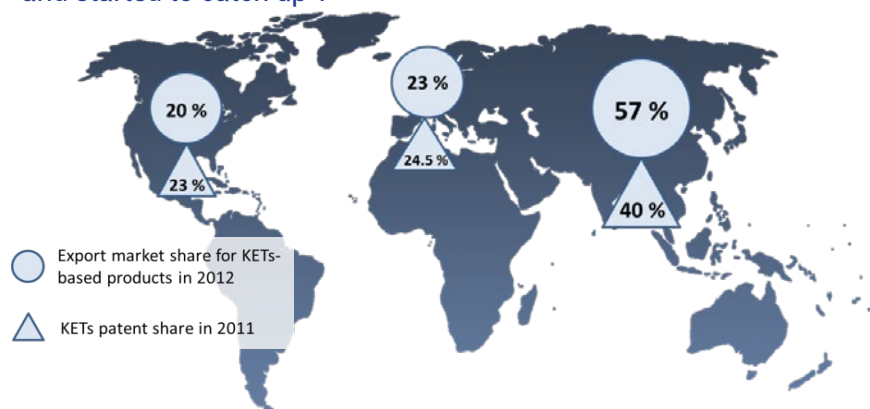
- ◇ KETs contribute to achieving the European Union reindustrialisation, energy and climate change targets simultaneously.

EUROPE'S TARGET OF 20% SHARE OF MANUFACTURING IN EUROPEAN UNION GDP BY 2020 CAN ONLY BE ACHIEVED THROUGH DEVELOPMENT AND DEPLOYMENT OF KETs

* European Competitiveness Report 2013, European Commission
** A European Industrial Strategic Roadmap for Micro- and Nano-Electronic Components and Systems, ELG, 2014

EUROPE HAS A STRONG KNOWLEDGE BASE IN KETs BUT FACES FIERCE COMPETITION FROM BLOCK ECONOMIES

- Europe has built up a worldwide leadership in KETs which is now endangered given that other regions have understood the relevance of this technology and started to catch up*.



- The EU's major weakness lies in translating its KETs-knowledge base into goods and services, creating a disruption in the innovation chain.



- Europe is one of the strongest regions globally in terms of public R&D spending. However,...

...more than 2/3 of European Commission R&D funding goes to basic research...

...while...

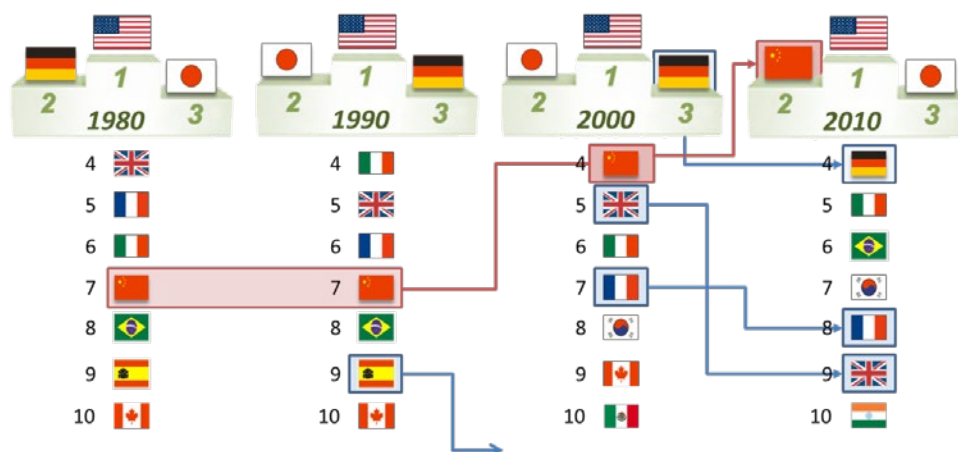
...other regions direct at least 2/3 of their public R&D funding to activities close to market in order to trigger innovation and manufacturing

EUROPE SHOULD CONTINUE TO REBALANCE ITS POLICIES TOWARD TECHNOLOGICAL RESEARCH AND INNOVATION

* Note from the Council of the European Union of 21 May 2014. « Key enabling technologies - State of play »

EUROPEAN COMPETITIVENESS IN GLOBAL MANUFACTURING IS RAPIDLY DECLINING

- ◇ Asian countries have risen up to the top rank of manufacturing displacing European Member States*.



- ◇ Between the first quarter of 2008 and the end of 2012...



...3.8 million jobs have been lost in manufacturing in the EU**.
(more than in the US and Japan cumulated)

- ◇ Competing economies leap-frogging up global manufacturer's ranking supported by political leadership.



US manufacturing has added about
500,000 jobs
over the past three years.



With **22%** of the market share, China is now **the world's largest factory** for advanced products, ahead of US and EU.

EUROPE MUST INVEST IN KETs TO REVERSE THIS TREND AND ACCELERATE THE EUROPEAN INDUSTRIAL MANUFACTURING RENAISSANCE

*Based on « Manufacturing the future: the next era of global growth of innovation », McKinsey Report November 2012.
** Member States' Competitiveness Performance and Implementation of EU Industrial Policy, SWD (2013) 346.

High-Level Expert Group on Key Enabling Technologies (KETs)

The High Level Expert Group on KETs (HLG KET) set up by the European Commission consists of representatives from key actors along strategic European value chains, including technology representatives from each of the six KETs, down-stream industry, cross-cutting KETs representatives, civil society representatives, the European Investment Bank, as well as representatives of relevant Public-Private-Partnerships (PPPs). It is tasked to provide advice on and accelerate the implementation of the European KETs strategy which aims to boost the manufacturing of KETs-based products in Europe.



HLG KET Final report June 2010



HLG KET report July 2013



HLG KET submission to European Council February 2014

Further information is available at:
http://ec.europa.eu/enterprise/sectors/ict/key_technologies/kets_high_level_group_en.htm



Disclaimer

The views expressed in this publication are those of the members of the High Level Expert Group on Key Enabling Technologies and do not necessarily reflect the views of the European Commission

APPENDIX 3:

JRC-IPTS

CONTRIBUTION

Analysis of KETs priorities declared by Regions
in their Research and Innovation Strategies
for Smart Specialisation (RIS3) by Institute for
Prospective Technological Studies, DG Joint
Research Centre, European Commission
(January 16th, 2015)

The European Commission recommends policy makers to consider how different aspects of their Smart Specialisation Strategies are interconnected. Such integrated research and innovation strategies prove to allow Regions and Member States to be more agile when faced with complex development challenges. Regional and national RIS3 priorities can change over time as a result of various technological or market developments, entrepreneurial discoveries, and reorientations of regional and national research and innovation related activities. The Eye@RIS3 database¹ of the European Commission's Joint Research Centre (DG JRC) S3 platform, facilitates searching for potential cooperation partners, within the context of the platform's work, thereby assisting Regions and Member States in tackling their Smart Specialisation Strategies, e.g. niches/priorities, entrepreneurial discovery processes, activities related to their chosen priorities.

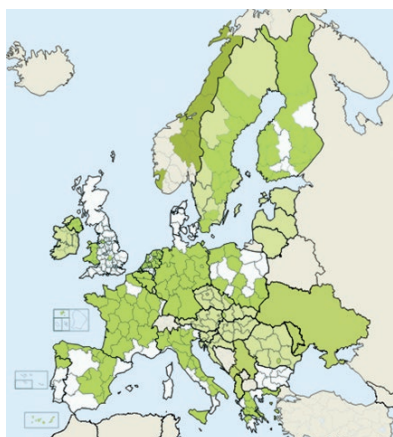
While most regions and Member States have to date defined a wide range of various Smart Specialisation priorities, many of these priorities increasingly focus on key enabling technologies. The Eye@RIS3 database provides such information on the priorities currently developed by European Regions and Member States. The following part of this report examines which European Member States and Regions have to date included KETs priorities in their Smart Specialisation Strategies. These priorities can be used as an indication of where the strengths are at regional level, KET by KET, in the context of the Smart Specialisation initiatives.

KETs-RELATED PRIORITIES AND THEIR DISTRIBUTION ACROSS THE EUROPEAN UNION

Figure a.3.1. (a)
Regions with
encoded RIS3
priorities (Jan-15)



Figure a.3.1. (b)
Regions with
encoded KETs
priorities (Jan-15)



The entire database as of January 2015 contains data encoded for 24 Member States (national priorities) and 174 EU Regions (regional priorities), covering 99% of the EU territory. Over 60% of these countries and Regions have indicated at least one KETs-related priority (14 EU countries and 111 EU Regions). This ratio (2 out of every 3 Regions and countries) remained fairly constant over the past two years, even though the overall number of registered RIS3 priorities in the database has increased significantly since 2013.

National level: Less than 50% of these 111 Regions and 14 MS encoded just one KETs-related priority each. The rest of the Regions and countries in the database have however indicated two or more such priorities. Interestingly, a number of Member States plan to focus on a significantly larger number of KETs areas in their national Smart Specialisation Strategies. Three national level KETs-related priorities are currently encoded for Latvia, four for Estonia and six for Sweden.

Regional level: A total of eleven EU Regions expect to focus their research and innovation activities on 4 to

1. See: <http://s3platform.jrc.ec.europa.eu/eye-ris3>

5 various KETs priorities, while five Regions are currently planning to invest in as many as 7 various KETs-related activities. Bretagne has selected 5 such priorities, while three Regions (Flemish region, Sachsen and Bratislavský kraj) are aiming to invest in 6 KETs-related priorities. One Region (Slaskie) is currently planning to specialise in as many as 7 such priorities.

DISTRIBUTION OF KETs-RELATED PRIORITIES

Advanced Materials (AM)

Advanced materials technologies are of key importance for the competitiveness of EU industry as they allow reducing resource dependency and environmental waste and hazards at the same time. With a first-class research infrastructure and major strengths in both producer and user industries, the EU is a world leader in advanced materials. The AM markets are expected to contribute significantly to the economic growth in Europe as a forecasted annual volume within the EU of 55 billion euros by 2016. There is considerable potential in the area of energy 19 billion euros (e.g. catalysts and batteries), environment 12 billion euros, health, transport and ICT².

Trend: The overall count of registered AM-related priorities has increased significantly since 2013. The share of AM-related priorities of the overall number of recorded priorities has increased to 6.1%. Furthermore, advanced materials remain to be the second largest group of KETs-related priorities at 29.5% (down from 31.3% in March 2013).

MS: Six Member States or 25% of all EU countries in the database have reported at least one priority related to advanced materials. Five countries (Estonia, Ireland, Lithuania, Luxembourg and Latvia) have reported one priority each, while (Sweden) has indicated 3 AM-related priorities.

Regions: A total of 58 Regions (every third region in the database) have indicated AM priorities in their regional S3 strategies. While approximately 9 out of 10 of these regions reported just one such priority, four Regions (Région Wallonne, Brandenburg, Galicia and Comunidad Valenciana) have reported 2 such priorities, and two Regions (Nord - Pas-de-Calais and Bratislavský kraj) have included 3 AM-related priorities in their regional Smart Specialisation Strategies.

Existing capabilities: Most KETs-related priorities require existing regional industrial, research, innovation and/or training capabilities. As advanced materials technologies are used in most manufacturing industries, overlaps with other KET-domains are not the exception but the rule³. Based on the Eye@RIS3 database, 90.5% of all AM priorities are supported by existing capabilities in 'Manufacturing and Industry'. Other AM activities are to be built on indicated capabilities in 'Construction' (5.4%), as well as 'ICT' (2.7%) and 'Energy production and distribution' (1.4%).

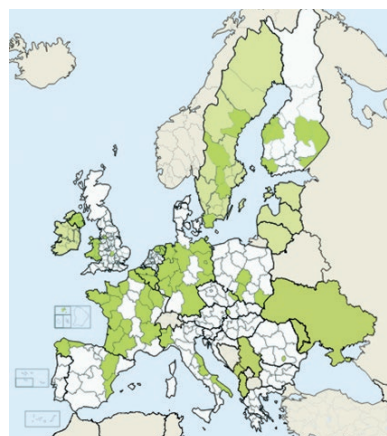


Figure a.3.2.
Regions with
AM priorities
(Jan-15)

2. Commission staff working document accompanying the communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions - "Preparing for our future: Developing a common strategy for key enabling technologies in the EU" - Current situation of key enabling technologies in Europe (COM(2009) 512). Link: <http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:52009SC1257>

3. See: http://ec.europa.eu/enterprise/sectors/ict/files/kets/2_hlg-materials-report_en.pdf

Targeted Markets: It is currently suggested by regional and national policymakers that a large share of all advanced materials related priorities are to feed into the 'Manufacturing and industry' market (79.7%). The rest of these priorities are to connect to the following markets: 'Construction' (6.8%), 'Transporting and storage' (2.7%), 'Energy production and distribution' (2.7%), 'Water supply, sewerage, waste management & remediation activities' (2.7%). The rest of the AM priorities are to be linked to four markets: 'Services' (1.1%), 'Tourism, restaurants & recreation' (1.1%) and 'Mining & quarrying' (1.1%).

Advanced Manufacturing Systems (AMS)

Many policymakers across the Union strongly believe that manufacturing should be seen as a key driver of jobs and economic growth in the EU. In 2012, the manufacturing sector in the European Union employed over 30 million persons directly with at least further 60 million jobs indirectly, manufactured goods amount to more than 80% of total EU exports as well as manufacturing accounted for 80% of private Research & Development expenditure⁴. Given its increasing importance, the uptake of advanced manufacturing systems and technologies in existing and new production processes is expected to lead to an increase in the competitiveness of the EU's manufacturing industry.

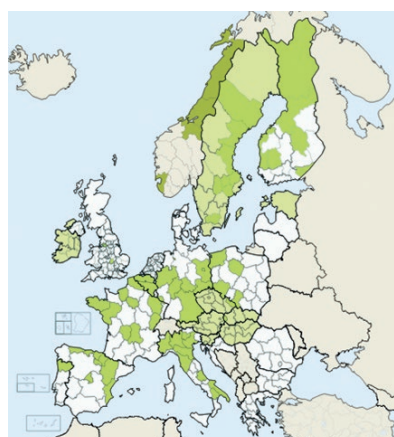


Figure a.3.3.
Regions with
AMS priorities
(Jan-15)

Trend: The European Commission's Industrial Policy Communication⁵ from 2012 has proposed to upturn the share of industry in Europe from its current level of around 16% of GDP to 20% by 2020. EU countries and regions are strongly encouraged to promote the commercialisation and deployment of advanced manufacturing technologies, and to develop transnational/transregional cooperation based on their national and regional specialisations.

This message seems to be well received across the Union as the overall number of AMS-related priorities has increased fourfold since March 2013. AMS-related priorities now form the largest group of KETs-related priorities and account for over one third of all KETs priorities registered in the Eye@RIS3 database to date.

MS: The database currently has data for a total of nine EU Member States with AMS-related priorities in their national Smart Specialisation Strategies. As of January 2015, seven EU countries (Austria, Czech Republic, Hungary, Ireland, Malta, Slovenia and Slovakia) have indicated one priority each, while both Estonia and Sweden have indicated 2 such priorities each.

Regions: Every third EU region in the entire Eye@RIS3 database (61 regions) has indicated at least one AMS-related priority in their regional strategies. Out of these, most EU Regions indicated just one AMS priority (78.7%), and 10 regions indicated two such priorities each (16.4%). Two regions (Piemonte and Kujawsko-Pomorskie) selected three AMS-related priorities each and one region (Śląskie) indicated six priorities related to advanced manufacturing systems.

Existing capabilities: Many envisaged AMS activities are of crosscutting nature, providing a crucial input for process innovation in any manufacturing sector and would therefore require

4. Source: http://europa.eu/rapid/press-release_MEMO-14-193_en.htm

5. See: <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2012:0582:FIN:EN:PDF>

certain existing capabilities in the region. Based on the data available in the database, an absolute majority (84.3%) of all AMS priorities will be supported by existing capabilities in 'Manufacturing and Industry'. Other AMS activities will be supported by reported capabilities in 'ICT' (9%), as well as 'Energy production and distribution' (3.4%), 'Services' (2.2%) and 'Construction' (1.1%).

Targeted markets: When asked about which markets would be targeted with the proposed AMS-related priorities, policymakers seem to believe that a majority of indicated AMS-related activities are to feed into the 'Manufacturing and industry' market (84.3%), while 4.5% of priorities will target the 'Transporting and storage' market and 4.5% are to provide inputs for the 'Information and communication technologies (ICT)' market. Just over 2.2 per cent of all AMS activities are to target the 'Energy production and distribution' market. The rest of the AMS priorities are expected to link to the 'Services' (1.1%), 'Agriculture, forestry and fishing' (1.1%) and 'Construction' (1.1%) markets.

Industrial Biotechnology (IB)

Europe currently holds a strong position in the development and production of enzymes, biochemicals, intermediates and bio-base polymers, and a weaker position in the biofuels industry⁶. Not only Industrial Biotechnology allows addressing certain Societal Challenges such as EU competitiveness, climate change and sustainability, but it also represents a strongly growing market. The overall value of biochemicals (other than pharmaceuticals) is expected to increase to between 12% and 20% of all chemical production by 2015⁷.

Trend: IB priorities account for 4.2% of all RIS3 priorities in the database. While the overall number of such priorities has significantly increased, the overall share of IB priorities of all KETs-related priorities encoded in the database has decreased from 26% in 2013 to just over 20% in January 2015.

MS: Five EU MS (Estonia, Croatia, Latvia, Romania, and Sweden). Most of these countries (80%) have indicated just one IB-related priority in their national RIS3 strategy with Latvia being one exception with two such priorities.

Regions: A total of 39 EU Regions have included at least one IB related priority. While over 90% of these Regions included one such priority each, three regions (Flemish region, Comunidad de Madrid and Sicily) have indicated two IB priorities each.

Existing capabilities: Similarly to AM and AMS priorities, a majority of all IB priorities (87.5%) are supported by existing capabilities in 'Manufacturing and Industry'. Another significant group of IB-related priorities is to be supported by existing capabilities in 'Agriculture, forestry and fishing'. Just 2.1% of planned IB priorities are to be plugged into existing capabilities in 'Human health and social work activities'.

Targeted Markets: A significant share of all IB-related priorities is to feed into the 'Manufacturing and industry' market (81.3%). The rest of IB priorities are to connect to the following markets: 'Human health and social work activities' (10.4%), 'Energy production and distribution' (4.2%) and 'Agriculture, forestry and fishing' (4.2%).

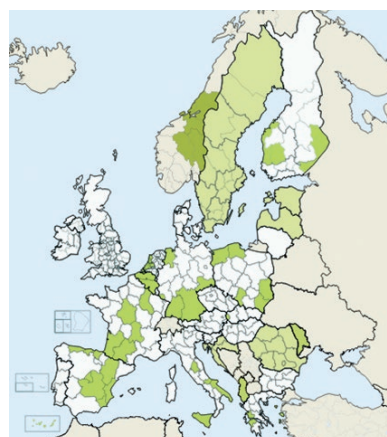


Figure a.3.4.
Regions with IB
priorities (Jan-15)

6. Source: http://ec.europa.eu/enterprise/sectors/ict/files/kets/4_industrial_biotechnology-final_report_en.pdf
7. OECD (2009) - The Bioeconomy to 2030: Designing a Policy Agenda

Photonics (PH)

Europe's share of the worldwide production volume in the photonics industry stands at approximately 18%. In the EU, over 5,000 companies are involved in photonics, most of them SMEs. The market volume of the photonics industry is expected to reach 615 billion euros in 2020⁹.

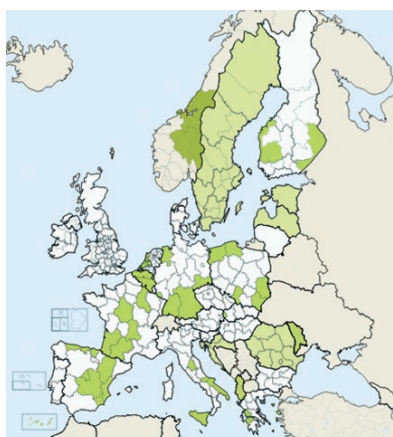


Figure a.3.5.
Regions with
PH priorities
(Jan-15)

Trend: A total of 13 photonics-related priorities account for just 1% of all RIS3 priorities in the database. While the absolute number of such priorities has increased, the overall share of photonics-related priorities of all KETs-related priorities encoded in the database has slightly decreased from 5.2% in 2013 to just over 4.9% in January 2015.

MS: To date, none of the 24 EU Member States in the Eye@RIS3 database has indicated a photonics-related priority in its national RIS3 strategy.

Regions: A total of 12 EU regions have included at least one photonics-related priority. Although most of these regions included one such priority each (11 regions or 92.3% of all regions in this group), Bretagne has included two photonics-related priorities in its regional Smart Specialisation Strategy.

Two thirds of all photonics priorities are registered by regions in either Germany or France (66.7% or 8 out of 12 priorities). The rest of priorities have been registered by Regions from the following five countries: Belgium, Finland, Italy, Poland and the UK (a priority per country).

Existing capabilities: Most photonics-related priorities (84.6%) are supported by some capabilities in the area of 'Manufacturing and Industry'. The rest of these priorities are to be supported by existing regional capabilities in 'ICT' (7.7%) and 'Services' (7.7%).

Targeted Markets: Similarly to many other KETs priorities, a majority of all photonics-related priorities are expected to feed into the 'Manufacturing and industry' market (92.3%). The rest of photonics priorities are to connect to the 'Information & communication technologies (ICT)' market (7.7%).

Micro- and Nanoelectronics (MNE)

Currently, semiconductors and related value chains underpin innovation and competitiveness in all major sectors of the economy. A recent report¹⁰ suggests that the semiconductor ecosystem in Europe itself employs approximately 250,000 people. Over 800,000 people across the European Union are engaged in the integration of components into systems, applications and services, and further 2,500,000 persons are involved in work in the complete components value chain. In total, micro- and nanoelectronic components and systems contribute to the generation of at least 10% of GDP in Europe and worldwide.

Trend: A total of 12 MNE-related priorities account for just 0.9% of all RIS3 priorities in the database. While the number of such registered priorities in the database has increased since 2013, the overall share of MNE-related priorities of all KETs-related priorities encoded has decreased from 5.2% in 2013 to just over 4.5% in January 2015.

8. See: http://ec.europa.eu/enterprise/sectors/ict/files/kets/photonics_final_en.pdf

9. See: http://www.photonics21.org/download/Photonics_industry_report_2013/photonics_industry_report_2013.pdf

10. See: http://ec.europa.eu/information_society/newsroom/cf/dae/document.cfm?doc_id=4482

MS: To date, the Czech Republic is the only EU Member State in the Eye@RIS3 database with an indicated MNE-related priority in its national RIS3 strategy.

Regions: A total of 11 EU Regions have encoded just one MNE-related priority in their regional Smart Specialisation Strategies as of January 2015. One half of all MNE-related priorities are registered by six in Germany or France (50%). The rest of priorities have been registered by Regions from five MS: Belgium, Greece, Spain, Italy and Poland (one MNE priority per country). Poland is currently the only EU-10 country with an MNE priority at the regional level.

Existing capabilities: Two thirds of all MNE-related priorities (66.6%) are supported by existing capabilities in 'Manufacturing and Industry'. One third of priorities will be supported by existing regional capabilities in 'ICT' (33.3%).

Targeted Markets: Similarly to other KETs priorities, a majority of all MNE-related priorities are expected to feed into the 'Manufacturing and industry' market (75.0%). The rest of these priorities are to be connected to the following two markets: 'Information & communication technologies (ICT)' (16.7%) and 'Energy production and distribution' (8.3%).

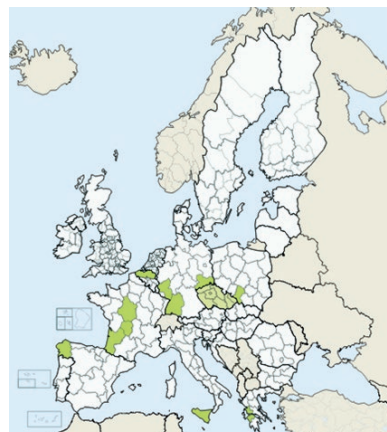


Figure a.3.6.
*Regions with MNE
priorities (Jan-15)*

Nanotechnology (NT)

The global market for nanomaterials is estimated at 11 million tonnes with a market value of 20 billion euros. Products underpinned by nanotechnology are expected to grow from a global volume of 200 billion euros in 2009 to 2 trillion euros by 2015¹¹. In addition, current direct employment in the sector stands at 300,000 to 400,000 across the European Union.

Trend: Nanotechnology is currently the smallest category of priorities out of the six KETs groups in the Eye@RIS3 database. The actual number of nanotechnology related priorities has decreased from ten in 2013 to just seven as of January 2015. Since 2013, the overall share of NT-related priorities dropped fourfold from 10.4% to current 2.6% of all KETs-related priorities in the Eye@RIS3 database (January 2015).

MS: Similarly to photonics-related priorities, none of the 24 EU Member States with registered priorities in the Eye@RIS3 database has indicated a national nanotechnology-related priority.

Regions: A total of seven Regions (Bratislavský kraj, Eastern Netherlands, Etelä-Savo, País Vasco, Podkarpackie, Sachsen, and Toscana) have indicated one nanotechnology-related priority each. As a result, these regional RIS3 priorities have been registered in Regions in each of the following EU Member States: Finland, Germany, Italy, the Netherlands, Poland, Slovakia and Spain.



Figure a.3.7.
*Regions with NT
priorities (Jan-15)*

11. See: http://ec.europa.eu/enterprise/sectors/chemicals/reach/nanomaterials/index_en.htm

Existing capabilities: Over 85% of all nanotechnology-related priorities are expected to be supported by existing capabilities in ‘Manufacturing and Industry’. One nanotechnology priority will be supported by existing regional capabilities in ‘Services’ in Eastern Netherlands (14.2%).

Targeted Markets: Currently, it is anticipated that all seven registered nanotechnology-related priorities will be linked into the ‘Manufacturing and industry’ market.

KETs-RELATED PRIORITIES AND THEIR LINKS WITH VARIOUS POLICY AREAS AT THE EU LEVEL

When inserting various regional and national priorities into the Eye@RIS3 database, regional and national policymakers are encouraged to indicate if these are linked to any of the listed EU priority areas. In order to facilitate this work, the S3 Platform has put together a list of ten EU wide policy areas based on a number of ‘Societal Grand Challenges’ identified in Horizon 2020 as well as the headline policies in the Innovation Union Flagship Initiative, including KETs, Creative and Cultural Industries, Social Innovation and the Digital Agenda.

Over 90% of all priorities encoded to date appear to be linked to at least one such EU policy area. Out of these, more than three quarters (75.7%) of these priorities seem to be well connected to just four policy areas: ‘Sustainable Innovation’ (24%), KETs (22.7%), ‘Public Health Security’ (16.3%) and ‘Digital Agenda’ (12.6%) (See table a.3.1.).

	Suggested policy areas	n	%
1	Sustainable innovation	283	24.0%
2	KETs	268	22.7%
3	Public health security	192	16.3%
4	Digital Agenda	149	12.6%
5	Cultural and creative industries	82	7.0%
6	Blue growth	53	4.5%
7	Service innovation	48	4.1%
8	Specific local policy priority	46	3.9%
9	Social innovation	23	2.0%
10	Aeronautics and space	20	1.7%
11	Nature and biodiversity	15	1.3%
		1179	100.0%

Table a.3.1.
EU level
priorities

PRELIMINARY RESULTS FROM AN IN-HOUSE STUDY BY THE IRIMA TEAM AT JRC-IPTS EXAMINING TECHNOLOGICAL ADVANTAGES OF EU REGIONS

The data for this study are extracted from the Regpat database, a regionalised version of the “EPO Worldwide Patent Statistical Database” provided by the OECD. Regional patent statistics are based on the region of residence of the patent applicants at NUTS2 level.¹² Our analysis focuses on the patents filed during the 2009-2011 period using the July-2014 version of Patstat.

A central task towards the assessment of Regions' capability to develop Key Enabling Technologies in terms of patents is the definition of the technical fields that are related to specific KETs. In order for our results to be consistent with existing evidence we will resort to the most recent definition of KETs that has been developed by the KETs Observatory.¹³ The definition is based on the International Patent Classification (IPC) used to systematically classify patents worldwide. Patents are not directly connected with products, but distinguished primarily by their technical implications.

Key Enabling Technologies (KETs)

Figure a.3.8. shows a mapping of the total patent filings related to KETs across the European Regions.

Over the 293 Regions with at least one patent filed during the period analysed, 253 have at least one KET-related patent. The number of total KETs-related filings in most European regions is below 140. There is a small number of Regions which perform particularly well in KETs patenting. In particular, 44% of KET-related patents originate from only ten Regions. In terms of total KETs-related patents, the top performer is Île de France with 2488 filings over the period considered. In the top ten there are 6 Regions from Germany (Oberbayern, 2228 – Stuttgart, 1166 – Rheinhesen-Pfalz, 750 – Düsseldorf, 687 – Köln, 634 – Darmstadt, 627), 1 from the Netherlands (Noord-Brabant, 1053), 1 from Italy (Lombardia, 546) and Rhône-Alpes (495) also from France.

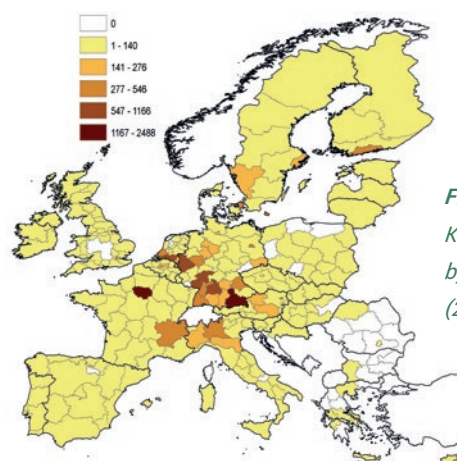
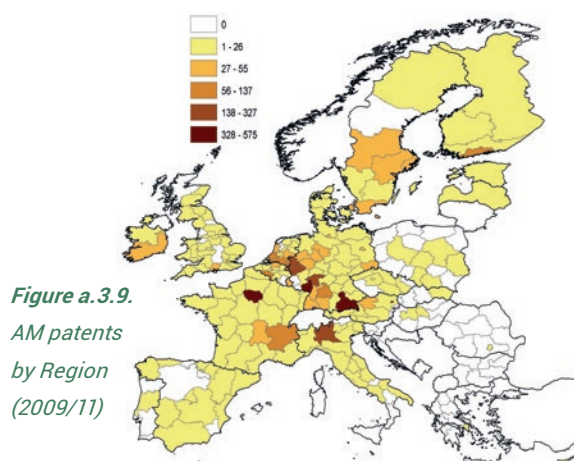


Figure a.3.8.
KET patents
by Region
(2009/11)

12. The OECD REGPAT database presents patent data that have been linked to regions utilizing the addresses of the applicants and inventors. The regional breakdowns provided in REGPAT correspond to the latest version of the Nomenclature of territorial units for statistics (NUTS, 2010 Eurostat)

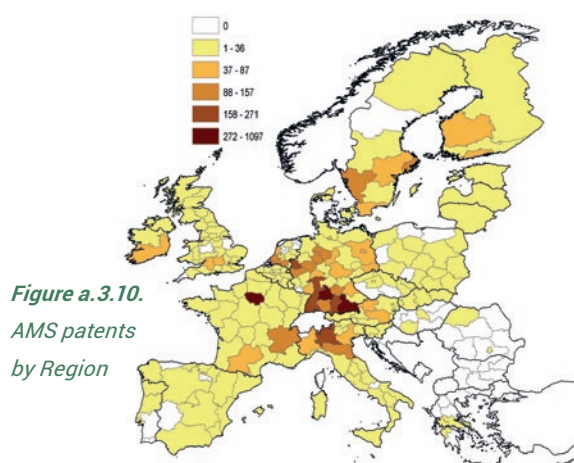
13. See <https://webgate.ec.europa.eu/ketsobservatory/> for the correspondence between IPC codes and KETs.



Advanced Materials (AM)

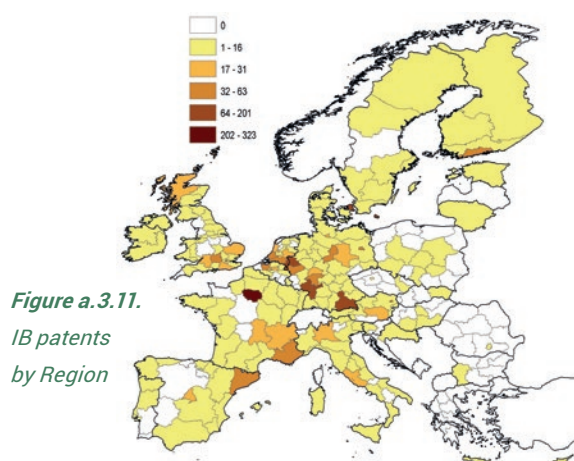
Figure a.3.9. shows the distribution of patents on Advanced Materials over Europe.

Patents on Advanced Materials have been filed at 198 European Regions. The number of filings in most of these Regions is below 26. As in the case of the overall KETs a small number of Regions perform particularly well in patenting Advanced Materials. In particular, 54% of Advanced Materials related patents originate from only ten Regions. Once again the top performer is Île de France with 575 patent applications. In the top ten there are 5 Regions from Germany (Rheinhausen-Pfalz, 443 – Oberbayern, 436 – Düsseldorf, 327 – Köln, 326 – Darmstadt, 215), 1 from Austria (Wien, 251), 1 from Italy (Lombardia, 213), 1 is from the Netherlands (Noord-Brabant, 137) and 1 is from Belgium (Brussels-Capital Region, 109).



Advanced Manufacturing Systems (AMS)

Advanced Manufacturing technologies are the most patented KET across Europe. As shown in **Figure a.3.10.** there are 223 Regions with at least 1 patent application related to this field. 44% of the total number of patents has been filed by applicants located in ten Regions. With 7 Regions in the top 10, Germany performs particularly well in Advanced Manufacturing technologies (Oberbayern, 1097 – Stuttgart, 790 – Freiburg, 271 – Schwaben, 222 – Darmstadt, 196 – Karlsruhe, 192 – Düsseldorf, 182), the other three Regions come from France (Île de France, 715), one from the UK (West Wales and The Valleys, 170), and one from Italy (Lombardia, 162).



Industrial Biotechnology (IB)

Figure a.3.11. shows a mapping of the total patent filings related to Industrial Biotechnologies across the European Regions. There are 191 Regions with at least one patent application in this KET. In total there have been 2917 applications related to Industrial Biotechnologies. Again, the top 10 Regions have the lion share in terms of patent applications, but for this technology they hold the lowest share (42%) of patents across Europe. The top Region is Île de France with 323 filings, followed by Hovedstaden (Denmark) with 201 filings. There are also six German Regions in the top ten (Oberbayern, 132 – Karlsruhe, 111 – Rheinhausen-Pfalz, 106 – Düsseldorf, 87 – Berlin, 52 – Köln, 49) and two Regions from the Netherlands (Limburg, 105 and Zuid-Holland, 63).

Photonics (PH)

During the period considered, there have been 3039 patent applications in Photonics at 180 European Regions. In **Figure a.3.12.** the distribution of patent applications in Photonics is depicted. The ten Regions with the largest number of patents applications have filed more than half (52%) of the total Photonic related patents in Europe. The top performer is the Region of Noord-Brabant in the Netherlands with 370 applications, followed by Île de France with 329. Scrolling down the top ten rank we find four German Regions (Oberbayern, 267 – Hamburg, 104 – Arnsberg, 96 – Oberpfalz, 92), one from Austria (Vorarlberg, 91), one from Italy (Lombardia, 77), Zuid-Holland (72) and Stuttgart (69) from the Netherlands and Germany respectively.

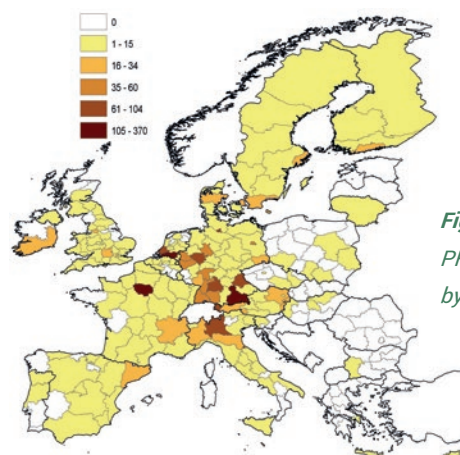


Figure a.3.12.
PH patents
by Region

Micro- and Nanoelectronics (MNE)

With 4712 filings, Micro- and Nanoelectronic technologies are the third most patented KETs across Europe. These applications originate from 174 European Regions, with only a few from Eastern Europe (**see Figure a.3.13.**). With 55% of the total applications filed by only ten Regions, Micro- and Nanoelectronic technologies are the most concentrated KETs. Again, Île de France with 608 filings is leading across Europe followed by the Region of Noord-Brabant in the Netherlands with 420 applications. Similarly to the previous KETS, Germany has a number of Regions among the top ten performers: Oberbayern, 354 – Oberpfalz, 240 – Stuttgart, 221 – Darmstadt, 157 – Rheinhessen-Pfalz, 147 – Köln, 110. The list of the top ten Regions includes also Rhône-Alpes in France (208) and Prov. Vlaams Brabant in Belgium (150).

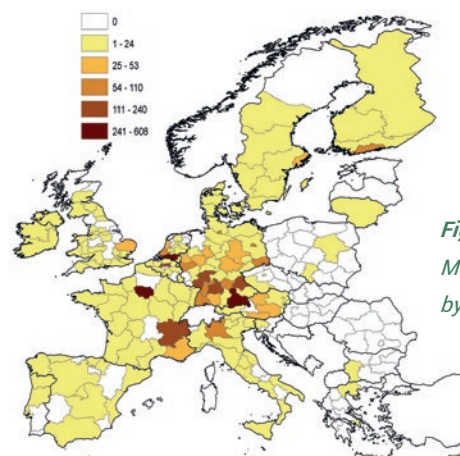


Figure a.3.13.
MNE patents
by Region

Nanotechnology (NT)

Finally, Nanotechnology related patents have been filed in 97 Regions which are presented in **Figure a.3.14.** The total number of applications that have been filed during the period considered is 508, by far the lowest among KETs. Nanotechnologies are quite concentrated among the top ten performers, which own more than half (53%) of the total European patents. Moreover, large differences can be observed even among the top ten performers. Île de France, the leading Region has 102 patent applications, the same number of patent owned by the Regions ranking between

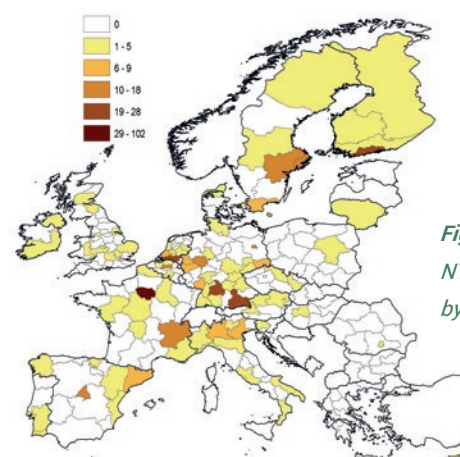


Figure a.3.14.
NT patents
by Region

the second and the fifth position. On the other hand, Nanotechnology is the KET with the highest number of different countries having at least one Region in the top ten. Scrolling down the top ten rank we find two Germans Regions (Stuttgart, 28 – Oberbayern, 27), one Region from the Netherlands (Noord-Brabant, 26), one from Finland (Helsinki-Uusimaa, 22), one from Belgium (Prov. Vlaams Brabant, 18), one from Spain (Comunidad de Madrid, 13), two from Sweden (Östra Mellansverige, 12 – Stockholm, 11) and another one from France (Rhône-Alpes, 11).

SUMMARY OF MAIN OBSERVATIONS

The carried out analysis of RIS3 priorities entered in the Eye@RIS3 database highlighted a number of interesting trends, which are summarised below.

Major Point 1: **A consistent interest in KETs-related priorities from 2013 to 2014.** Two out of every three regions and countries have selected such priorities in their Smart Specialisation Strategies.

Major Point 2: **Not all KETs have to date made it to national Smart Specialisation Strategies.** As of January 2015, none of the EU Member States with priorities registered in the Eye@RIS3 database has chosen a national RIS3 priority linked to either 'Photonics' or 'Nanotechnology'.

Major Point 3: **Over 80 per cent of all KETs-related priorities belong to three KETs groups.** Priorities in just three groups ('Advanced Manufacturing Systems', 'Advanced Materials' and 'Industrial Biotechnology') remain the largest share of all KETs-related priorities. Since 2013, their accumulative share has increased from 77.3% to 84.3% of all registered KETs-related priorities. Priorities in these three categories currently account for 17.5 per cent of all priorities registered in the Eye@RIS3 database.

Major Point 4: **A strong and consistent increase in the number of priorities in two KETs groups: 'Advanced Manufacturing Systems' and 'Advanced Materials'.** Priorities in these two groups have shown a considerable growth rate over the last two years. Their accumulative share of all KETs-related priorities has increased from 77.3% in 2013 to 84.3% in January 2015. Their share of all priorities registered in the database during the same period has increased from 9.7% to 13.3%.

Major Point 5: **A substantial decrease in the number of priorities in other groups of KETs.** The overall share of all other KETs-related priorities ('Industrial Biotechnology', 'Photonics', 'Micro- and Nanoelectronics' and 'Nanotechnology') has witnessed a consistent drop. Their joint share of all KETs priorities has decreased to 6.6%, while their share of all RIS3 priorities in the Eye@RIS3 database has plunged from 46.8% to 32.1%.

	Share of all registered priorities		Share of all registered KETs-related priorities	
	Mar-2013	Jan-2015	Mar-2013	Jan-2015
Advanced Manufacturing Systems	3.9%	7.2%	20.0%	34.7%
Advanced Materials	5.8%	6.1%	31.3%	29.5%
Industrial Biotechnology	4.8%	4.2%	26.0%	20.1%
Photonics	1.0%	1.0%	5.2%	4.9%
Micro and Nano-Electronics	1.0%	0.9%	5.2%	4.5%
Nanotechnology	1.9%	0.5%	10.4%	2.6%
All priorities classified as KETs-related	18.4%	19.9%	-	-

*Table a.3.2.
Changes in
priorities since
2013*

The carried out analysis on regional technological advantages and patent statistics highlighted a number of elements illustrated below.

Major Point 1: **Key Enabling Technologies are developed in most of the European Regions.** 253 European Regions had at least one KET-related patent application during the 2009-2011 period. This finding is consistent with the importance given by the Regions to KETs in setting their Smart Specialisation Strategies.

Major Point 2: **The development of KETs across the European Union is not homogeneous.** There are 29 Regions in total which appear in the top 10 best performing Regions for each KET. The top 10 Regions hold about 50% of all patent applications related to KETs. Île de France and Oberbayern are present in all top 10 rankings.

Major Point 3: **The production of KETs-related patents is very concentrated on Advanced Manufacturing Systems, Advanced Materials, and Micro- and Nanoelectronics.** Almost 75% of the total patent applications are related to these technologies. There is a special focus of most European Regions on Advanced Manufacturing Systems, and this is illustrated by the large number of related patents which amount for almost 1/3 of the total patent applications.

Major Point 4: **Currently, the number of Nanotechnology related patents is by far the smallest among KETs.** Also the number of Regions where Nanotechnology related patents are filed is the lowest compared to the other KETs.

