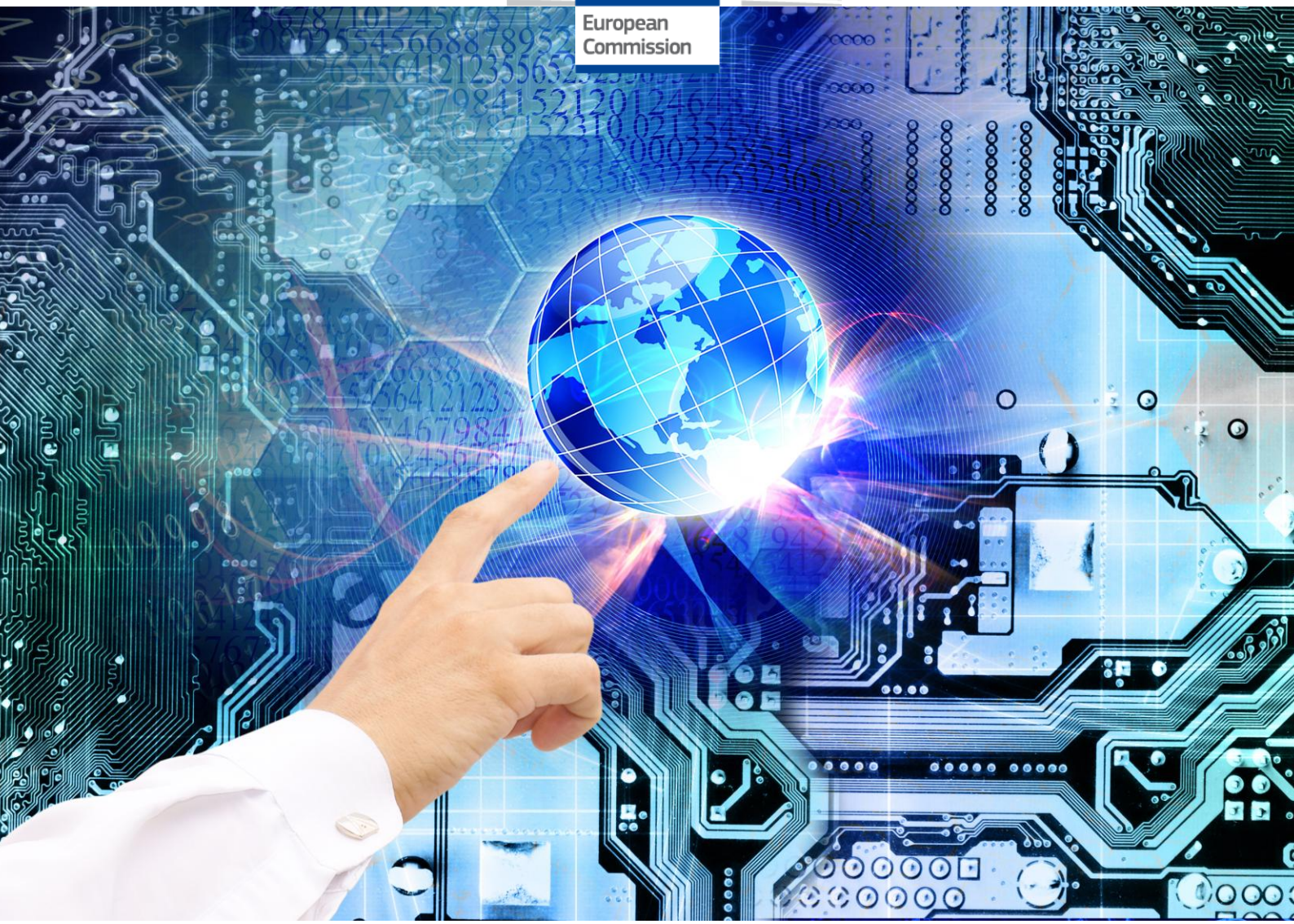
European Commission



Roadmap for cross-cutting KETs activities in Horizon 2020

Overview

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FOREWORD

If enterprises are the driving engine of European economy, then innovation is their fuel, the key ingredient that propels them forward. Those who do not innovate and do not keep up with technological developments will gradually lose market share and eventually risk going out of business.

Investment in innovation is one of the key pillars in our strategy on industrial policy: without innovation we will not achieve our goal of raising industry's contribution to GDP to 20 % in 2020. This emphasis will continue. Stimulating investment in new technologies is one of the priorities of Commissioner for Internal Market, Industry, Entrepreneurship and SMEs, Elżbieta Bieńkowska.

This is why we are focusing our efforts on Key Enabling Technologies (KETs) to stimulate technological innovation in the EU. KETs - micro- and nano-electronics, nanotechnology, industrial biotechnology, photonics, advanced materials and manufacturing - define the functionality of many of the products and devices that shape our daily lives. They drive innovation in many traditional and newly emerging sectors and are already a major source of employment in Europe. KETs are essential in order to succeed in raising the profile and importance of industry in our economy as well as to solve Europe's major societal challenges. Globally the market is estimated to be worth more than €1 trillion in 2015 – but the benefit will go only to those who master these key enabling technologies and embed them into new products. Europe is a global leader in the development of these technologies but our record in translating this knowledge advantage into marketable products and services has not been as good.

The Commission has proposed an all-encompassing and long-term strategy for KETs in 2012 with the aim to boost manufacturing in Europe of KETs-based products and applications. Implementation is ongoing and many opportunities are already provided. KETs are now a priority in Horizon 2020, for the European Structural and Investment Funds (ESIF) and also for the European Investment Bank. The new state aid rules give more flexibility to Member States to support KETs-investments. Further actions are being launched to promote the required multidisciplinary skills, to facilitate access of SMEs to KETs technology platforms and to stimulate important industrial projects bringing together public and private actors.

Horizon 2020 is the biggest single support instrument in Europe for KETs. Horizon 2020 gives high importance and visibility to KETs to foster industrial innovation with a dedicated budget for KETs of almost 6 billion euro, and rebalanced R&D&I support towards closer-to-the-market projects (including pilot lines and demonstrators) in order to facilitate industrial take-up and commercialisation. There is also a dedicated budget (around 30% of the Horizon 2020 budget allocated to KETs) for activities integrating the different KETs, the so called cross-cutting KETs activities.

It is of utmost importance to focus on more innovative products which integrate different key enabling technologies. While each of the KETs individually already have huge potential for innovation, their cross-fertilisation is particular important as combinations of KETs offer even greater possibilities to foster innovation and create new markets.

As one of the projects launched by DG GROWTH, 'RO-cKETs' (Roadmap for cross-cutting KETs) helps the Commission 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 RO-cKETs roadmap clearly shows the importance and potential of combining KETs for developing innovative products and KETs-based applications for Europe's societal challenges.

Because of their systemic relevance to Europe's capacity to innovate, to modernise its industrial base and to solve societal challenges, the Commission believes that the full exploitation of KETs will ensure a social return on investment and the creation of jobs in the EU, in line with the new agenda of President Juncker for jobs, growth, fairness and democratic change.

Antti PELTOMÄKI

Deputy Director-General of DG Internal Market, Industry, Entrepreneurship and SMEs

PURPOSE FOR A ROADMAP ON CROSS-CUTTING KETs ACTIVITIES

Key Enabling Technologies

On 26 June 2012, the European Commission tabled its strategy to boost the industrial production of innovative products, goods and services based on Key Enabling Technologies (KETs). The strategy aims to keep pace with the EU's main international competitors, restore growth in Europe and create jobs in industry, at the same time addressing today's major societal challenges. According to this strategy, KETs are defined as 'knowledge intensive technologies associated with high R&D intensity, rapid innovation cycles, high capital expenditure and highly skilled employment. They enable process, goods and service innovation throughout the economy and are of systemic relevance. They are multidisciplinary, cutting across many technology areas with a trend towards convergence and integration[1].

KETs provide the technological building blocks that enable a wide range of product applications. They already play an important role in the R&D, innovation and cluster strategies of many industries and are regarded as crucial for ensuring the competitiveness of European industries in the knowledge economy. KETs are therefore at the core of the EU's Industrial Policy flagship initiative, as confirmed in the communication 'For a European Industrial Renaissance'[2].

Cross-cutting Key Enabling Technologies

'Cross-cutting KETs' activities bring together and integrate different KETs and reflect the interdisciplinary nature of technological development. They have the potential to lead to unforeseen advances and new markets, and are important contributors to new technological components or products.

The concept of 'cross-cutting KETs' refers to the integration of different KETs in a way that creates value beyond the sum of the individual technologies. Whilst each of the KETs individually already has huge potential for innovation, their cross-fertilization is particularly important as combinations of KETs offer even greater possibilities to foster innovation and create new markets.

The integration of different KETs represents a vital activity in Horizon 2020. Over the course of Horizon 2020, around 30% of the budget allocated to KETs will go to integrated KETs projects.

In order to tap into the high cross-fertilization potential of these technologies, the European Commission launched a study to define a methodology by which to identify potential areas of industrial interest relevant for cross-cutting KETs and to develop a roadmap for cross-cutting KETs activities, which will provide input to the preparation of the cross-cutting KETs part of Horizon 2020.

The roadmap for cross-cutting KETs activities

Taking the demand side as a starting point, the roadmap for cross-cutting KETs activities identifies the most promising areas of innovation for cross-cutting KETs that address clear industrial and market needs, outlining how the combination of different KETs could contribute to addressing the challenges facing European industry, economy and society. The roadmap has been developed starting from actual market needs and industrial challenges in a broad range of industrial sectors relevant for the European economy. The roadmapping activity has focused on exploring potential innovation areas in terms of products, processes or services with respect to which the cross-fertilization between KETs could provide an added value, taking into account the main market drivers for each of those innovation areas, as well as their societal and economic context.

Cross-cutting KETs activities will in general include activities closer to the market and applications. The study focused on identifying potential innovation areas of industrial interest, implying Technology Readiness Levels of between 4 and 8.

Roadmapping approach

Taking the demand side as a starting point, the roadmapping activity has focussed on identifying the most promising areas of innovation for cross-cutting KETs that address clear industrial and market needs in a broad range of industrial sectors. This has been based, among other things, on desk research and interviews, as well as workshops with industrial stakeholders, workshops with policy makers, and the validation of findings through surveys involving both KETs experts as well as industrial stakeholders. Throughout all phases of this roadmapping process, more than 700 technology and industry experts were involved. The implemented methodology consisted of three main steps:

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[1] A European strategy for Key Enabling Technologies – A bridge to growth and jobs (COM/2012/0341 final)

2 (COM(2014)14 final)

1. Identification of innovation fields of industrial interest potentially providing promising opportunities for cross-cutting KETs developments. To this aim a broad analysis of the demand was undertaken. Activities consisted of a broad desk analysis aimed at mapping potential innovation areas along with their associated market needs and industrial challenges, which was complemented by further input from more than 80 representatives of key industrial players. From this initial activity, 257 innovation fields were identified, which were classified into 13 cross-sectoral domains.

2. Matching of the identified innovation fields with the technological offering to be provided by the cross-fertilization between KETs. The analysis leveraged views of 272 experts in the six KETs, who were called to provide input regarding which KETs could contribute to each innovation field and moreover to assess whether the integration of the potentially contributing KETs could constitute an additional success factor. This resulted in a shortlist of innovation fields with cross-cutting KETs relevance.

3. Identification of the most promising areas of converging industrial interest for cross-cutting KETs. To this aim industry representatives were called to assess the identified innovation fields in terms of market impact and opportunity toward industrial growth and job creation. The results leveraged opinions of 285 experts.

The outcome of these steps was furthermore complemented with results of patent scenario analyses.

This approach allowed the definition of a shortlist of **117 key innovation fields of industrial interest with the highest potential for answering market, industry and society demands from cross-cutting KETs developments**, which constitute the nodes of the roadmap for cross-cutting KETs activities.

Please note, this exercise does not intend to substitute any former roadmapping activity carried out under the framework of specific initiatives, but rather intends to complement those activities by providing a focus on developments that might be implemented benefitting from the cross-fertilization of different KETs in a way that creates value beyond the sum of the individual technologies.

THE ROADMAP FOR CROSS-CUTTING KETs ACTIVITIES

The overall roadmap for cross-cutting KETs activities comprises 117 innovation fields of industrial interest which are organized into the following 13 specific roadmaps:

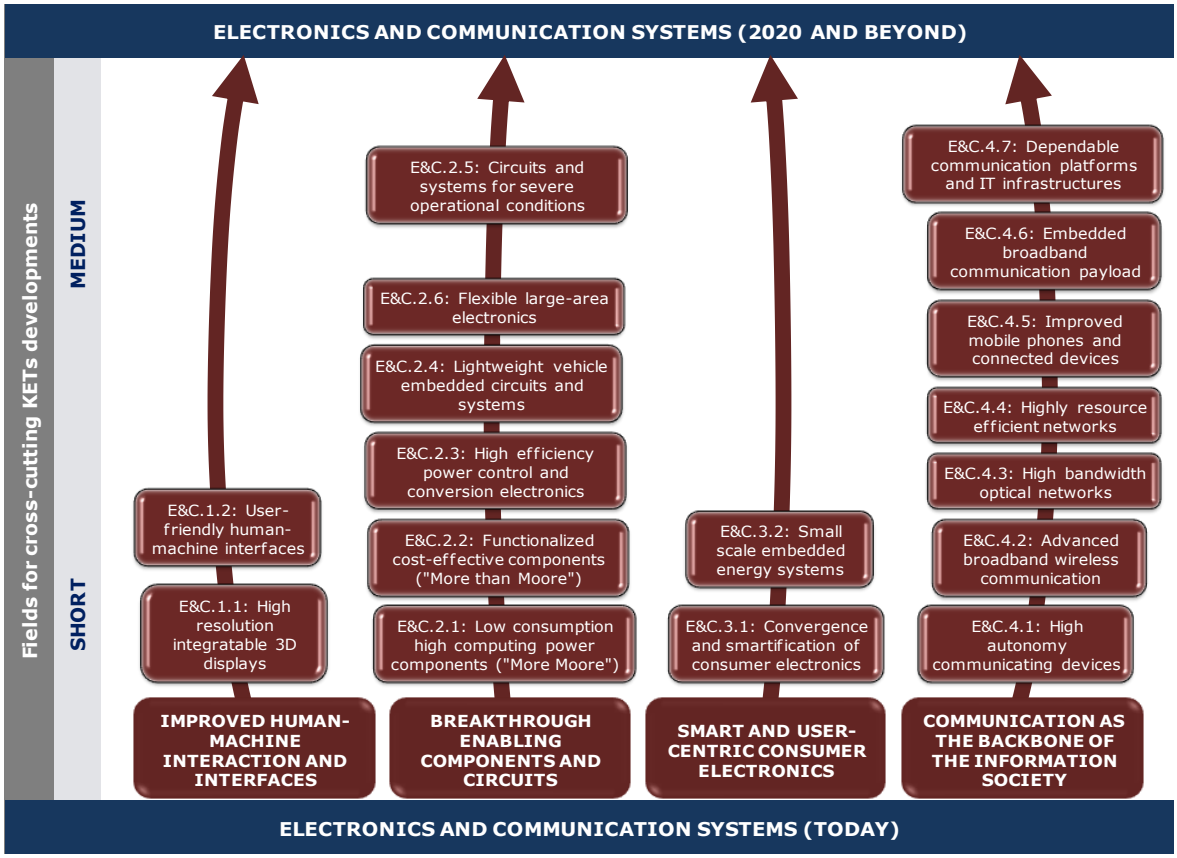
- Electronics and communication systems;
- Chemical processes, chemicals, chemical products and materials;
- Manufacturing and automation (including robotics);
- Energy (including energy generation, storage, transmission and distribution);
- Transport and mobility (including road, rail, marine and air transport as well as logistics, besides space);
- Construction;
- Civil security (including dual use applications);
- Mining, quarrying and extraction;
- Environment (including water supply, sewerage, waste management and remediation);
- Health and healthcare;
- Training, education and edutainment;
- Textiles;
- Agro-food.

Each roadmap displays the key innovation fields of industrial interest for Europe with the highest potential for cross-cutting KETs developments relevant for the specific domain, also highlighting cross-sectoral development opportunities and relevance for short-term or medium-term developments.

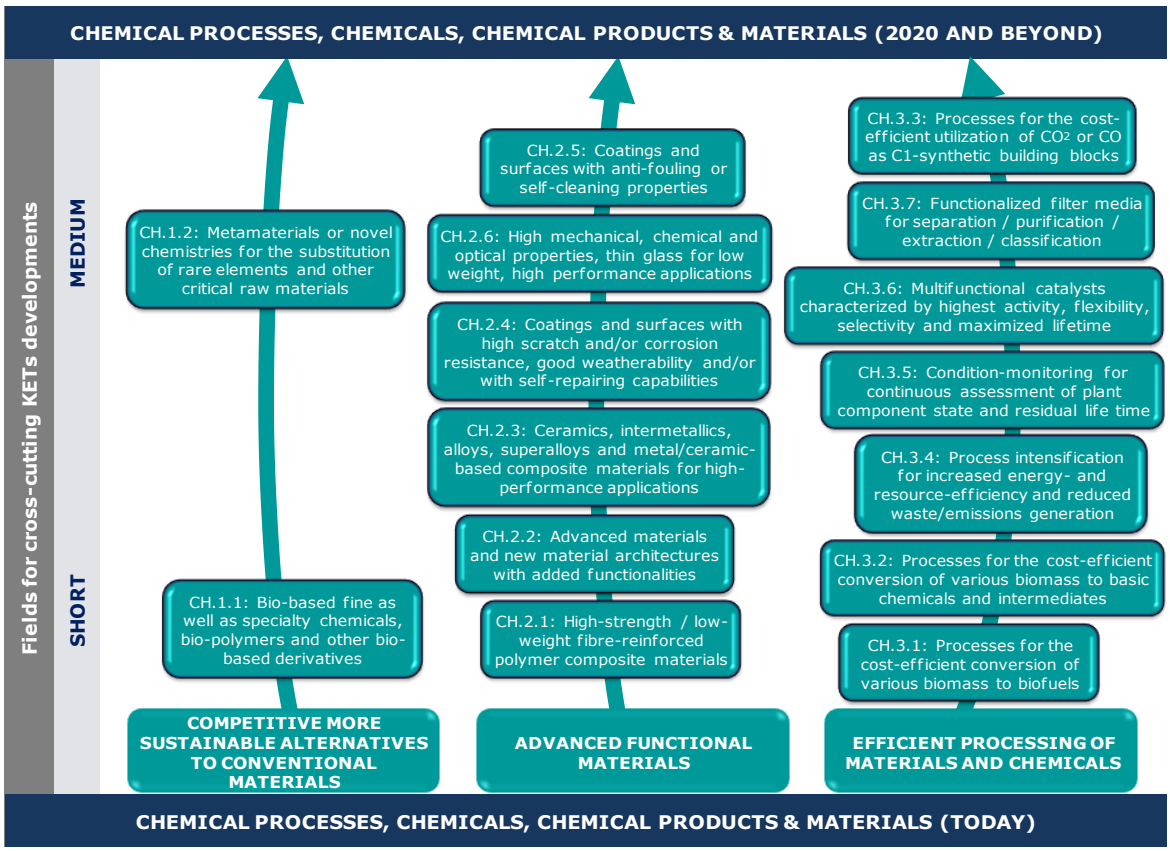
Short-term versus medium-term opportunities identify cross-cutting KETs developments for which a necessary time of up to 5 years versus longer than 5 years (from 2013) has been estimated as being necessary for solving the main technological issues delaying the achievement of cross-cutting KETs based products. Despite this grouping, however, many of the innovation fields can be considered as being subject to continuous, incremental improvement.

For each innovation field of industrial interest, a dedicated fiche describes the relevant information retrieved throughout the study such as challenges, potential markets, expected impact and the results of the patent scenario analysis.

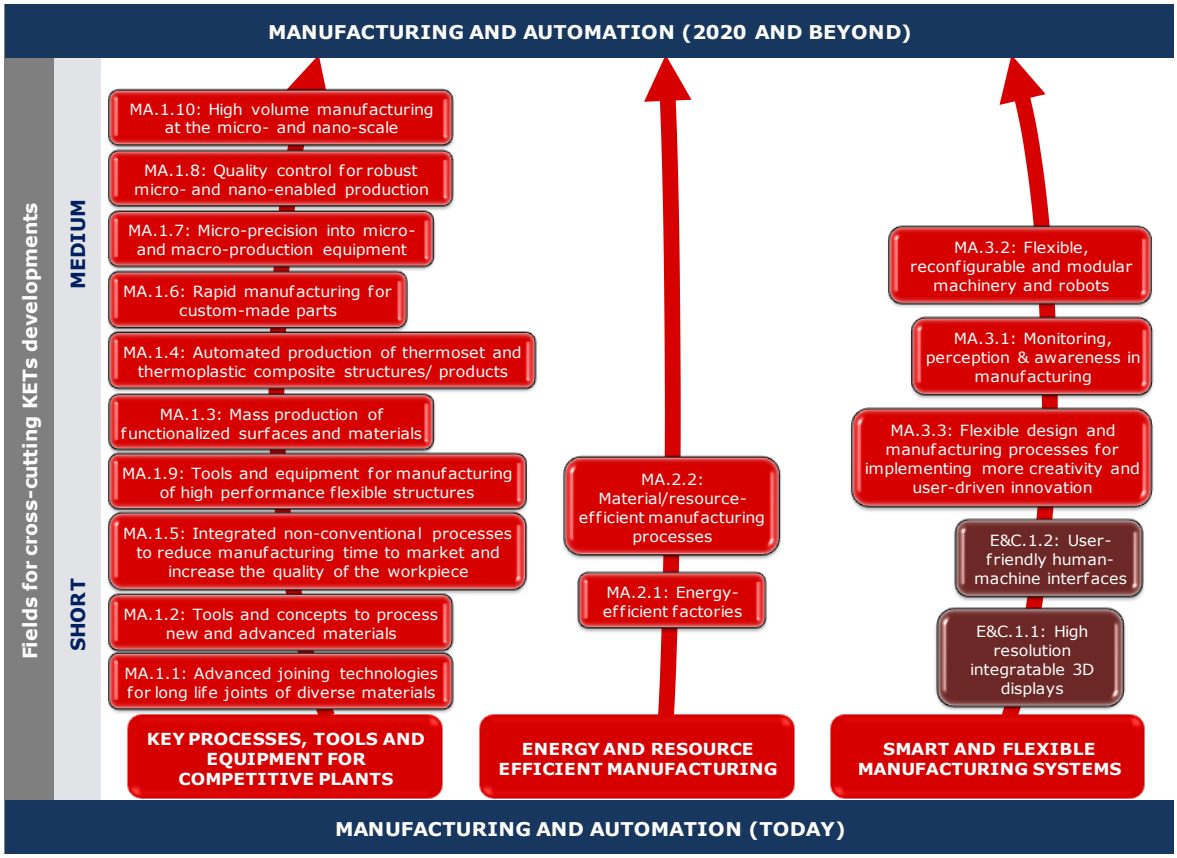
Potential areas of industrial interest relevant for cross-cutting KETs in the Electronics and Communication Systems domain



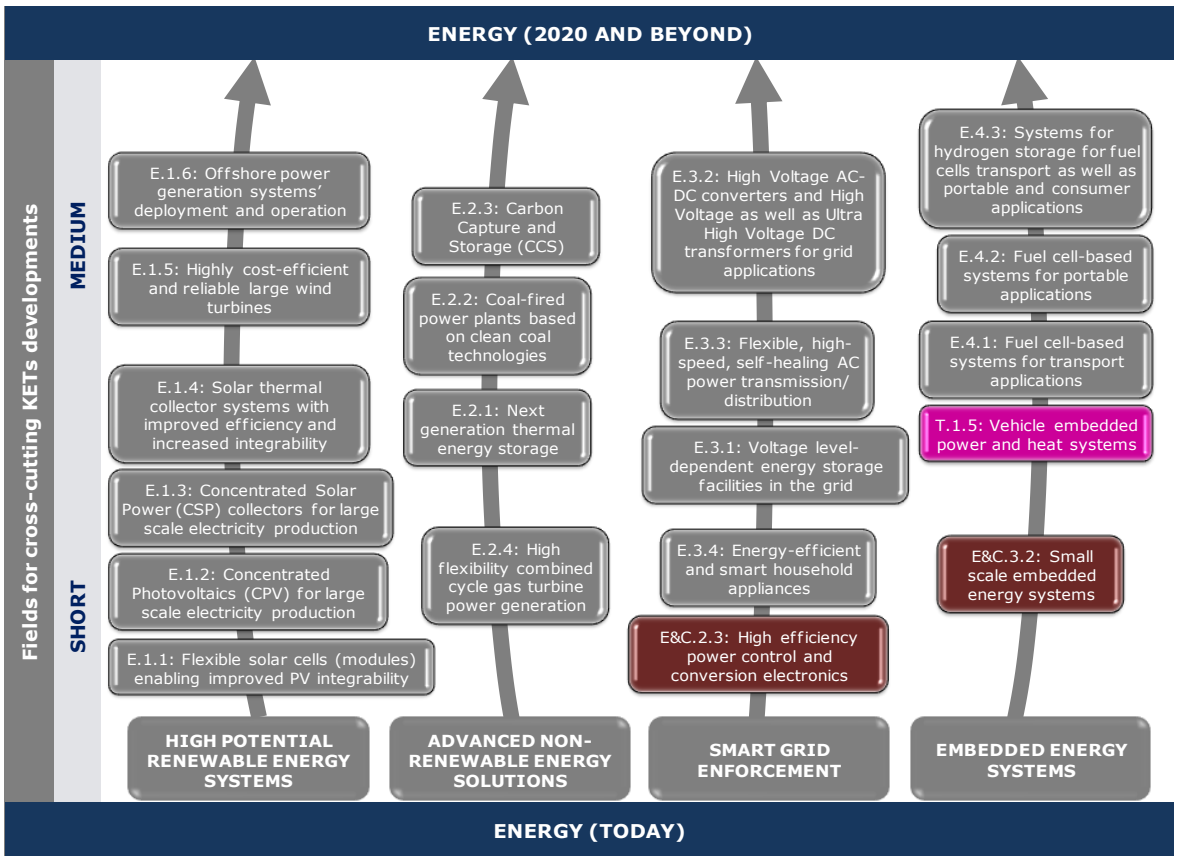
Potential areas of industrial interest relevant for cross-cutting KETs in the Chemical Processes, Chemicals, Chemical Products and Materials domain



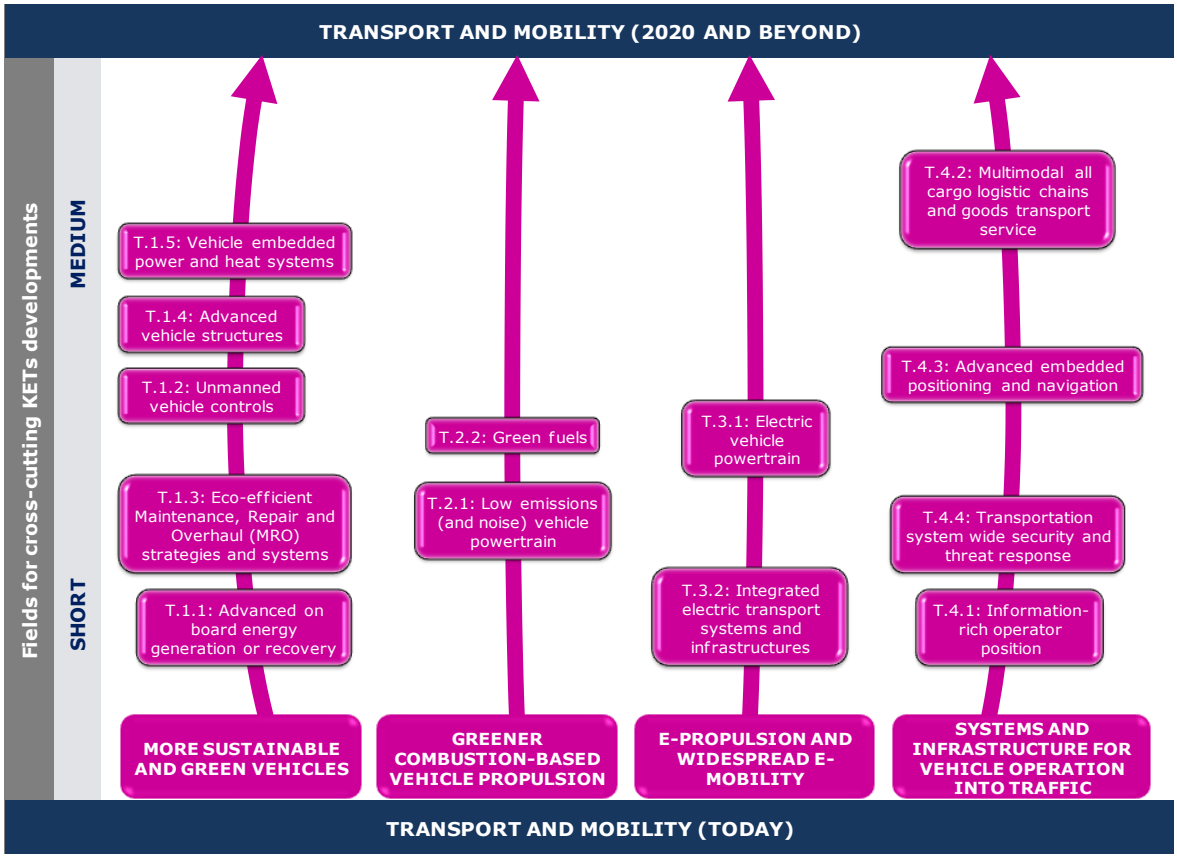
Potential areas of industrial interest relevant for cross-cutting KETs in the Manufacturing and Automation domain



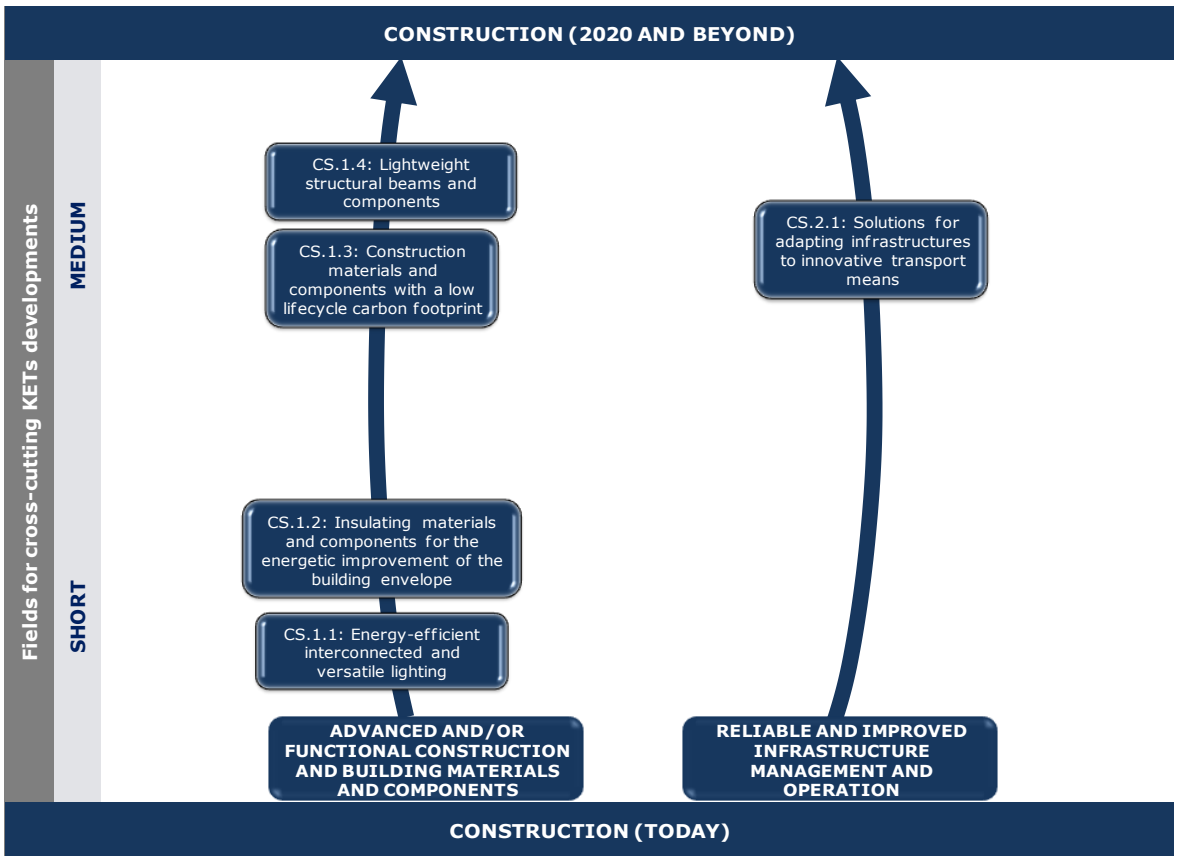
Potential areas of industrial interest relevant for cross-cutting KETs in the Energy domain



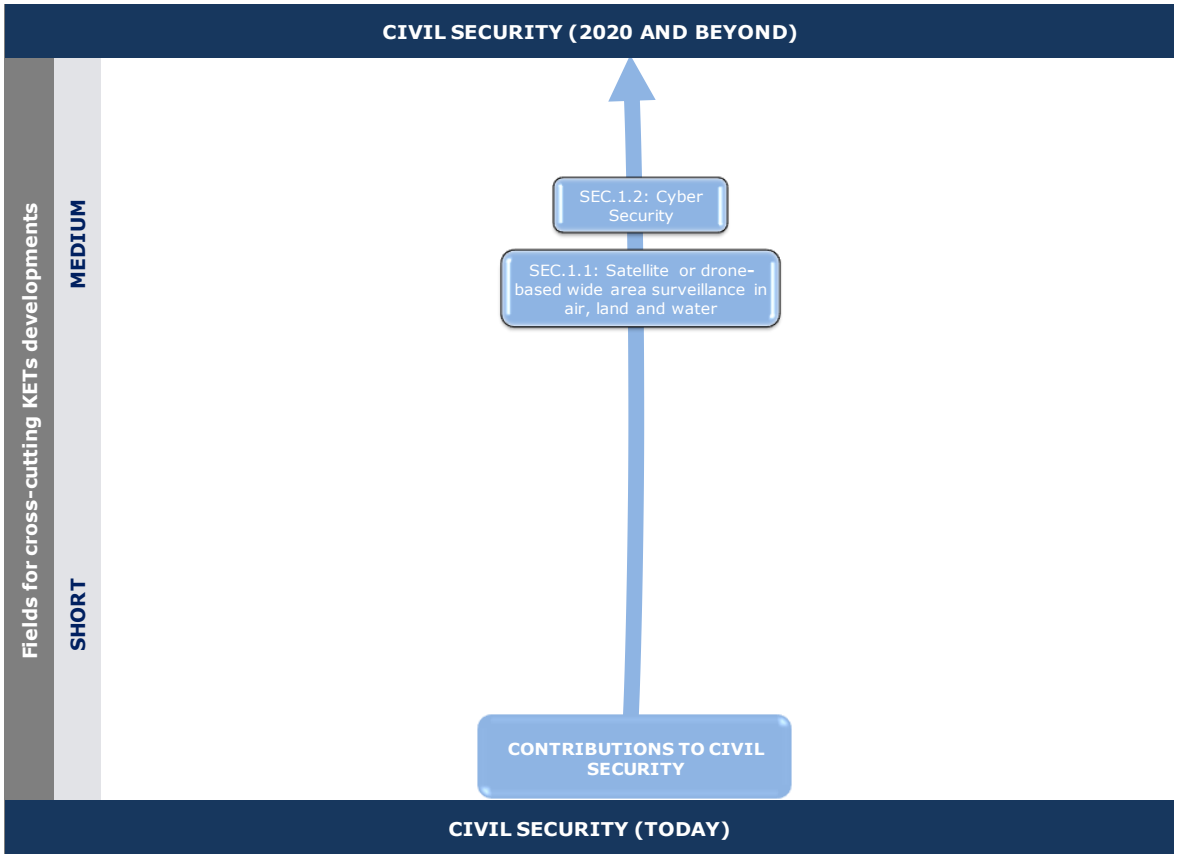
Potential areas of industrial interest relevant for cross-cutting KETs in the Transport and Mobility domain



Potential areas of industrial interest relevant for cross-cutting KETs in the Construction domain

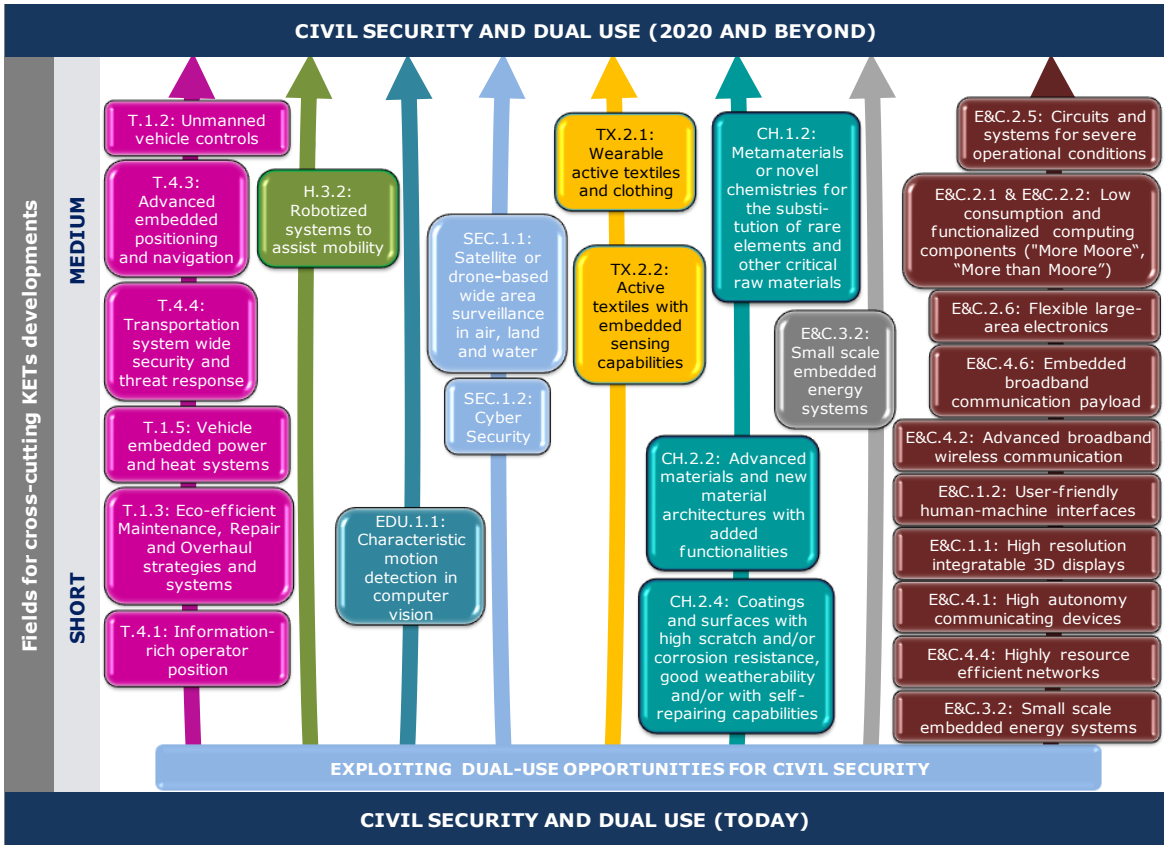


Potential areas of industrial interest relevant for cross-cutting KETs in the Civil Security domain

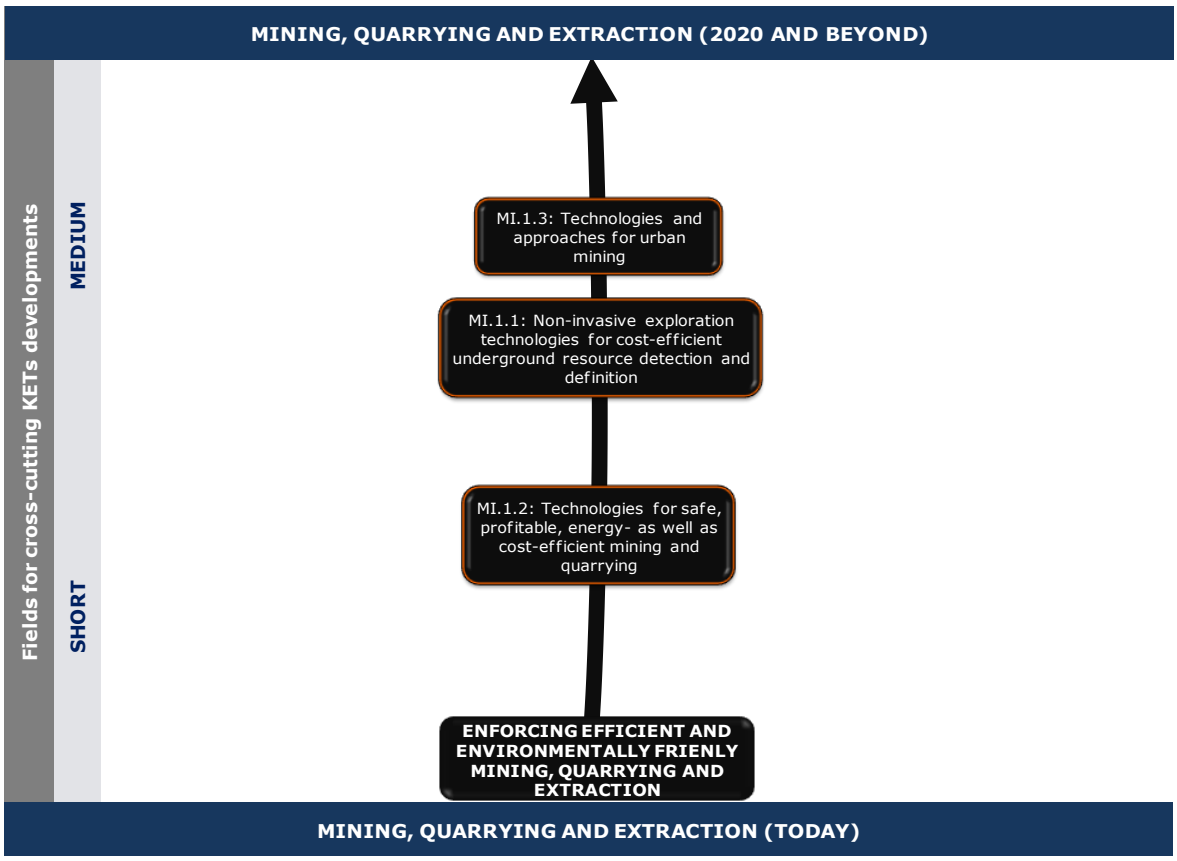


Exploitation of dual use opportunities

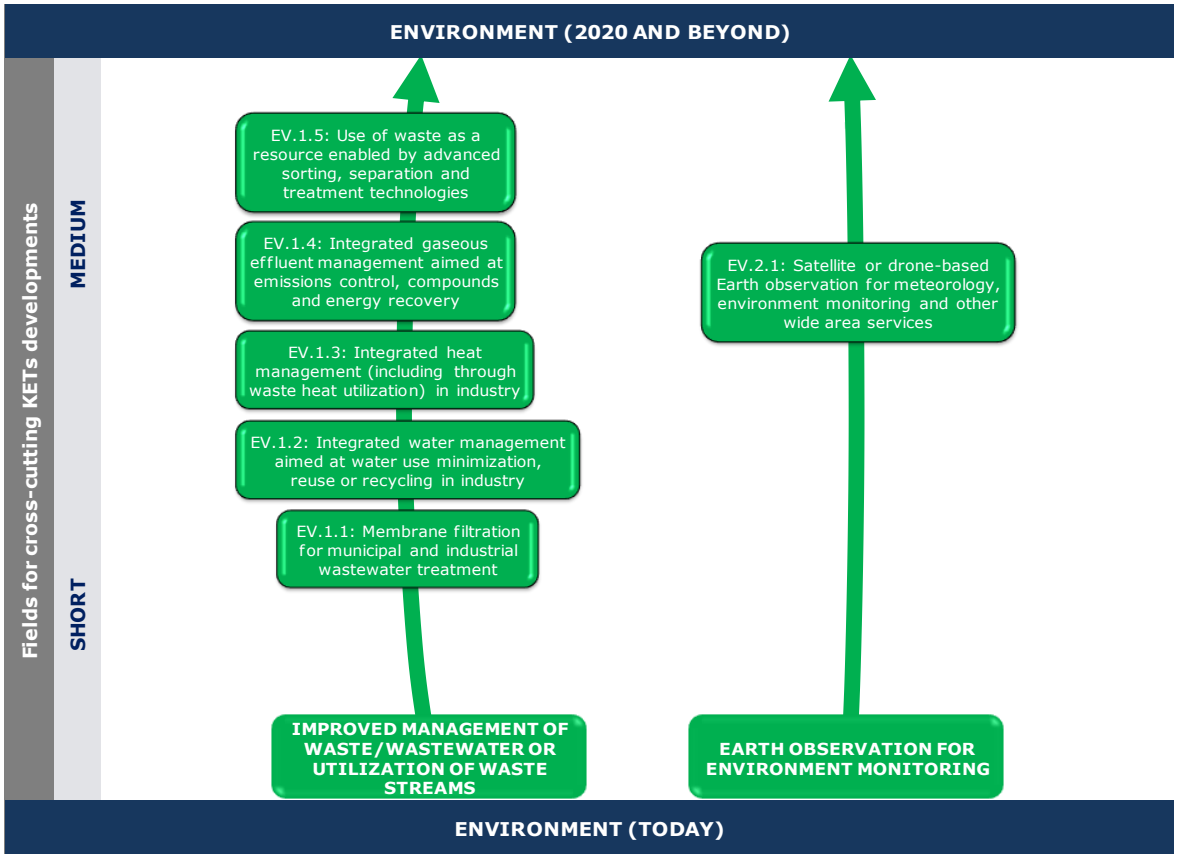
Whilst already described within the framework of the specific domains to which these innovation fields pertain, besides benefitting from the cross-fertilization of Key Enabling Technologies, some innovation fields comprised in this roadmap for cross-cutting KETs activities might also have a dual-use potential, thus they could also be of a high interest to defence and security industries. The following roadmap view depicts the specific innovation fields that could exploit dual-use opportunities. A colour code as well as a label are used in order to locate these innovation fields within the framework of the specific domain to which they pertain.



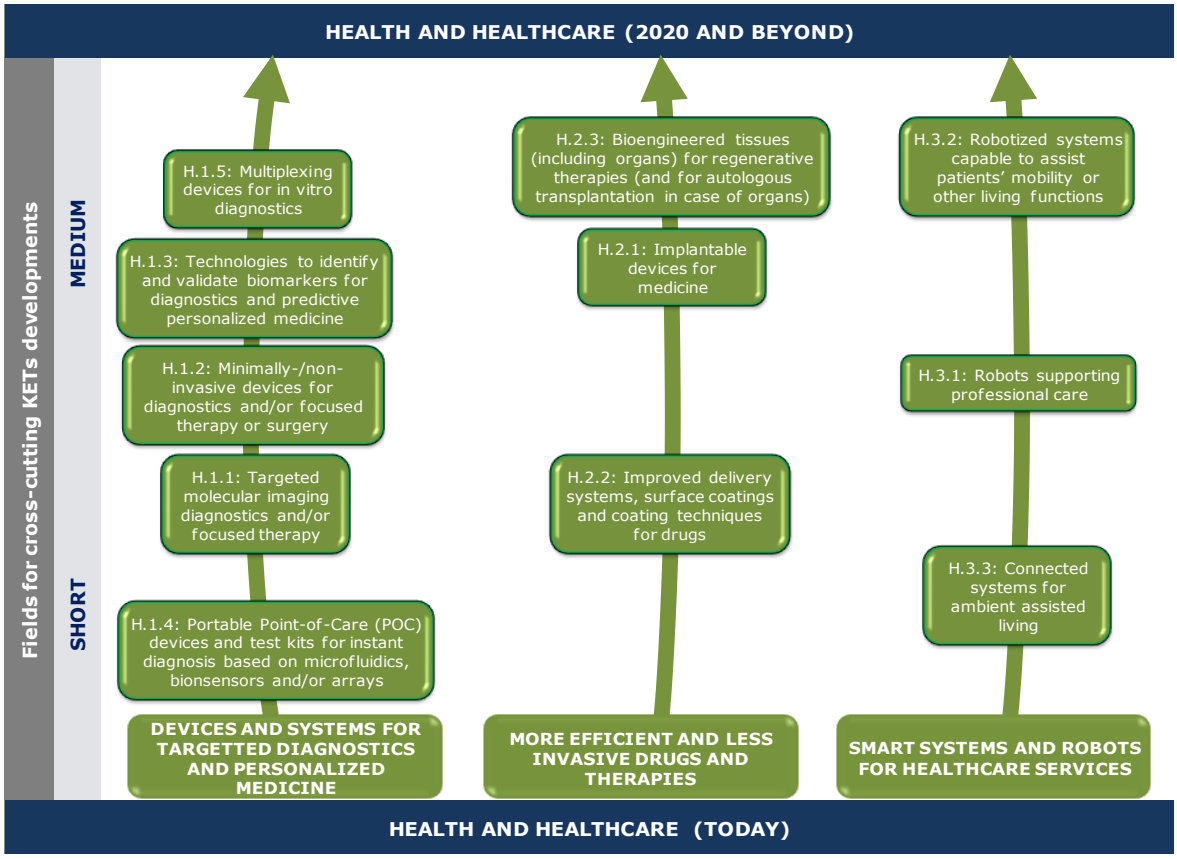
Potential areas of industrial interest relevant for cross-cutting KETs in the Mining, Quarrying and Extraction domain



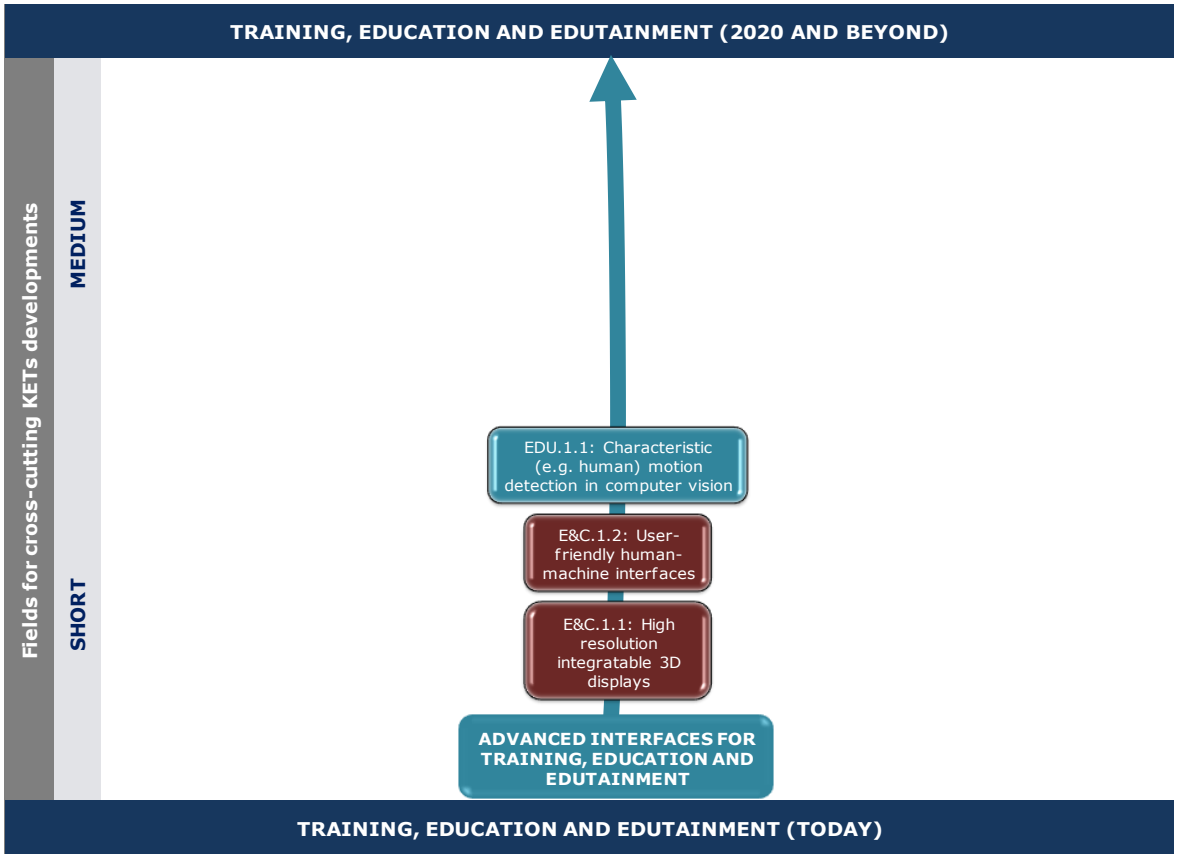
Potential areas of industrial interest relevant for cross-cutting KETs in the Environment domain



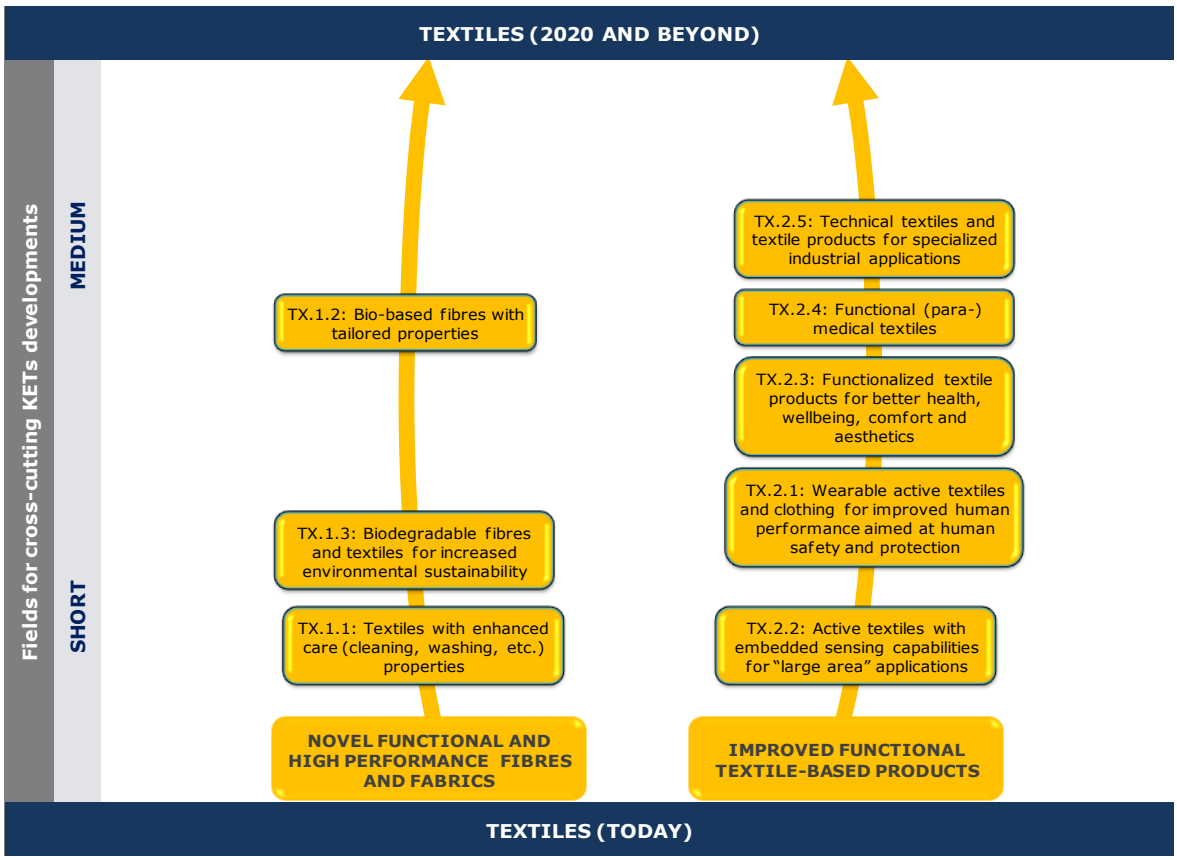
Potential areas of industrial interest relevant for cross-cutting KETs in the Health and Healthcare domain



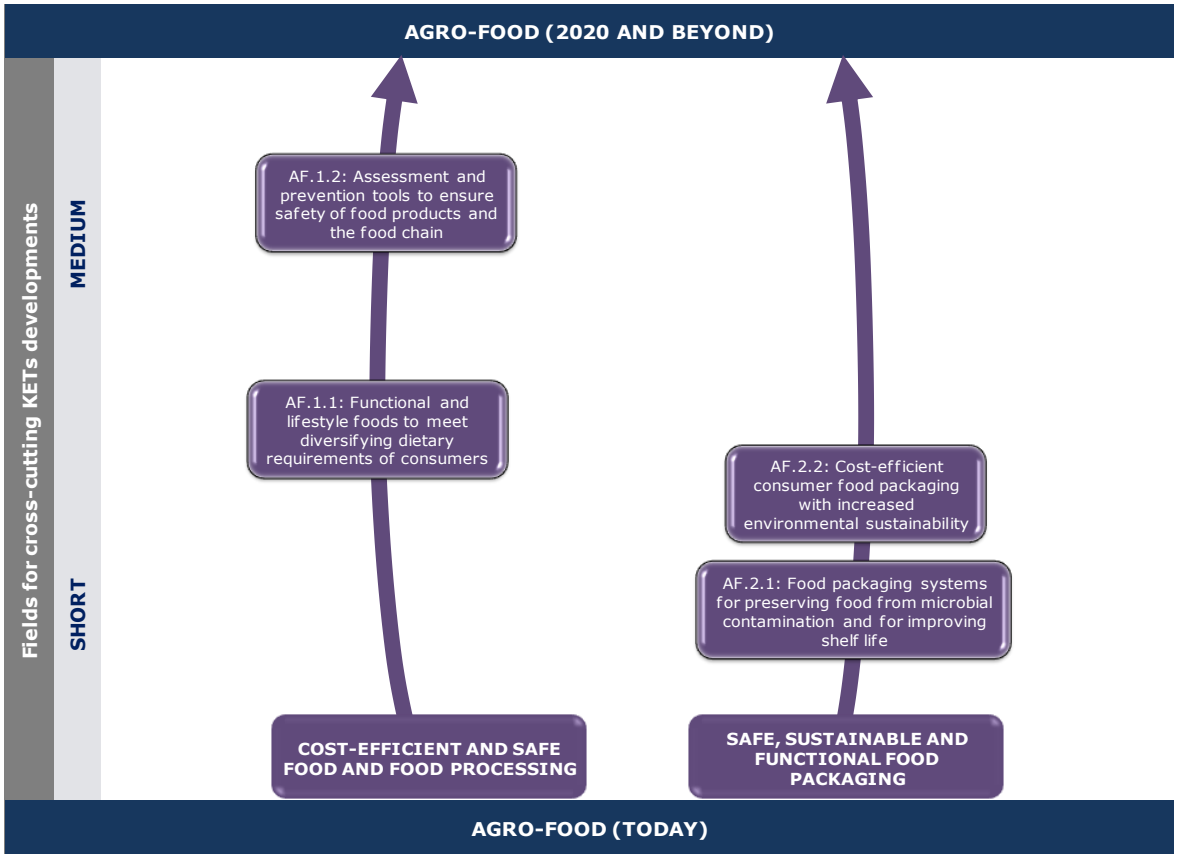
Potential areas of industrial interest relevant for cross-cutting KETs in the Training, Education and Edutainment domain



Potential areas of industrial interest relevant for cross-cutting KETs in the Textiles domain



Potential areas of industrial interest relevant for cross-cutting KETs in the Agro-food domain



In the following synoptic overview, the contribution of cross-cutting KETs toward each innovation field is highlighted. Innovation fields are moreover grouped into innovation fields with short-term priority relevance and innovation fields with medium-term priority relevance.

For all 117 innovation fields, individual fiches are available with more information at the following webpage: http://ec.europa.eu/growth/industry/key-enabling-technologies/eu-actions/ro-ckets/index_en.htm.

ID	Innovation field	Short description	Short	Medium	AMS	AM	IB	MNE	N-T	PhT
Electronics and Communication Systems domain										
Sub-domain: Improved Human-Machine interaction and interfaces										
E&C. 1.1	High resolution integratable 3D displays	To develop displays offering realistic and immersive three-dimensional (3D) video reproduction.		▨						
E&C. 1.2	User-friendly human-machine interfaces	To enable easy human-machine interactions and interfaces that increase user-friendliness.								
Sub-domain: Breakthrough enabling components and circuits										
E&C. 2.1	Low consumption high computing power components ("More Moore")	To develop affordable and sustainable high computing power, low consumption components and circuits, basically "more Moore".								
E&C. 2.2	Functionalized cost-effective components ("More than Moore")	To develop components and circuits going beyond CMOS technologies ("more than Moore") to deliver powerful, functionalized computing, sensing and actuation.								
E&C. 2.3	High efficiency power control and conversion electronics	To develop efficient, effective, reliable and sustainable solid-state fast dynamics power electronics.		▨						

ID	Innovation field	Short description	Short	Medium	AMS	AM	IB	MNE	N-T	PhT
E&C. 2.4	Lightweight vehicle embedded circuits and systems	To develop electronic components and circuits adapted to the specific constraints of vehicle embedded systems.								
E&C. 2.5	Circuits and systems for severe operational conditions	To develop dedicated circuits and systems for severe environmental conditions of operation.								
E&C. 2.6	Flexible large-area electronics	To develop semi-conductive inks, substrate treatments and related manufacturing processes enabling printed and thin film electronics.								
Sub-domain: Smart and user-centric consumer electronics										
E&C. 3.1	Convergence and smartification of consumer electronics	To develop high usability and multi-functional consumer lifestyle products, supported by high degrees of connectivity.								
E&C. 3.2	Small scale embedded energy systems	To develop miniaturized power systems and solutions for supplying energy to mobile and other devices.								
Sub-domain: Communication as the backbone of the Information Society										
E&C. 4.1	High autonomy communicating devices	To develop cost-effective and all-size embedded sensors with high connectivity making use of remote power supply/storage and/or micro energy harvesting.								
E&C. 4.2	Advanced broadband wireless communication	To develop radio-frequency technologies for seamless, high-performance (broadband), reliable, interoperable, efficient and secure wireless communication.								
E&C. 4.3	High bandwidth optical networks	To develop advanced network infrastructures with ultrahigh bandwidth.								
E&C. 4.4	Highly resource efficient networks	To develop resource-efficient networks and infrastructures with a low use of energy, spectrum and processing power.								
E&C. 4.5	Improved mobile phones and connected mobile devices	To develop mobile devices that go beyond current devices in terms of functionalities, convergence, connectivity and autonomy.								
E&C. 4.6	Embedded broadband communication payload	To develop transponder systems enabling embedded communication payloads to provide a broadband communication service at a reasonable cost, with a limited energy consumption.								
E&C. 4.7	Dependable communication platforms and IT infrastructures	To build more secure and dependable communication platforms and Information Technology (IT) infrastructures.								
Chemical Processes, Chemicals, Chemical Products and Materials domain										
Sub-domain: Competitive more sustainable alternatives to conventional materials										
CH. 1.1	Bio-based fine as well as specialty chemicals, bio-polymers and other bio-based derivatives	To develop novel bio-based fine and specialty chemicals, bio-polymers, bio-lubricants, and other bio-based materials as well as derivatives starting from renewable resources.								
CH. 1.2	Metamaterials or novel chemistries for the substitution of rare elements and other critical raw materials	To develop metamaterials or novel chemistries to be applied as safe and cost-effective equivalents to rare and toxic adjuvants or to allow minimal use of them.								
Sub-domain: Advanced functional materials										
CH. 2.1	High-strength/low-weight fibre-reinforced polymer composite materials	To develop fibre-reinforced polymer composite materials with superior strength and lower weight.								
CH. 2.2	Advanced materials and new material architectures with added functionalities	To develop advanced, mainly structural, materials with added functionalities and new material architectures capable to provide added functionalities.								

ID	Innovation field	Short description	Short	Medium	AMS	AM	IB	MNE	N-T	PhT
CH. 2.3	Ceramics, intermetallics, alloys, superalloys and metal/ceramic-based composite materials for high-performance applications	To develop lower cost, lower density, high-strength, high-temperature or corrosion-resistant ceramics, intermetallics, alloys, supealloys as well as metal-matrix, ceramic-matrix or metal-ceramic composites for high-performance applications.								
CH. 2.4	Coatings and surfaces with high scratch and/or corrosion resistance, good weatherability and/or with self-repairing capabilities	To develop long-lasting coatings and surfaces with high scratch and/or corrosion resistance, good weatherability as well as coatings and surfaces with self-healing, self-repairing or self-replicating properties.								
CH. 2.5	Coatings and surfaces with anti-fouling or self-cleaning properties	To develop coatings and surfaces with anti-fouling or self-cleaning properties able to recognise and inhibit e.g. bio-fouling agents, pollutants, corrosion agents, etc.								
CH. 2.6	High mechanical, chemical and optical properties thin glass for low weight, high performance applications	To develop cost-effective, high mechanical, chemical and optical properties thin glass layers for low weight, high performance applications, such as to improve or replace costly coatings and surface treatments.								
Sub-domain: Efficient processing of materials and chemicals										
CH. 3.1	Processes for the cost-efficient conversion of various biomass to biofuels	To develop bio-chemical and thermo-chemical conversion processes for the cost-efficient conversion of biomass to biofuels.								
CH. 3.2	Processes for the cost-efficient conversion of various biomass to basic chemicals and intermediates	To develop bio-chemical and thermo-chemical processes for the cost-efficient conversion of biomass to basic chemicals and intermediates, characterized by high performance, stability and selectivity.								
CH. 3.3	Processes for the cost-efficient utilization of CO_2 or CO as C1-synthetic building blocks	To develop new routes and processes for the utilisation of CO_2 or CO as C1-synthetic building block.								
CH. 3.4	Process intensification for increased energy- and resource-efficiency and reduced waste/emissions generation	To develop intensified processes for increased energy as well as resource-efficiency and reduced waste as well as emissions generation, including through performance and control options as well as new reaction pathways and conditions and intensification in the energy input.								
CH. 3.5	Condition-monitoring for continuous assessment of plant component state and residual life time	To develop advanced condition-monitoring tools based on e.g. sensors and inline analyser technology for continuous assessment of plant component state and residual life-time.								
CH. 3.6	Multifunctional catalysts characterized by highest activity, flexibility, selectivity and maximized lifetime	To develop the next generation of multifunctional organic and inorganic catalysts characterized by highest activity, flexibility, and lifetime, capable to achieve near 100% selectivity in multi-step and complex syntheses.								
CH. 3.7	Functionalized filter media for separation/ purification/ extraction/ classification	To develop higher performance functionalized filter media for liquids and gases for application in purification/separation/extraction/ classification processes.								

ID	Innovation field	Short description	Short	Medium	AMS	AM	IB	MNE	N-T	PhT
Manufacturing and Automation domain										
Sub-domain: Key processes, tools and equipment for competitive plants										
MA. 1.1	Advanced joining technologies for long life joints of diverse materials	To develop improved, new or hybrid joining technologies enabling competitive incorporation of materials into structures.								
MA. 1.2	Tools and concepts to process new and advanced materials	To develop new tools and concepts for precise and fast machining and processing of new and advanced materials.								
MA. 1.3	Mass production of functionalized surfaces and materials	To develop scalable processes, either physical or chemical, for treating or coating surfaces so as to provide them high added-value functionalities.								
MA. 1.4	Automated production of thermoset and thermoplastic composite structures/ products	To develop new combinations of methods and materials for weight reduction and novel constructs.								
MA. 1.5	Integrated non-conventional processes to reduce manufacturing time to market and increase the quality on the workpiece	To integrate non-conventional technologies to develop new multifunctional manufacturing processes that reduce time to market and increase quality.								
MA. 1.6	Rapid manufacturing for custom made parts	To develop new processes enabling flexibility and rapid change, including optimal topological features, added functionality and levels of personalization not previously possible at large scale.								
MA. 1.7	Micro-precision into micro- and macro-production equipment	To provide for high-precision manufacturing and micro-precision or micro-manufacturing more accurate by one order of magnitude in both micro- and macro-production environments.								
MA. 1.8	Quality control for robust micro- and nano-enabled production	To develop quality control systems with high resolution and accuracy measurement capability over large areas or with high aspect ratio on complex parts, in less temperature-controlled environments and a speed/throughput compatible with industrial standards.								
MA. 1.9	Tools and equipment for manufacturing of high performance flexible structures	To develop methods and technologies realising the full potential of high performance flexible structures.								
MA. 1.10	High volume manufacturing at the micro- and nano-scale	To develop methods for the mass production of highly integrated functional 3D micro-products and their combination into systems.								
Sub-domain: Energy and resource efficient manufacturing										
MA. 2.1	Energy-efficient factories	To develop new and improved concepts for energy generation and recovery in production, including substitution of high-temperature processes.								
MA. 2.2	Material/resource-efficient manufacturing processes	To provide for material-saving production processes with improved material efficiency and recovery.								
Sub-domain: Smart and flexible manufacturing systems										
MA. 3.1	Monitoring, perception & awareness in manufacturing	To develop new methods for monitoring the actual state of components and machines in a continuous manner to allow diagnosis and context-awareness in the associated systems.								

ID	Innovation field	Short description	Short	Medium	AMS	AM	IB	MNE	N-T	PhT
MA. 3.2	Flexible, reconfigurable and modular machinery and robots	To develop new methods for the as-autonomous-as-possible reconfiguration of machinery and robots to support mass customized and highly personalized products and fast reactions to shifts of market demands.								
MA. 3.3	Flexible design and manufacturing processes for implementing more creativity and user-driven innovation	To develop new methods allowing to increase flexibility to continuously modify products without drastic re-design of core-product base and operations.								
Energy domain										
Sub-domain: High potential renewable energy systems										
E.1.1	Flexible solar cells (modules) enabling improved PV integrability	To develop flexible solar cells (modules) enabling flexibility for improved PV integration, major modularity, easier installation, better aesthetics, and in which cost is reduced.								
E.1.2	Concentrated Photovoltaics (CPV) for large scale electricity production	To develop concentrated photovoltaic systems (CPV) utilizing improved materials and components for enhanced reliability and stability, and in which cost is reduced.								
E.1.3	Concentrated Solar Power (CSP) collectors for large scale electricity production	To develop advanced concentrating solar power (CSP) collectors (whether for parabolic trough, power tower, or dish systems) whose components are improved to operate at the high temperatures needed to significantly increase conversion efficiency and whose cost is reduced.								
E.1.4	Solar thermal collector systems with improved efficiency and increased integrability	To develop solar thermal collector systems for low temperature application whose efficiency is improved and whose integrability is enhanced, as well as solar thermal collector systems for medium and high temperature application benefitting of high temperature-resistant materials.								
E.1.5	Highly cost-efficient and reliable large wind turbines	To develop large wind turbines based on lightweight materials and improved designs along with large and more flexible rotors with improved performance.								
E.1.6	Offshore power generation systems' deployment and operation	To develop solutions for offshore power generation systems' deployment and operation, comprising solutions for substructure manufacturing and maintenance, large scale systems assembly, installation, and decommissioning.								
Sub-domain: Advanced non-renewable energy solutions										
E.2.1	Next generation thermal energy storage	To develop the next generation of thermal energy storage solutions and systems for the storage of heat and cold.								
E.2.2	Coal-fired power plants based on clean coal technologies	To develop coal-fired power plants based on clean coal technologies towards coal-based near-zero emission power production.								
E.2.3	Carbon Capture and Storage (CCS)	To develop new and improved carbon capture technologies, to optimize storage capacity and efficiency, to develop storage infrastructure.								
E.2.4	High flexibility combined cycle gas turbine power generation	To develop Combined Cycle Gas Turbine power generation systems whose flexibility is maximized along with efficiency.								

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Sub-domain: Smart Grid enforcement										
E.3.1	Voltage level-dependent energy storage facilities in the grid	To develop voltage level-dependent energy storage facilities for the grid, meaning storage facilities for the transmission, distribution and consumer grid to cope with the volatility of renewable energy sources.								
E.3.2	High Voltage AC-DC converters and High Voltage as well as Ultra High Voltage DC transformers for grid applications	To develop High Voltage AC-DC converters and High Voltage as well as Ultra High Voltage DC transformers for grid applications to transmit electric power efficiently and reliably over long distances.								
E.3.3	Flexible, high-speed, self-healing AC power transmission/ distribution	To develop flexible AC power transmission/distribution systems based on high-speed power routing equipment and systems, allowing for self-healing grids.								
E.3.4	Energy-efficient and smart household appliances	To develop more energy-efficient, auto-balancing or active, smart-grid ready, internet-linked appliances, enabling smart home and home automation concepts.								
Sub-domain: Embedded energy systems										
E.4.1	Fuel cell-based systems for transport applications	To develop fuel cell-based systems for transport applications with improved performance eventually combined with efficient units for fuel processing.								
E.4.2	Fuel cell-based systems for portable applications	To develop fuel cell-based systems for portable applications toward miniaturisation, compatibility, simplicity and cost-effectiveness.								
E.4.3	Systems for hydrogen storage for fuel cells for transport as well as portable and consumer applications	To develop systems for hydrogen storage for fuel cells for transport as well as portable and consumer applications.								
Transport and Mobility domain										
Sub-domain: More sustainable and green vehicles										
T.1.1	Advanced on board energy generation or recovery	To develop systems and solutions for the generation or recovery of energy on board vehicles.								
T.1.2	Unmanned vehicle controls	To develop complete vehicle control chains enabling high level capabilities for autonomous or remote controlled operations of all sorts of unmanned vehicles.								
T.1.3	Eco-efficient Maintenance, Repair and Overhaul (MRO) strategies and systems	To design vehicles and systems for maintainability, including regular, condition-based, predictive and preventive maintenance, based on eco-efficient Maintenance, Repair and Overhaul (MRO) systems.								
T.1.4	Advanced vehicle structures	To develop vehicle structures that are light-weight, crashworthy and wear/fatigue resistant, eventually functionalized.								
T.1.5	Vehicle embedded power and heat systems	To develop more efficient embedded subsystems, utilities and power components that require less energy provision and entail less heat dissipation.								
Sub-domain: Greener combustion-based vehicle propulsion										
T.2.1	Low emissions (and noise) vehicle powertrain	To develop combustion powertrains taking into account fuel feeding and real operational conditions so as to reduce energy consumption and pollutants emissions.								
T.2.2	Green fuels	To develop cost-effective fuels from sustainable resources that demonstrate sufficient energy density and satisfy operational characteristics.								

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Sub-domain: E-propulsion and wider e-mobility										
T.3.1	Electric vehicle powertrain	To improve the electric vehicle powertrain through improved embedded energy storage and charging, on-board power management, and hybridization.								
T.3.2	Integrated electric transport systems and infrastructures	To rethink, especially, road transport holistically to take into account the shift towards electric mobility, considering not only vehicles but also the charging infrastructure and related power grid management.								
Sub-domain: Systems and infrastructure for vehicle operation into traffic										
T.4.1	Information-rich operator position	To develop solutions for providing the vehicle operator with full situational awareness and decision-making assistance.								
T.4.2	Multimodal all cargo logistic chains and goods transport service	To setup door-to-door, just-in-time and highly resource efficient lean logistic systems, serviced with streamlined multimodal chains that benefit from integrated information-based facilitators, specialized vehicles and highly dependable automated cargo and baggage handling systems.								
T.4.3	Advanced embedded positioning and navigation	To develop beacon-based, satellite-based or inertial systems, eventually coupled, able to deliver a highly precise and dependable positioning and navigation service.								
T.4.4	Transportation system wide security and threat response	To develop security systems with a holistic approach and with no breach all over the vehicle operation and infrastructure.								
Construction domain										
Sub-domain: Advanced and/or functional construction and building materials and components										
CS. 1.1	Energy-efficient interconnected and versatile lighting	To develop more energy-efficient interconnected and versatile lighting solutions (interoperable, adaptable, highly comfortable and customizable).								
CS. 1.2	Insulating materials and components for the energetic improvement of the building envelope	To develop cost-effective and environmentally sustainable insulating materials and components for the energetic improvement of the building envelope.								
CS. 1.3	Construction materials and components with low lifecycle carbon footprint	To develop cost competitive and high performance construction materials and components with low lifecycle carbon footprint (such as green concrete, concrete using recycled aggregates, etc.).								
CS. 1.4	Lightweight structural beams and components	To develop lightweight structural beams and components easing construction towards higher performance works.								
Sub-domain: Reliable and improved infrastructure management and operation										
CS. 2.1	Solutions for adapting infrastructures to innovative transport means	To develop solutions for adapting infrastructures to innovative transport means, such as solutions to make infrastructures able to support operation of new sustainable energy sources vehicles.								
Civil Security domain										
Sub-domain: Contributions to Civil Security										
SEC. 1.1	Satellite or drone-based wide area surveillance in air, land and water	To develop multi-robot systems and drones for surveillance in air, land and water environments aimed at border security or critical infrastructure/perimeter protection.								
SEC. 1.2	Cyber security	To develop tools and techniques for the cyber security including wireless security, cloud security and privacy, and autonomic network defence.								

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Mining, Quarrying and Extraction domain										
Sub-domain: Enforcing efficient and environmentally friendly mining, quarrying and extraction										
MI. 1.1	Non-invasive exploration technologies for cost-efficient underground resource detection and definition	To develop improved non-invasive exploration and other geophysical technologies for more cost-efficient and environment-friendly detection and definition of underground resources.								
MI. 1.2	Technologies for safe, profitable, energy as well as cost-efficient mining and quarrying	To improve technologies and processes to ensure safe as well as profitable mining or quarrying, with a focus on risk mitigation, cost reduction, productivity enhancement, energy efficiency, environmental impact reduction.								
MI. 1.3	Technologies and approaches for urban mining	To develop new technologies for dismantling, sorting, separation, recovery and processing of waste capable to exploit the potential of urban waste.								
Environment domain										
Sub-domain: Improved management of waste/wastewater or utilization of waste streams										
EV. 1.1	Membrane filtration for municipal and industrial wastewater treatment	To develop membrane filtration/separation processes for municipal and industrial wastewater treatment characterized by superior product water quality, reduced footprint and reduced energy consumption.								
EV. 1.2	Integrated water management aimed at water use minimization, reuse or recycling in industry	To develop integrated water management solutions for the reuse or recycle of process water in a closed-loop inside a factory or on a broader perimeter among different factories and/or solutions for optimizing water-energy coupling aimed in water cooling.								
EV. 1.3	Integrated heat management (including through waste heat utilization) in industry	To develop integrated heat management approaches exploiting the integration of energy and effluents management systems at site and/or local environment scale.								
EV. 1.4	Integrated gaseous effluents management aimed at emissions control, compounds and energy recovery	To develop advanced integrated gaseous effluents management approaches aimed at both improved emissions control in industrial plants as well as transport means, and compounds and energy recovery in industrial facilities.								
EV. 1.5	Use of waste as a resource enabled by advanced sorting, separation and treatment technologies	To provide for an increased use of waste as a resource, enabled by advanced sorting technologies, separation approaches, and treatment technologies, towards a circular economy.								
Sub-domain: Earth observation for environment monitoring										
EV. 2.1	Satellite or drone-based Earth observation for meteorology, environment monitoring and other wide area services	To develop satellite or drone-based Earth observation systems for meteorology, environment monitoring, land exploration and other wide area services including homeland surveillance.								
Health and Healthcare domain										
Sub-domain: Devices and systems for targeted diagnostics and personalized medicine										
H.1.1	Targeted molecular imaging diagnostics and/or focussed therapy	To develop cost-effective techniques for higher efficiency and more biocompatible targeted molecular imaging for in vivo diagnostics eventually combined with focussed therapy (theranostics).								
H.1.2	Minimally-/non-invasive devices for diagnostics and/or focussed therapy or surgery	To develop minimally invasive endoscopic instrumentation and devices for in vivo medical diagnostics/imaging eventually combined with focussed therapy or surgery.								

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H.1.3	Technologies to identify and validate biomarkers for diagnostics and predictive personalized medicine	To develop technologies able to identify and validate more accurate and informative biomarkers for diagnostics.								
H.1.4	Portable Point-of-Care (POC) devices and test kits for instant diagnosis based on microfluidics, bionsensors and/or arrays	To develop rapid, safe and cheap diagnostics, portable and miniaturized devices or easy kits for diagnosis or treatment monitoring at home (capable of data collection and communication with the medical doctor).								
H.1.5	Multiplexing devices for in vitro diagnostics	To develop multi-parameter measuring devices for fast, accurate, easy medical laboratories analyses.								
Sub-domain: More efficient and less invasive drugs and therapies										
H.2.1	Implantable devices for medicine	To develop new and improved devices for assisting vital functions or controlled drug delivery.								
H.2.2	Improved delivery systems, surface coatings and coating techniques for drugs	To develop new and improved delivery systems and surface coatings for conventionally fabricated tablets.								
H.2.3	Bioengineered tissues (including organs) for regenerative therapies	To develop new and improved techniques for tissues (or organs) regeneration.								
Sub-domain: Smart systems and robots for healthcare services										
H.3.1	Robots supporting professional care	To develop improved robotic systems supporting healthcare workers in patients' monitoring and care activities.								
H.3.2	Robotized systems capable to assist patients' mobility or other living functions	To develop passive robotized systems (including intelligent prostheses) capable to assist patients' mobility or other living functions.								
H.3.3	Connected systems for ambient assisted living	To develop improved connected systems for ambient assisted living, i.e. integrated solutions for (home) care support.								
Training, Education and Edutainment domain										
Sub-domain: Advanced interfaces for training, education and edutainment										
EDU. 1.1	Characteristic (e.g. human) motion detection in computer vision	To develop characteristic motion detection in computer vision characterized by real-time performance and insensitivity to background clutter and movement.								
Textiles domain										
Sub-domain: Novel functional and high performance fibres and fabrics										
TX. 1.1	Textiles with enhanced care	To develop textiles and textile products with enhanced care (cleaning, washing, etc.) properties.								
TX. 1.2	Bio-based fibres with tailored properties	To develop bio-based fibres with tailored properties intended for biomedical, textile and technical textile applications to move away from refined-oil based products.								
TX. 1.3	Biodegradable fibres and textiles for increased environmental sustainability	To develop biodegradable fibres and textiles for increased environmental sustainability.								

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Sub-domain: Improved functional textile based products										
TX. 2.1	Wearable active textiles and clothing for improved human performance aimed at human safety and protection	To develop wearable textiles and clothing capable to measure and communicate human living functions and/or react autonomously to changing activities or conditions of the wearer.								
TX. 2.2	Active textiles with embedded sensing capabilities for "large area" applications	To develop textile products reacting autonomously or actively to the changing conditions of the environment for environmental protection and climate-related environmental risks mitigation.								
TX. 2.3	Functionalized textile products for better health, wellbeing, comfort and aesthetics	To develop functionalized textile products with enhanced functionalities and performance for better health, wellbeing, comfort characteristics and aesthetics.								
TX. 2.4	Functional (para-) medical textiles	To develop functional (para-) medical textiles and textile-based products with built in functionalities such as the release of drugs or active components, etc.								
TX. 2.5	Technical textiles and textile products for specialized industrial applications	To develop technical textiles for specialized industrial applications with improved functionalities and performance.								
Agro-food domain										
Sub-domain: Cost-efficient and safe food and food processing										
AF. 1.1	Functional and lifestyle foods to meet diversifying dietary requirements of consumers	To develop functional foods aimed at meeting diversifying dietary requirements of consumers of different age groups, life styles and health conditions.								
AF. 1.2	Assessment and prevention tools to ensure safety of food products and the food chain	To develop assessment and prevention tools (including sensors) aimed at diminishing the risk of biological contamination, chemical hazards, undesirable components or fake components of food products.								
Sub-domain: Safe, sustainable and functional food packaging										
AF. 2.1	Food packaging systems for preserving food from microbial contamination and for improving shelf life	To develop intelligent/ communicative or functionalized packaging materials and/or coatings that improve food safety, reduce the need of cold chain use and enable in-package food processing.								
AF. 2.2	Cost-efficient consumer food packaging with increased environmental sustainability	To develop new solutions for sustainable packaging aimed at packaging waste minimization, as well as packaging items aimed at material recycling or item reuse.								

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