EFECS 2020 – Co-located Workshop

5E: JOINT VISION AND META ROADMAP FOR EUROPEAN ELECTRONICS INDUSTRIES

26 November 2020, 13:30 – 15:30 CET

The Coordination and Support Action 5E has received funding from the European Community's Programme Horizon 2020 under GA Number: 825113

AGENDA

13:30 ►Arrival of Delegates
13:35 ►Welcome and Introduction to the Workshop, Introduction to the 5E Project and Consortium
13:45 ►Presentation of Joint Vision for European electronics industries based on Functional Electronics
13:55 ►Workshop part & Discussion on Joint Vision and Functional Electronics
14:10 ►Insights into relevant Horizon Europe Destinations
14:20 ►Introduction to the Meta-Roadmap and transversal aspects
14:30 ►Vision Papers and respective modules of the Meta-Roadmap
15:10 ►Workshop part & Discussion on Meta-Roadmap
15:25 ►5E Digital Showcase Quiz
15:30 ►Wrap-up & Closing of the Workshop

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Welcome and Introduction to the Workshop

Introduction to the 5E Project and Consortium

Petra Weiler, VDI/VDE-IT

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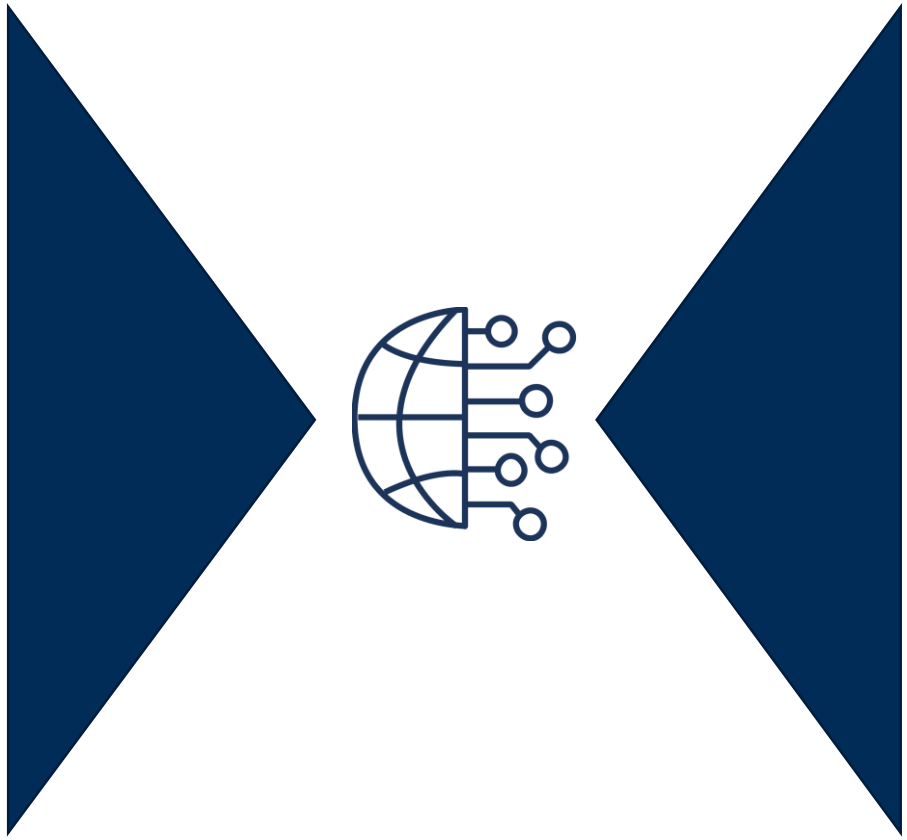
OUTPUT:
5E RESULTS

- Presentation of 5E Joint Vision based on Functional Electronics
- Presentation of 5E Vision Papers
- Presentation of 5E Meta-Roadmap
  - Methodology
  - Eisenhower Ranking
  - Recommendations per Module



INPUT:
YOUR THOUGHTS

- Feedback
  - Joint Vision
  - Functional Electronics
  - Vision Papers
  - Meta-Roadmap
- Expressions of Interest
  - Vision Papers
  - Recommendations
  - Implementation of Meta-Roadmap

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5E Project

FEDERATING EUROPEAN ECOSYSTEMS

NANO-ELECTRONICS

FLEXIBLE, ORGANIC & PRINTED ELECTRONICS

ELECTRONIC SMART SYSTEMS

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OBJECTIVES

1. Support industrial perspectives of EU Electronics Ecosystems
2. Position Electronics as fundamental for digitalisation
3. Foster collaboration and cross-fertilisation in Electronics

HOW

- **Federating a coherent European Electronics Community**
  Large-scale community building & networking, identifying areas of cross-fertilisation, addressing hurdles and highlighting joint opportunities
- **Develop a joint vision and implement a respective technology and application meta-roadmap that complements the EC strategy on electronics**
  Defining main priorities, future missions and actions, closing loops with other areas of digitalisation and demand-side industries, and cascading strategies on European, national and regional levels
- **Increasing outreach and visibility of European electronics**
  Along 3 key axes: industrial engagement, promising applications and internationalisation

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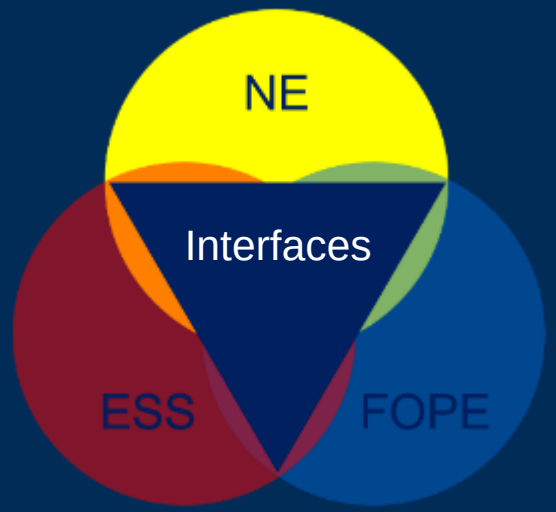

VISION PAPERS OF INNOVATION

Addressing the European Areas of Intervention

JOINT VISION

Of European Electronics Ecosystems

- Validation and ranking of 39 opportunities
- Identification of additional opportunities

150+ STAKEHOLDERS INVOLVED

- 4 Community events
- 2 Workshops at EFECS and OE-A
- 1 Online Survey

3 VALIDATION PATHS

TOP DOWN

ASSESSMENT APPROACH — VISION PAPERS — ANALYSIS APPROACH

BOTTOM UP

TOP10 OPPORTUNITIES

WOULD YOU LIKE TO LEARN MORE?
SCAN ME

39 OPPORTUNITIES

- Fact Sheets including
  - Title
  - Technologies
  - Applications
  - Challenges
  - Opportunities

→ DISCOVER MORE ON www.5e-project.eu

6 FUNCTIONALITIES

- Actuating
- Communicating
- Computing/Processing
- Energy Harvesting/Storage
- Sensing
- Signalling

13 APPLICATION SECTORS

- (Aero)Space
- Building/Construction
- Consumer Electronics
- Digital Manufacturing
- Energy
- Environment
- Food & Agriculture
- IoT/Smart Connected Objects
- Medical/Pharmaceutical/Life Science
- Natural Resources
- Packaging/Logistics
- Safety/Security
- Transport/Mobility/Automotive

11 SECTORIAL STATES OF PLAY

- Landscape Analysis
  Extraction of opportunities at the interfaces of at least 2 electronics areas

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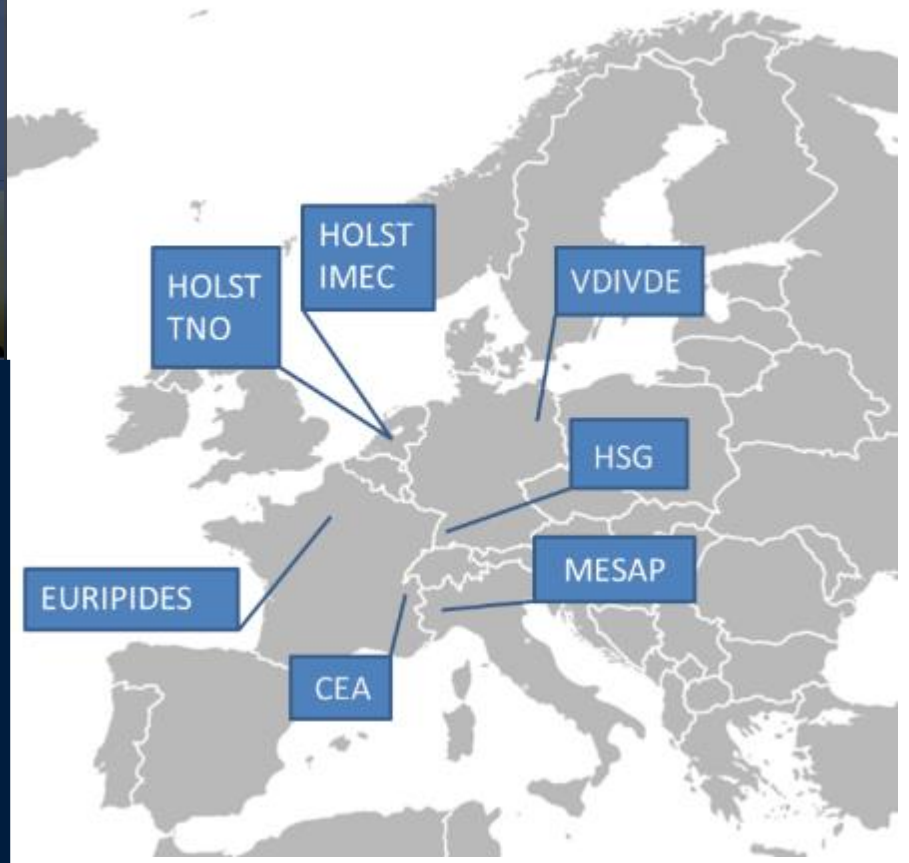

37 Associated partners

11 countries

CONSORTIUM + ASSOCIATED PARTNERS

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Presentation of Joint Vision for European electronics industries based on Functional Electronics

Sywert Brongersma, IMEC

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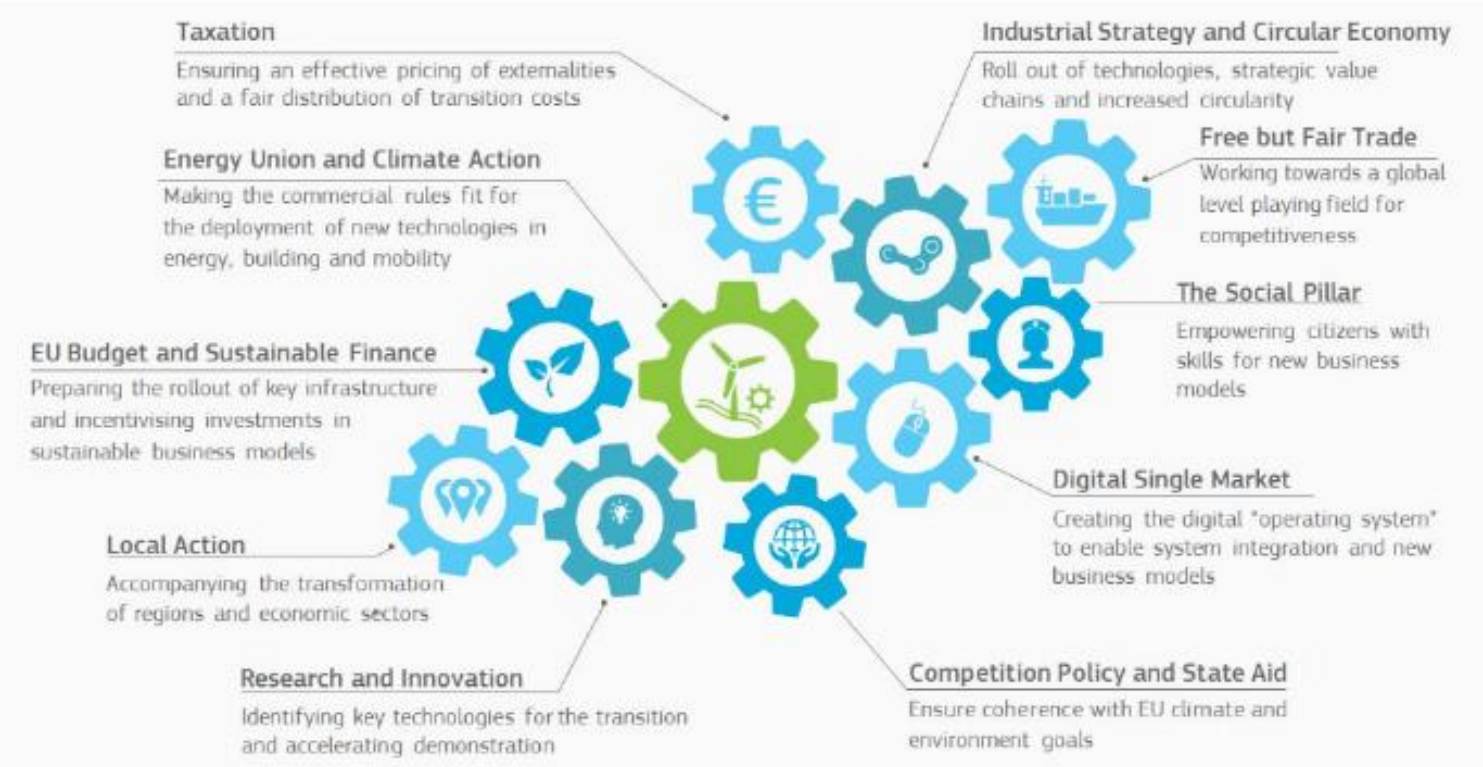
VISION OF THE EUROPEAN COMMISSION

Our vision

A sustainable, fair and **prosperous** future for **people** and **planet** based on European values.

- Tackling **climate change** (35 % budgetary target)
- Helping to achieve **Sustainable Development Goals**
- Boosting the Union's **competitiveness and growth**



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6 CLUSTERS AS PRIORITIES IN HORIZON EUROPE PILLAR 2

Global Challenges & European Industrial Competitiveness: boosting key technologies and solutions underpinning EU policies & Sustainable Development Goals

Commission proposal for budget: € 52.7 billion

Clusters in 'Global Challenges and European Industrial Competitiveness'

Clusters	Areas of intervention	
Health	• Health throughout the life course • Non-communicable and rare diseases • Tools, technologies and digital solutions for health and care, including personalised medicine	• Environmental and social health determinants • Infectious diseases, including poverty-related and neglected disease • Health care systems
Culture, creativity and inclusive society	• Democracy and Governance • Social and economic transformations	• Culture, cultural heritage and creativity
Civil security for society	• Disaster-resilient societies • Protection and Security	• Cybersecurity
Digital, Industry and space	• Manufacturing technologies • Advanced materials • Next generation internet • Circular industries • Space, including Earth Observation • Emerging enabling technologies	• Key digital technologies, including quantum technologies • Artificial Intelligence and robotics • Advanced computing and Big Data • Low-carbon and clean industry • Emerging enabling technologies
Climate, Energy and Mobility	• Climate science and solutions • Energy systems and grids • Communities and cities • Industrial competitiveness in transport • Smart mobility	• Energy supply • Buildings and industrial facilities in energy transition • Clean, safe and accessible transport and mobility • Energy storage
Food, bioeconomy, natural resources, agriculture and environment	• Environmental observation • Agriculture, forestry and rural areas • Circular systems • Food systems	• Biodiversity and natural resources • Seas, oceans and inland waters • Bio-based innovation systems in the EU Bioeconomy

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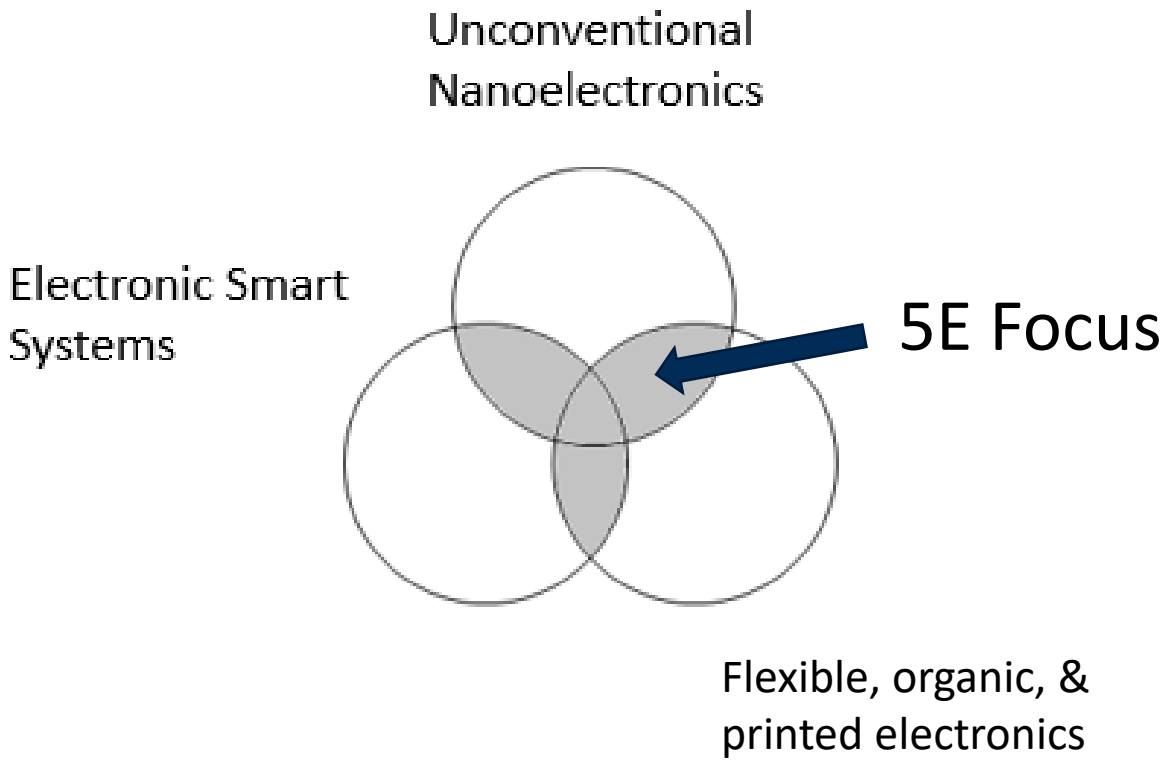
Electronics as a transversal enabler

A next generation of solutions can build on Europe's expertise in:



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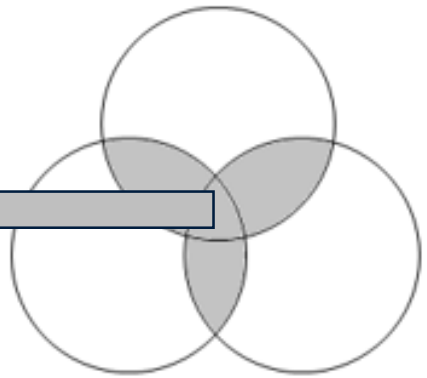
Identify Federating Opportunities

6 Product's functionalities vs. 13 Sectors of applications	(AERO)SPACE	BUILDING / CONSTRUCTION	CONSUMER ELECTRONICS	DIGITAL MANUFACTURING	ENERGY	ENVIRONMENT	FOOD & AGRICULTURE	IOT/SMART CONNECTED OBJECTS	MEDICAL / PHARMACEUTICAL / LIFE	NATURAL RESOURCES	PACKAGING / LOGISTICS	SAFETY / SECURITY	TRANSPORT / MOBILITY /
ACTUATING													
COMMUNICATING													
COMPUTING / PROCESSING / DATA STORAGE													
ENERGY HARVESTING / STORAGE													
SENSING													
SIGNALLING (OPTICAL IMAGING, LIGHTING)													



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Based on public Information

4.1 Strategic Research Agendas

Area 1	Area 2	Area 3
		♦ EPoSS SRA 2017 link ♦ Augmented SRA 2015 link ♦ EPoSS SRA 2013 link
Boosting Electronics Value Chains in Europe – June 2018 Link		
		SRA 2019 link

4.2 Position papers

Area 1	Area 2	Area 3
♦ International Focus Teams' Roadmap Reports (IRDS, 2017): "Application benchmarking" / "Environmental, Safety, Health, and Sustainability" / "More Moore"; ♦ Report Risk Governance and R&I Priorities in Nanotechnologies: a focus on food, health and the energy sector	♦ OEA brochure (7th edition)	♦ EPoSS Position Paper on Automation: Transport link ♦ EPoSS Position Paper on Automation: Hospital link ♦ EPoSS Pos Automation: N ♦ Internationa

4.3 Roadmaps

Area 1	Area 2	Area 3
♦ International Roadmap for Devices and Systems (IRDS™) 2017 Edition ♦ NEREID NanoElectronics Roadmap	♦ OEA roadmap (7th edition);	♦ For EPoSS, roadmaps are included in the EPoSS SRAs and in the ECS-SR

4.4 Market studies

Area 1	Area 2	Area 3
♦ Medical Devices Market Driver (IRDS, 2017) ♦ ZVEI Mikroelektronik – Trendanalyse bis 2022 (in German) link	♦ Business climate survey (oct 2018; 3 surveys per year) ♦ Flexible, Printed and Organic Electronics 2019-2029: Forecasts, Players & Opportunities, IDTECHEX 2018"	♦ EPoSS Response to the Self-Assessment Exercise Launched by the European Commission for Renewed Recognition as European Technology Platform (September 2013)

4.5 Literature

Literature sources cover conferences, papers and workshops publications.

Area 1	Area 2	Area 3
♦ EC Workshop report 'Artificial intelligence, low-power computing and acceleration' ♦ edaWorkshop and ADTC (European Nanoelectronics Applications, Design & Technology Conference) ♦ European	♦ EC Workshop report 12/2018 ♦ TSensor Summits and corresponding Trillion sensor roadmap --> Promotes flexible hybrid systems as enabler for IoT solutions link ♦ Yearly Pre-symposium at Sensor Expo, San Jose, on "Paper	♦ 'Health, well-being and medical technologies' EC workshop report link ♦ 'Robotics, automation and autonomous systems (industry 4.0 and beyond)' EC workshop report link ♦ 'Energy management, including

4.6 EU funding programmes

The main EU funding programmes sustaining R&I activities on electronics are:

Area 1	Area 2	Area 3
	♦ H2020	♦ H2020 ♦ ECSEL ♦ EURIPIDES (EUREKA)

4.7 Websites

Area 1	Area 2	Area 3
♦ IEEE link	♦ OE-A association link	♦ Smart Systems Knowledge Gateway link ♦ Smart Systems Trademark website with showcases link ♦ inSSIght website with videos, webinars link

4.8 International/EU regulations, directives and standards

Area 1	Area 2	Area 3
ACH, EU Sustainable velopment Strategy[1], HS on lead, EU conflict eral restriction, DEEE ycling ncil Directive on the al protection of ographies of niconductor products.	REACH, TSCA, RoHS, EMV (201430/EU), Packaging & packaging waste, WEE, Battery directive, Low voltage directive (2006/95/EC), JEDEC, ECIA standards, ASTM standards, Industry standards, Laws	♦ List of standardisation committees and activities of relevance for Area 3 per application sector, technologies link ♦ Council regulation establishing the ECSEL joint undertaking ♦ EMCD (Electromagnetic Compatibility Directive) ♦ LVD (Low Voltage Directive) ♦ RED (Radio Equipment Directive)

4.9 Key opinion leaders

Key opinion leaders are defined as entities, industrial association, working groups and task forces.

Area 1	Area 2	Area 3
♦ SiNANO Institute, European Academic and Scientific Association for Nanoelectronics ♦ AENEAS: Association for European NanoElectronics ActivitieS ♦ ENCOS (European	♦ OE-A with 5 WGs (EU) ♦ FLEXTECH (US) ♦ TSensors workgroup (Janusz Bryzek, Steve Walsh, Roger Grace)"	♦ EPoSS (with its Working Groups and members) ♦ Industry: Bosch, Siemens, ST, I NXP, AVL, Continental, Thales, G Vermon, Murata, Roche, I&M, BLM FESTO ♦ RTOs: Ikerlan, Hahn-Schickard, Fraunhofer, CEA, IMEC, Tyndall, F CSEM, VTT, SINTEF, CNM, FEM

4.10 Other (e.g. EC consultations, videos…)

Area 1	Area 2	Area 3
NA	♦ EU consultation Dec '18 & Report May '19 issuing 5 main recommendations	♦ EPoSS Response to MNBS consultation ♦ EPoSS Response to H2020 consultation: EPoSS Position on the Green Paper "From Challenges to Opportunities: Towards a Common Strategic Framework for EU Research and Innovation Funding" link ♦ inSSIght Trademark Showcases link ♦ inSSIght Videos link ♦ inSSIght Webinars link ♦ Smart Systems Knowledge Gateway link ♦ Smart Systems Showcases link

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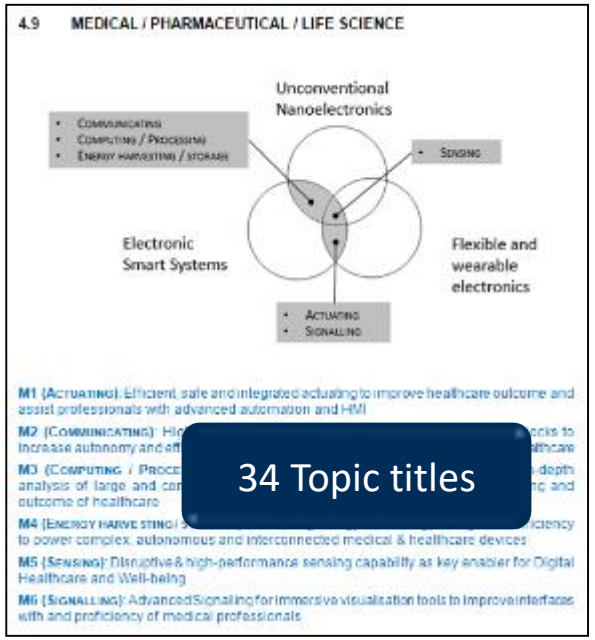
11 Sectorial States of Play

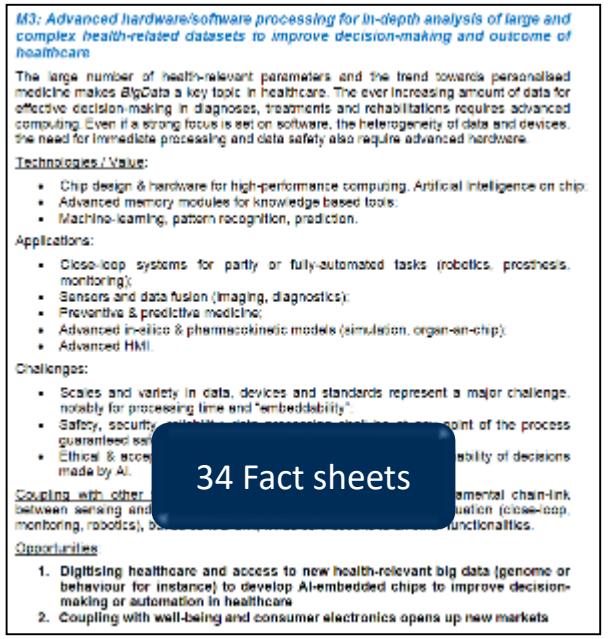
To create a catalogue of opportunities

List of topics for each sector



34 Topic titles

Fact sheet for each topic



34 Fact sheets

CATALOGUE

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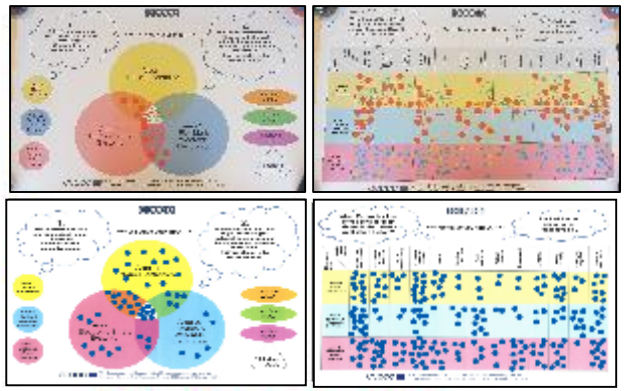
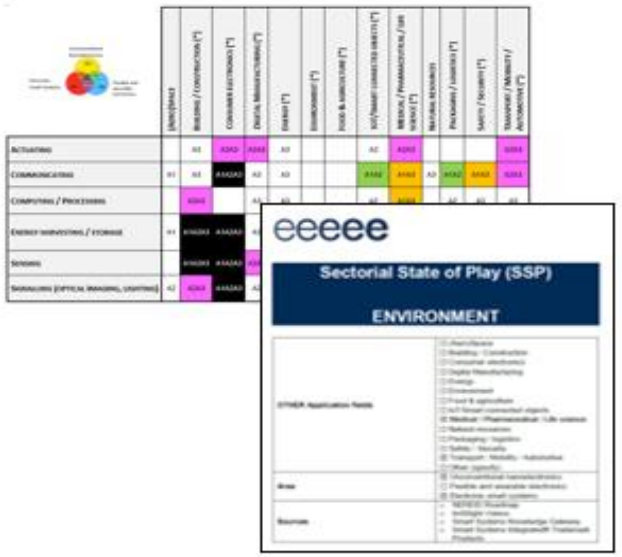
Validated through external Consultation

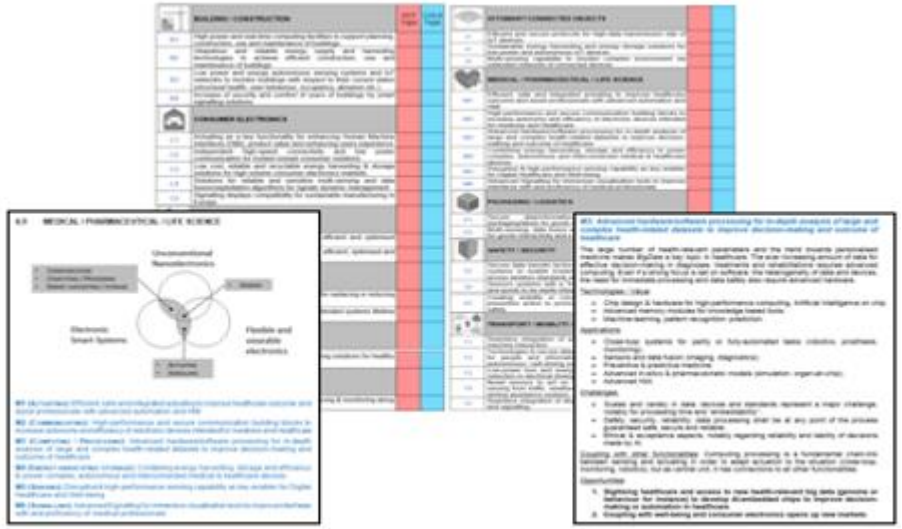


Interface analysis

> 150 Experts
In several Workshops
at international events



State of Play



Hot – Cold Ranking

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To obtain a consolidated list of 39 opportunities

	BUILDING / CONSTRUCTION
B1	High power and real-time computing facilities to support planning, construction, use and maintenance of buildings
B2	Ubiquitous and reliable energy supply and harvesting technologies to achieve efficient construction, use and maintenance of buildings
B3	Low power and energy autonomous sensing systems and IoT networks to monitor buildings with respect to their current status (structural health, user behaviour, occupancy, abrasion etc.)
B4	Increase of security and comfort of users of buildings by smart signalling solutions
	CONSUMER ELECTRONICS
C1	Actuating as a key functionality for enhancing Human Machine Interfaces (HMI), product value and enhancing users experience
C2	Independent high speed connectivity and low power communication for trusted nomad consumer solutions
C3	Low cost, reliable and recyclable energy harvesting & storage solutions for high volume consumer electronics markets
C4	Solutions for reliable and sensitive multi-sensing and data fusion/exploitation algorithms for signals dynamic management
C5	Signalling displays compatibility for sustainable manufacturing in Europe
	DIGITAL MANUFACTURING
D1	Actuating as key functionality for safe, efficient and optimised production processes in industry 4.0
D2	Next generation sensor systems for safe, efficient, optimised and self-enabled manufacturing
	ENERGY
N1	High yield energy harvesting approaches for replacing or reducing primary energy uses
N2	Flexible energy storage solutions with extended systems lifetime and multi-uses, including secondary use
	ENVIRONMENT
E1	Gas, pollutant, particle and waste monitoring solutions for healthy and safe working & living environments
	FOOD & AGRICULTURE
F1	Sensing for quality, safety and security tracing & monitoring along food value chains

	IOT/SMART CONNECTED OBJECTS
I1	Efficient and secure protocols for high-data transmission rate of IoT devices
I1	Sustainable energy harvesting and energy storage solutions for low-power and autonomous IoT devices
I3	Multi-sensing capability to monitor complex environment via extended networks of connected devices
	MEDICAL / PHARMACEUTICAL / LIFE SCIENCE
M1	Efficient, safe and integrated actuating to improve healthcare outcome and assist professionals with advanced automation and HMI
M2	High-performance and secure communication building blocks to increase autonomy and efficiency of electronic devices intended for medicine and Healthcare
M3	Advanced hardware/software processing for in-depth analysis of large and complex health-related datasets to improve decision-making and outcome of healthcare
M4	Combining energy harvesting, storage and efficiency to power complex, autonomous and interconnected medical & healthcare devices
M5	Disruptive & high-performance sensing capability as key enabler for Digital Healthcare and Well-being
M6	Advanced Signalling for immersive visualisation tools to improve interfaces with and proficiency of medical professionals
	PACKAGING / LOGISTICS
P1	Secure data/information wireless transmission in packaging/labels for goods interconnectivity and e-services
P2	Multi-sensing, data fusion and management in packaging/labels for goods interactivity and e-services
	SAFETY / SECURITY
S1	Secure data transfer technologies for flexible and adaptable IoT systems to enable trusted solutions in data communication, across wireless standards and applications
S2	Sensors systems with a "trusted label" for protection of people and goods to be easily integrated into products
S3	Creating visibility or convey information as informative or preventive action to promote effective operation and physical safety
	TRANSPORT / MOBILITY / AUTOMOTIVE
T1	Seamless integration of actuators in car interiors for human machine interaction
T2	Technologies to secure data transfer and enable trusted solutions for people and information in car2car communicating for autonomous / self-driving vehicles
T3	Low-power loss and energy harvesting for emission and CO_2 reduction in electrical driving
T4	Novel sensors to act on changing situations in surrounding, varying from traffic, weather, … to assist in ADAS (autonomous driving assistance system), safety and power consumption
T5	Seamless integration of displays for human machine interaction and signalling

	New opportunities based on stakeholder feedback
A1	High performance and high reliability sensing tools & technologies for embedded applications in harsh environment such as aeronautics &/or (aero)space
D3	Explainable AI – Transparent, comprehensible and traceable classification and decision processes in safety critical applications
N3	High-performance and compact power electronics for grid connection of distributed resources and storage, based on wide-band gap components
N4	Smart solutions combining monitoring, control and diagnostics for optimal operation of energy systems and smart grids
T6	Edge AI for autonomous mobility

All available on the 5E website

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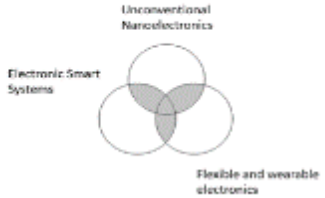
That can be matched with Global Challenges



	(Aero)Space	Building / Construction	Consumer electronics	Digital Manufacturing	Energy	Environment	Food & agriculture	IoT/Smart connected objects	Medical / Pharmaceutical / Life science	Natural resources	Packaging / Logistics	Safety / Security	Transport / Mobility / Automotive
Actuating			■	■					■				■
Communicating			■					■	■		■	■	■
Computing / Processing / Data storage		■			■				■				■
Energy harvesting / conversion / storage		■	■		■			■	■				■
Sensing	■	■	■	■		■	■	■	■		■	■	■
Signalling (optical imaging, lighting)		■	■						■			■	■

Sweet Spots for Innovation

Clusters in 'Global Challenges and European Industrial Competitiveness'

Clusters	Areas of intervention	
Health	• Health throughout the life course • Non-communicable and rare diseases • Tools, technologies and digital solutions for health and care, including personalised medicine	• Environmental and social health determinants • Infectious diseases, including poverty-related and neglected disease • Health care systems
Culture, creativity and inclusive society	• Democracy and Governance • Social and economic transformations	• Culture, cultural heritage and creativity
Civil security for society	• Disaster-resilient societies • Protection and Security	• Cybersecurity
Digital, Industry and space	• Manufacturing technologies • Advanced materials • Next generation internet • Circular industries • Space, including Earth Observation • Emerging enabling technologies	• Key digital technologies, including quantum technologies • Artificial Intelligence and robotics • Advanced computing and Big Data • Low-carbon and clean industry • Emerging enabling technologies
Climate, Energy and Mobility	• Climate science and solutions • Energy systems and grids • Communities and cities • Industrial competitiveness in transport • Smart mobility	• Energy supply • Buildings and industrial facilities in energy transition • Clean, safe and accessible transport and mobility • Energy storage
Food, bioeconomy, natural resources, agriculture and environment	• Environmental observation • Agriculture, forestry and rural areas • Circular systems • Food systems	• Biodiversity and natural resources • Seas, oceans and inland waters • Bio-based innovation systems in the EU Bioeconomy

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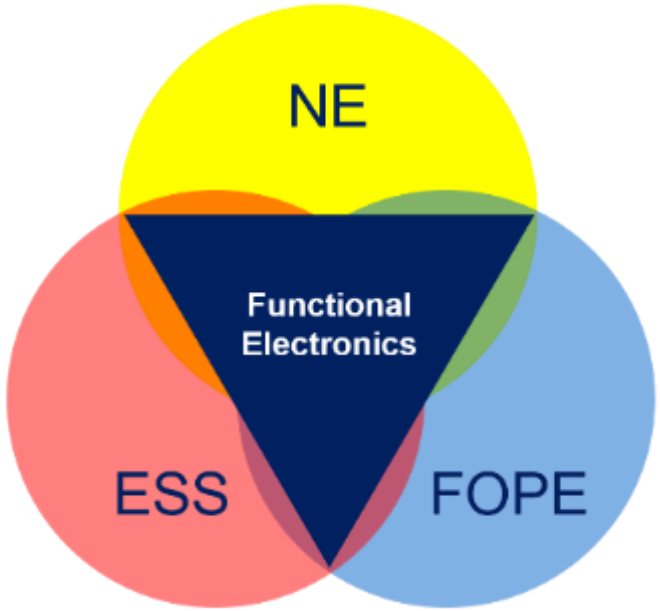
Functional Electronics

as transversal enabler & differentiator
for Europe's digital transformation

To identify sweet spots for innovation where functional electronics provides solutions

A vision for Functional Electronics



Shift from physical to functional integration (cognitive)

Use of novel substrates (flexible, organic, printed) and structural systems (textiles, plastics, laminates, glass, steel)

Eco-design approaches at product, process and business model levels

Real time capture & management of multi-physics data and contextual information (high sensitivity, selectivity and reliability)

Networked, autonomous operations, complemented by software solutions (incl. AI)

Seamless integration in everyday objects in a broad spectrum of new applications

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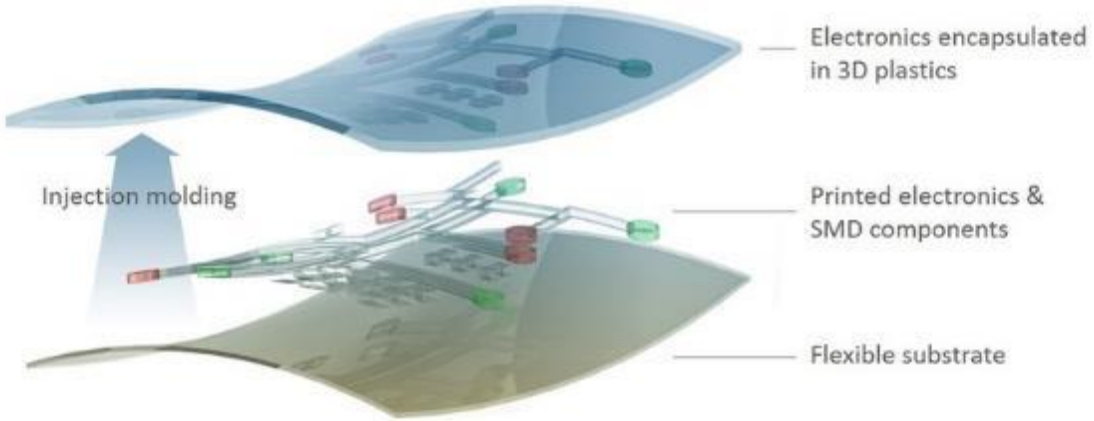
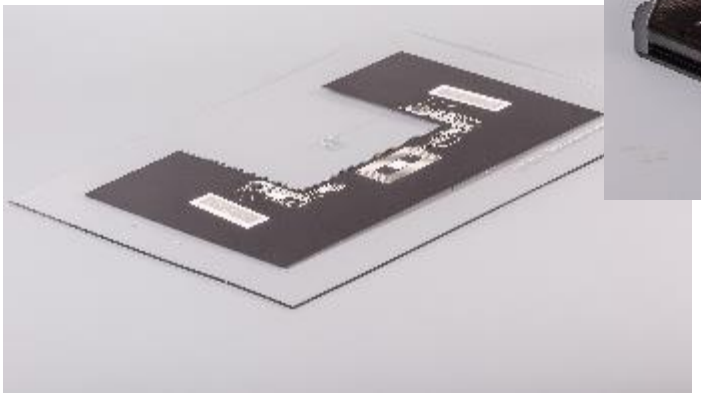
through new system implementations





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Functional Electronics
will provide key solutions to global societal challenges

Described in 4 Vision Papers

Circular Economy

Energy

Autonomous Operation of Machines

Sensing

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Workshop part & Discussion on Joint Vision and Functional Electronics

All delegates

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Insights into some relevant Horizon Europe "Destinations"

Henri RAJBENBACH

European Commission

DG CONNECT
Digital Industry
Competitive Electronics Industry

EFECS - 2020, 26 November 2020

Outline

© Caramel

- Political context
  - Commission priorities
  - Financing the Digital Age
- Horizon Europe
  - Overview, Structure
  - Cluster 4: Digital, Industry and Space
  - “Destinations” in Cluster 4 (in a converging technology landscape)
  - Two examples: Multi-functional integration
    - Integrated photonics, PICs and hybrid technologies

European Commission

Von der Leyen Commission Priorities

- A European Green Deal
- A Europe fit for the digital age
- An economy that works for people
- Promoting the European way of life
- A stronger Europe in the world
- A new push for European democracy

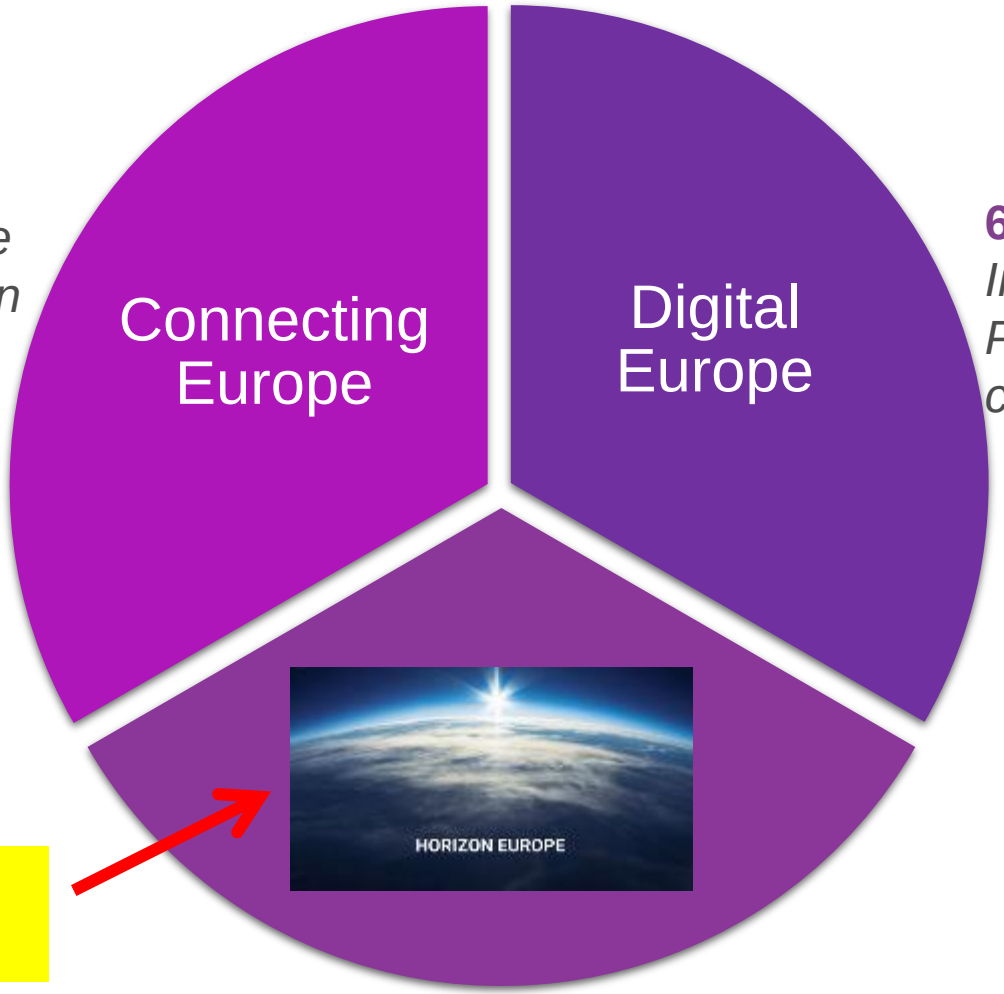
European Commission

Financing the digital age (2021 – 2027)

Draft

1 832 million
Connectivity and the digital transformation

(Infrastructures, facilities)



6 761 million
Investing in High Performance computing, AI, cybersecurity

(Deployment of technologies, Procurement)

75 900 million
Investing in research and innovation

European Commission

Programme structure

75 B€

Draft

15 B€ (2021-2027)

Pillar 1
Excellent Science

- European Research Council
- Marie Skłodowska-Curie Actions
- Research Infrastructures

Pillar 2
Global Challenges and European Industrial Competitiveness

Clusters
- Health
- Culture, Creativity and Inclusive Society
- Civil Security for Society
- Digital, Industry and Space
- Climate, Energy and Mobility
- Food, Bioeconomy, Natural Resources, Agriculture and Environment

- Joint Research Centre

Pillar 3
Innovative Europe

- European Innovation Council
- European innovation ecosystems
- European Institute of Innovation and Technology

Widening Participation and Strengthening the European Research Area

- Widening participation and spreading excellence
- Reforming and Enhancing the European R&I system

European Commission

Workprogramme 2021-22
Cluster 4: Digital, Industry and Space

400 pages

Cluster 4:
“Digital, Industry and Space”

4 B€
(2021-2022)

Draft

2nd draft WP to Member States: ‘Soon’

European Commission

“Destinations” in Cluster 4”

- TWIN-TRANSITION
- RESILIENCE
- DATA
- DIGITAL-EMERGING
- SPACE
- HUMAN

Draft

Horizon Europe legislative package → Strategic Plan 2021-2024 → Work programme 2021-2022 → Calls for proposals

European Commission

“Destinations” in Cluster 4” in more detail

Draft

Short name	Full name	Topics includes:
TWIN-TRANSITION	1. Climate neutral, circular and digitised production	Green, flexible Manufacturing, construction, Renewable resources, waste, CO/CO2
RESILIENCE	2. A digitised, resource-efficient and resilient industry	Materials (raw, green, sustainable) Multi-functional materials, green electronic materials
DATA	3. World leading data and computing technologies	Data, platforms, OS, Cloud to Edge computing, Internet infrastructures
DIGITAL-EMERGING	4. Digital and emerging technologies for competitiveness and fit for the green deal	Electronics, Photonics, low-power processors, AI, Robotics, Quantum, Graphene
SPACE	5. Strategic autonomy in developing, deploying and using global space-based infrastructures, services, applications and data	Space, Satellite, Observation systems, space services, Galileo
HUMAN	6. A human-centred and ethical development of digital and industrial technologies	Trustworthy AI, Ethics, data sovereignty Internet communities, digital interactions

DIGITAL-EMERGING

Draft

Sections:

Ultra-low power processors
European Innovation Leadership in Electronics
European Innovation Leadership in Photonics
6G and foundational connectivity technologies
Innovation in AI, data and robotics
Tomorrow's deployable Robots
European leadership in Emerging Enabling Technologies
Quantum Technologies (Flagship)
Graphene (Flagship)

European Commission

Electronics and Photonics -

Beware of Convergence !!

Co-Design !!

Electronics		Photonics	
Nanoelectronics **More-Moore** **More-than-Moore Analog, RF…** **Beyond CMOS (Neuromorphic, Spintronics Quantum)**	Flexible, Printed Wearable Electronics	Photonic Integrated Circuits, Communication, & Sensors	Supporting Software

Smart Systems Integrated

Integration and Packaging

European Commission

Electronics and Photonics - Topics

Draft

DIGITAL-EMERGING - 03 — Semiconductor processes for the post-Moore era (RIA)

→ DIGITAL-EMERGING - 04 — Multi-functional integration (RIA)

DIGITAL-EMERGING - 06 — Advanced optical communication components (IA)

→ DIGITAL-EMERGING - 07 — Integrated photonics, PICs and hybrid technologies (RIA)

2021

DIGITAL-EMERGING – 02 — Functional electronics for green and circular economy (RIA)

DIGITAL-EMERGING - 03 — Sensor-based systems for biomedical, environmental and other advanced applications (RIA)

2022

European Commission

DIGITAL-EMERGING - 05

Multi-functional integration (RIA)

Draft

Expected Outcomes:

- Integration of new functionalities at package level
- Affordable multi-functional integrated devices
- Provide a European strategic autonomy in key integration and packaging technologies and related manufacturing value chains
- Industrial leadership for automotive, aerospace defence and security, and healthcare

Scope:

- Heterogeneous integration for multi-functional digital devices.
- Heterogeneous integration and smart packaging, integrating sensing, storing, processing, actuation, energy harvesting and wideband communication.
- Integration microelectronics, micro-nano-mechanic, micro-fluidic, magnetic, photonics, RF or bio-chemical.

TRLs 2 to 4, RIA (Research and Innovation Actions)

European Commission

DIGITAL-EMERGING - 07

Integrated photonics, PICs and hybrid technologies (RIA)

Draft

Expected Outcomes:

- Integrated devices enabled by core technologies and technology building blocks.
- Strengthening industrial capability of photonic device fabrication by integration and miniaturisation of technologies
- Lowering the barrier to the use of advanced photonic integration technologies for companies (high-tech SMEs)

Scope:

- Enhancing functionality and spectral coverage
- New applications in biomedical, environmental, industrial and sensing fields
- New materials, design, fabrication, assembly and packaging techniques
- Co-integration of photonic and electronic components.
- Demonstrate the developed integration technologies in at least two application oriented use cases .

European Commission

To conclude:

&

Framework Programme Portal:

https://ec.europa.eu/info/funding-tenders/opportunities/portal/

European Commission

Introduction to the 5E Meta-Roadmap and transversal aspects

Nicolas Gouze, VDI/VDE-IT

The Coordination and Support Action 5E has received funding from the European Community's Programme Horizon 2020 under GA Number: 825113

META-ROADMAP: From Vision papers to recommendations (e.g. call texts)

1. Topic for recommendations
2. Issue to be addressed
3. Link to 5E catalogue of opportunities
4. Importance
5. Urgency (timeline)
6. Targeted stakeholder group
7. Technical and non-technical barriers to be solved
8. Proposed funding scheme

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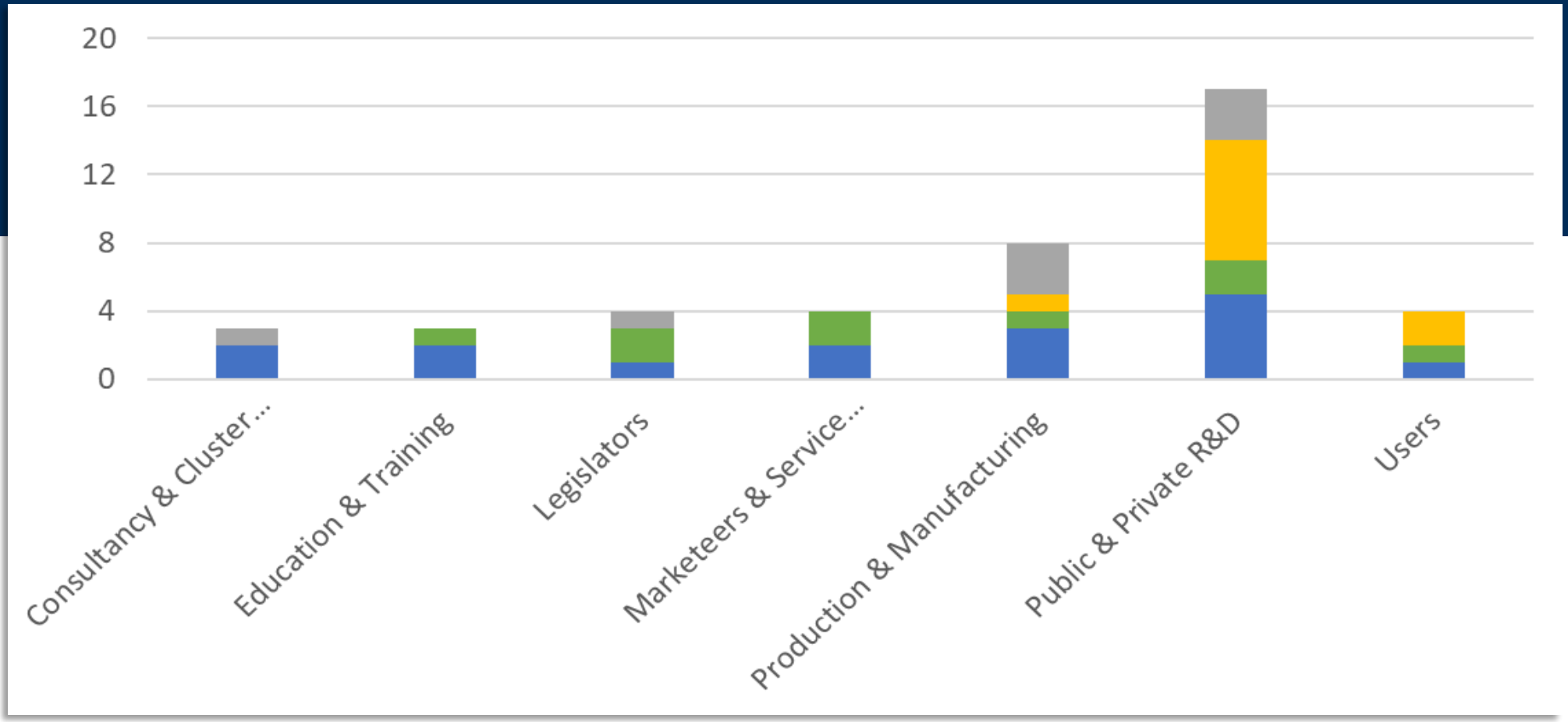
RECOMMENDATIONS PER TARGETED STAKEHOLDER GROUP



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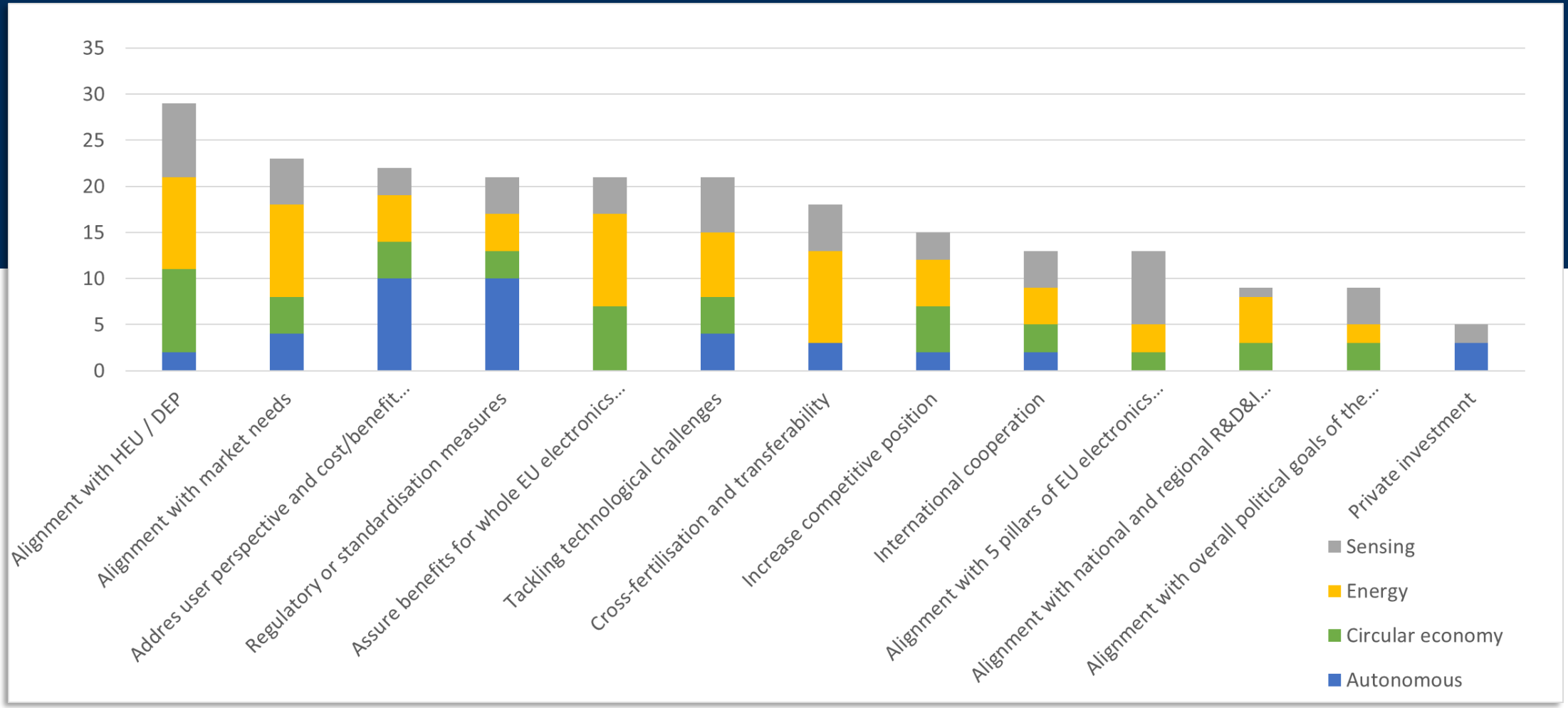
BARRIERS TO OVERCOME



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Vision Paper	Topic	Issue
Autonomous	AI for autonomous operation	Edge AI for autonomous mobility Level 1
Autonomous	Data Transfer and IoT systems	Technologies to secure data transfer and enable trusted solutions for people and information in car2car communicating for autonomous / self-driving vehicles
Autonomous	AI for autonomous operation	Explainable AI – Transparent, comprehensible and traceable classification and decision processes in safety critical applications
Autonomous	AI for autonomous operation	Edge AI for autonomous mobility Level 2
Autonomous	Transverse	Discuss liability issues with the stakeholders (industry, academia, public authorities etc.)
Autonomous	Sensor and mulit sensor systems	Next generation sensor systems for safe, efficient, optimised and self-enabled manufacturing
Autonomous	Data Transfer and IoT systems	Secure data transfer technologies for flexible and adaptable IoT systems to enable trusted solutions in data communication
Autonomous	Transverse	Set-up of a legal framework for development, testing and use of autonomous operating machines
Circular economy	Green Electronics	1. Ecodesign
Circular economy	Green Electronics	4. Sustainable product policy framework
Circular economy	Green Electronics	2. Circular electronics initiative
Circular economy	Green Electronics	3. Ecodesign approaches
Circular economy	Transverse	9. Holistic impacts assessment
Energy	Power management circuit	Power supply in the high-power and real-time computing sector
Energy	Energy harvesting	High-efficiency energy harvesting approaches for replacing or reducing primary energy uses
Energy	Transverse Energy harvesting / energy storage / Wireless power transmission	Sustainable energy harvesting and energy storage solutions for low-power and autonomous system: - harsh environment & remote sites - Multi-energy harvesting - extended systems lifetime
Energy	Power electronics	High-performance and compact power electronics for grid connection of distributed resources and storage, based on wide-band gap components (SiC and/or GaN)
Energy	Energy management system	Safe, efficient and optimised production processes in industry: multi-level efficiency and safety (energy supply..)
Energy	Transverse Energy harvesting / energy storage / Wireless power transmission	New approaches for low-cost, reliable and recyclable including secondary use energy harvesting and storage integration at system/component levels
Sensing	Environment	High density monitoring for fast changing conditions in situation based awareness (Big data sensing)(*): Sensing products, history and waste streams
Sensing	Environment	High density monitoring for fast changing conditions in situation based awareness (Big data sensing)(*): Sensing waste streams and data management

21 issues classified as highly important (+5)

Importance vs. Urgency

9 issues classified as most urgent (+5)

Autonomous	AI for autonomous operation	Edge AI for autonomous mobility Level 1
Autonomous	Sensor and multi sensor systems	Novel sensors to act on changing situations
Autonomous	Transverse	Create Living Labs to test the technological achievements and to include the general public
Autonomous	Transverse	Establish centers for knowledge transfer of best practice into all relevant sectors and domains
Circular economy	Green Electronics	1. Clean materials cycles
Circular economy	Green Electronics	4. Sustainable product policy framework
Sensing	Medical	Beyond algorithms sensor development (re-active towards proactive, AI, product integration): sensors for patient well-being (monitoring), prevention, prediction (AI)
Sensing	Data and IoT	Large, area, high density monitoring in sensing platforms: 1 Trillion sensors, sensor swarms, integration, data cloud storage monitoring
Sensing	Data and IoT	Building/ city integrated safety sensors: data storage, cloud computing AI

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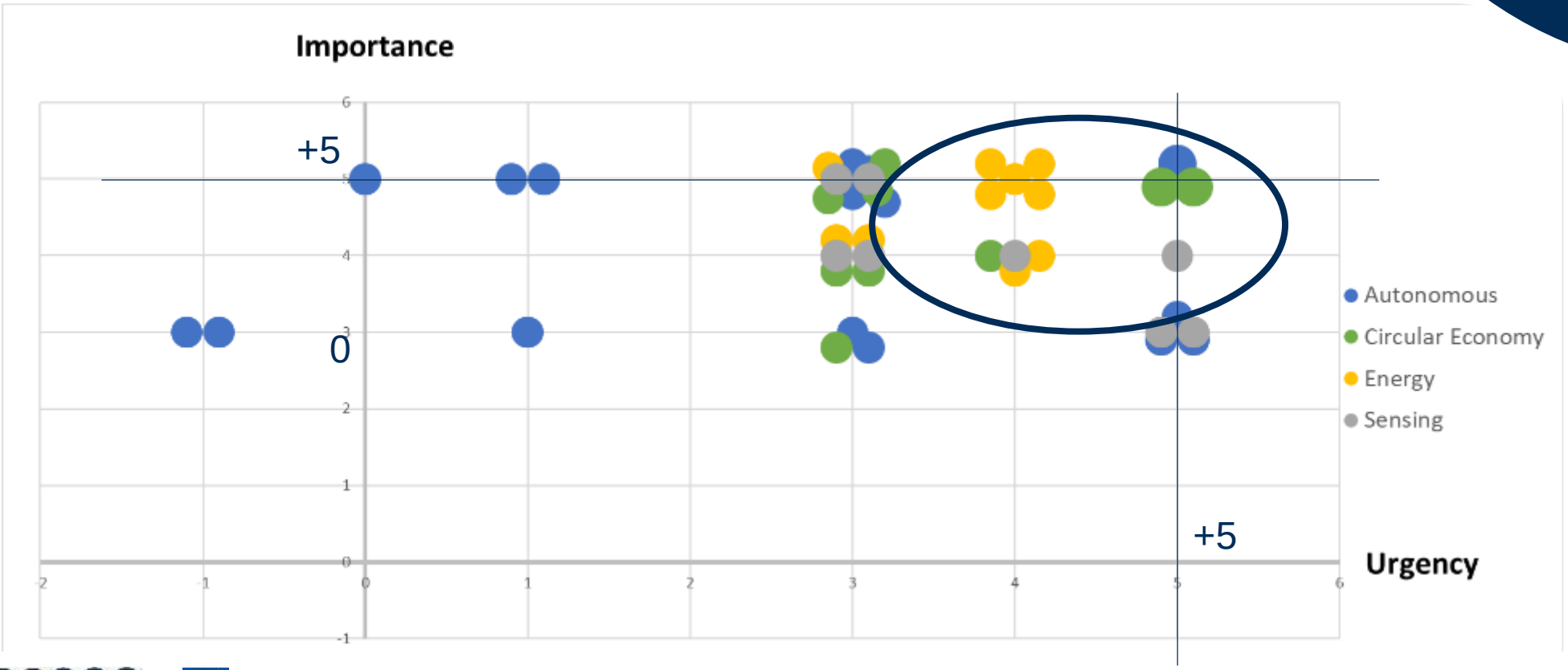
Analysis with Eisenhower matrix



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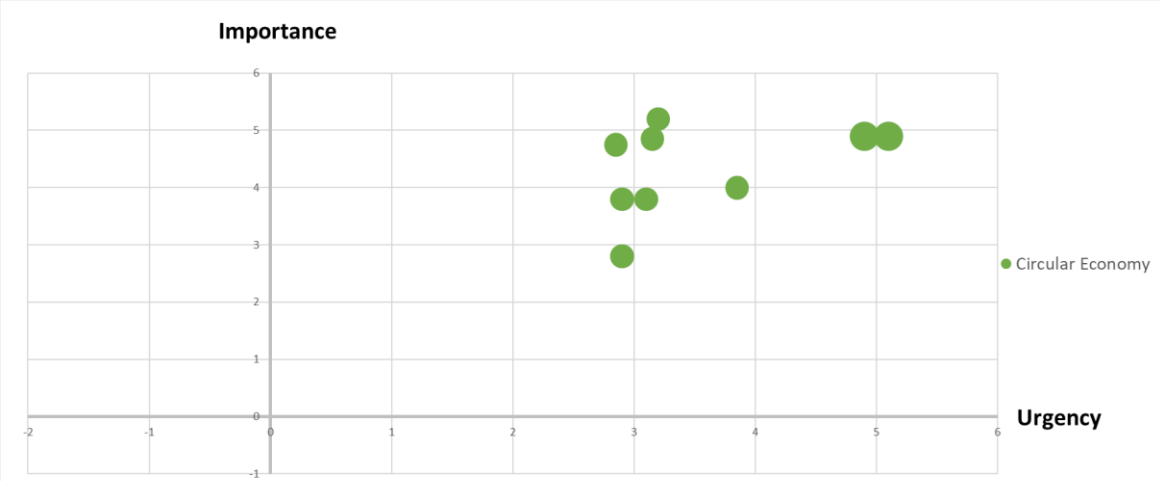
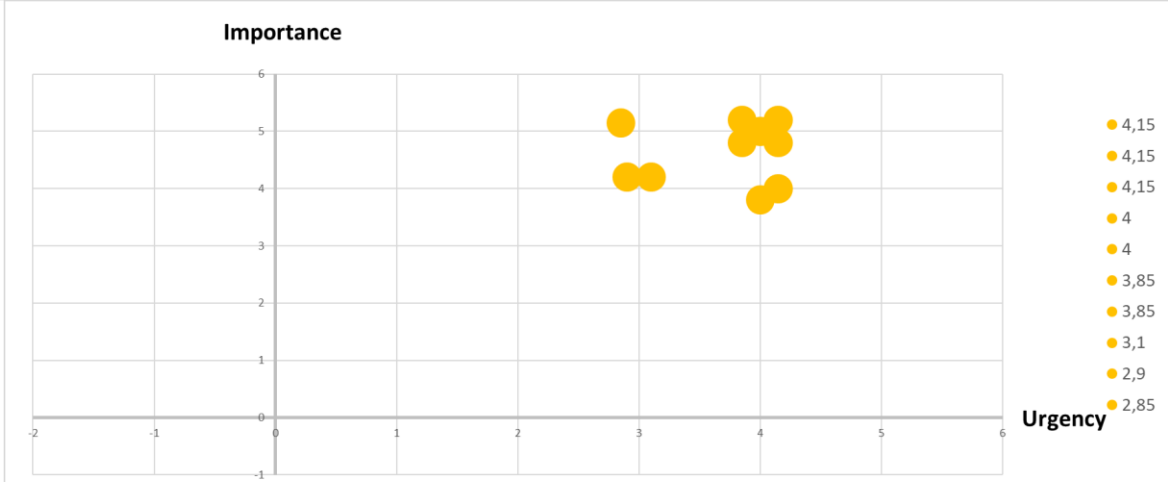
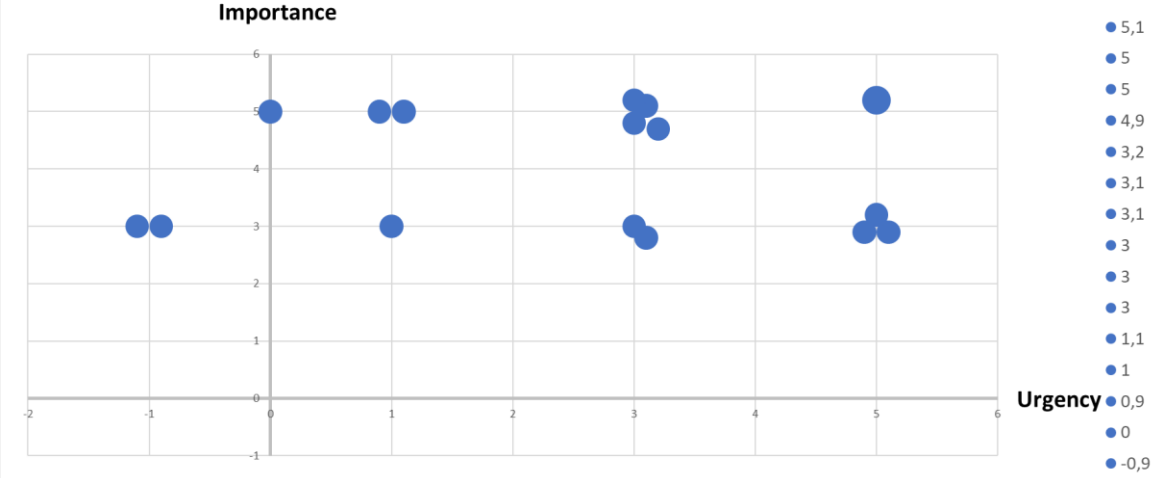
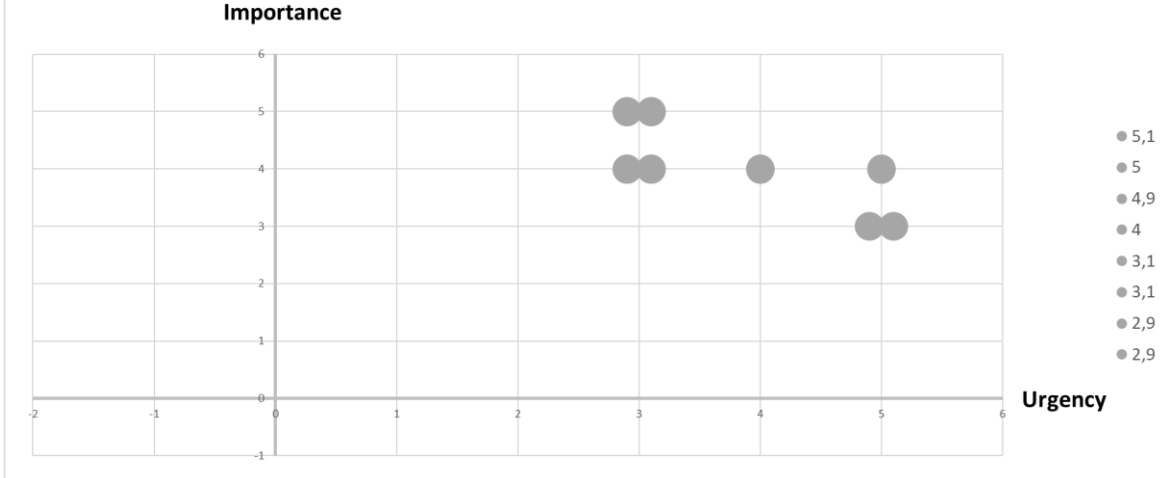
EISENHOWER RANKING PER META-ROADMAP MODULE









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15 WRITTEN RECOMMENDATIONS BY META-ROADMAP MODULE

Circular Economy

1. Ecodesign
2. Sustainable product policy framework

Energy

1. Real-time computing
2. High-efficiency energy harvesting approaches for replacing or reducing primary energy uses
3. High-storage density technologies
4. High-performance and compact power electronics for grid connection of distributed resources and storage, based on wide-band gap components (SiC and/or GaN)
5. Smart energy management and smart solutions for ubiquitous and reliable energy supply: harvesting technologies, digital twin and AI

Autonomous Operation of Machines

1. Novel sensor systems to act on quickly changing situations
2. AI liability issues
3. Edge AI for Autonomy Levels 1 and 2
4. Centres for knowledge transfer

Sensing

1. Smart sensing systems to monitor fast changing conditions in self driving cars
2. Environment monitoring sensing systems
3. Sensors in Medical applications
4. Data acquiring sensors for IoT applications

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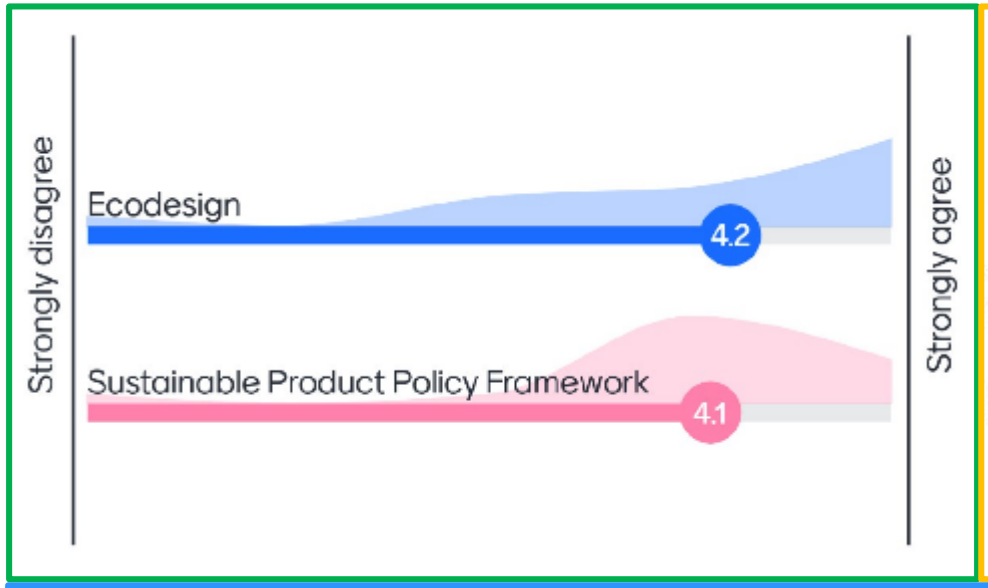
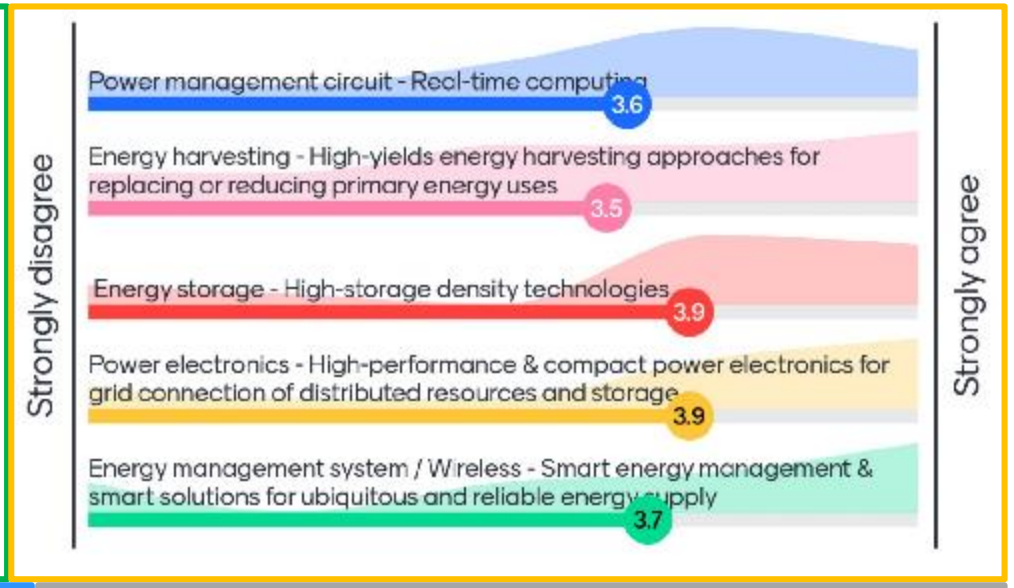
PRE-VALIDATION

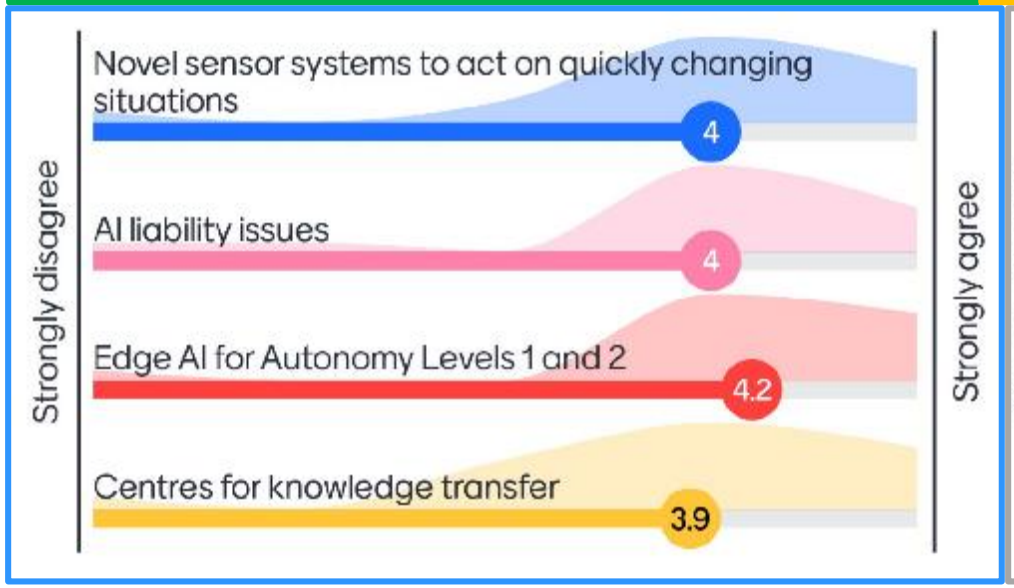
CIRCULAR ECONOMY



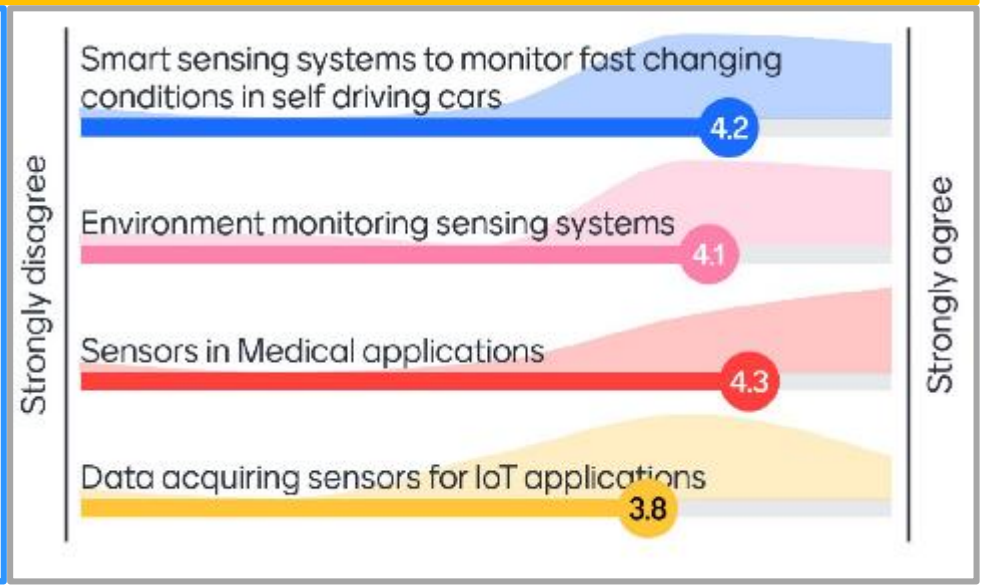
ENERGY



AUTONOMOUS OPERATION



SENSING



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Next steps

- Analysis of feedback and expressions of interest
- Finalisation and publication of Meta-Roadmap as a pdf document for download
- Dissemination of Meta-Roadmap
  Closing Loops and Cascading Strategies exercises

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Vision Papers and respective modules of the Meta-Roadmap

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Circular Economy

Jérôme Gavillet, CEA

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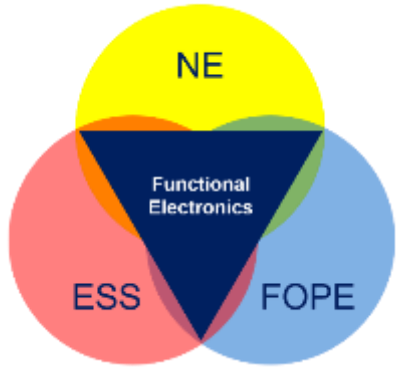
Role and Impact of Functional Electronics on the Transition towards a Circular Economy



A SOUND INTEGRATION FOR AN EFFICIENT TWINING OF GREEN AND DIGITAL TRANSITIONS

THE EUROPEAN GREEN DEAL
New Circular Economy Action Plan

SHAPING EUROPE'S DIGITAL FUTURE
New Industrial Strategy for Europe

HOLISTIC IMPACTS ASSESSMENT

CLEAN MATERIALS CYCLES

CIRCULAR DATA SPACE

ECODESIGN APPROACHES

PRODUCT PASSPORT

CIRCULAR ELECTRONICS INITIATIVE

SMART MAINTENANCE

SUSTAINABLE PRODUCT POLICY FRAMEWORK

NEW BUSINESS MODELS

Unlock digital potential to maximise product value

Develop safe, sustainable & low-carbon solutions

FUNCTIONAL ELECTRONICS

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green & digital twin-transitions

❑ Issue

- Majority of products placed on the EU market today rely mainly on **unsustainable and sub-optimal use of resources**, leading to **excessive use of energy and production of waste**
- Particularly true for **resource-intensive and high impact sectors such as electronics**
- Electronics industry clearly present in different market segments (healthcare, consumer goods, energy, buildings, mobility, safety & security, agri & food, retail...) with a **manufacturing sector accounting for 15% GDP** and providing around **33 million jobs in Europe**

❑ Need & Opportunity

- **Decouple economic activity** and well-being **from resource uses and its environmental impacts**
- **Essential and urgent to understand the role and mitigate associated environmental & societal risks of electronics in a transition towards a circular economy and a low-carbon society**
- **Digital transformation** presents an **enormous potential of wealth creation** for EU business and society

❑ Context / EC recent communications

- **European Green Deal** and adoption of **a new circular economy action plan**
- **Shaping Europe's digital future** and **New Industrial Strategy for Europe**

❑ Vision / Positioning

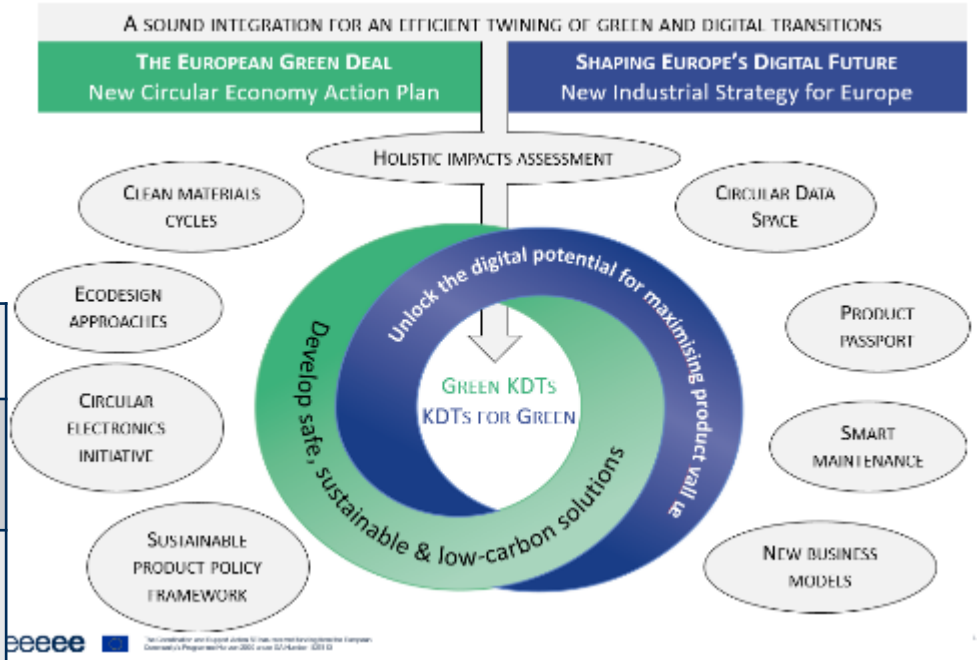
- **Design safe, sustainable and circular solutions**
- **Unlock the potential of electronics**

GREEN & DIGITAL TWIN-TRANSITIONS

The Coordination and Support Action 5E has received funding from the European Community's Programme Horizon 2020 under GA Number: 825113

Contribution/Support:

OE-A WG Sustainability, **EPoSS**, **Textile ETP**, **EMIRI**, **BATTERIES EUROPE** WG Raw materials & Recycling, The European Circular Economy Research Alliance (**ECERA**)



CLEAN MATERIALS CYCLES	Shift to '**safe-by-design chemicals**' through the progressive substitution of hazardous substances to better protect citizens and the environment / **Recycling**
ECODESIGN APPROACHES	Take into account **all environmental impacts** of a product (including the use of raw materials and natural resources, manufacturing, packaging, transport, disposal and recycling) right **from the earliest stage of design**.
CIRCULAR ELECTRONICS INITIATIVE	**Implement regulatory measures** for electronics and ICT so that devices are designed for energy efficiency and durability, reparability, upgradability (incl. software), maintenance, reuse and recycling.
SUSTAINABLE PRODUCT POLICY FRAMEWORK	**Propose a sustainable product policy legislative initiative to widen the Ecodesign Directive beyond energy-related products so as to make the Ecodesign framework applicable to the broadest possible range of products and make it deliver on circularity.**
CIRCULAR DATA SPACE	The **European data space** for smart circular applications will provide the architecture and governance system to drive applications and services such as **product passports**, **resource mapping** and **consumer information**, **based on European rules and values**.
PRODUCT PASSPORT	Data record that summarises the components, materials and chemical substances or information on reparability, spare parts or proper disposal for a product. The **data originates from all phases of the product life cycle** and can be **used for different purposes** in all these phases (**design, production, use, disposal**).
SMART MAINTENANCE	Enhance **end of life management practices**, **predictive** and **condition-based maintenance** extending product lifetime.
NEW BUSINESS MODELS	Incentivising product-as-a-service or other models where **producers keep the ownership of the product** or the **responsibility for its performance throughout its lifecycle**.
HOLISTIC IMPACTS ASSESSMENT	**Overall environmental, economic and societal net benefits** assessment based on advanced dedicated tools & methodologies (e.g. LCA, techno-economic assessment, business strategy, societal acceptance surveys etc…) to **support decision-making on more circular solutions**.

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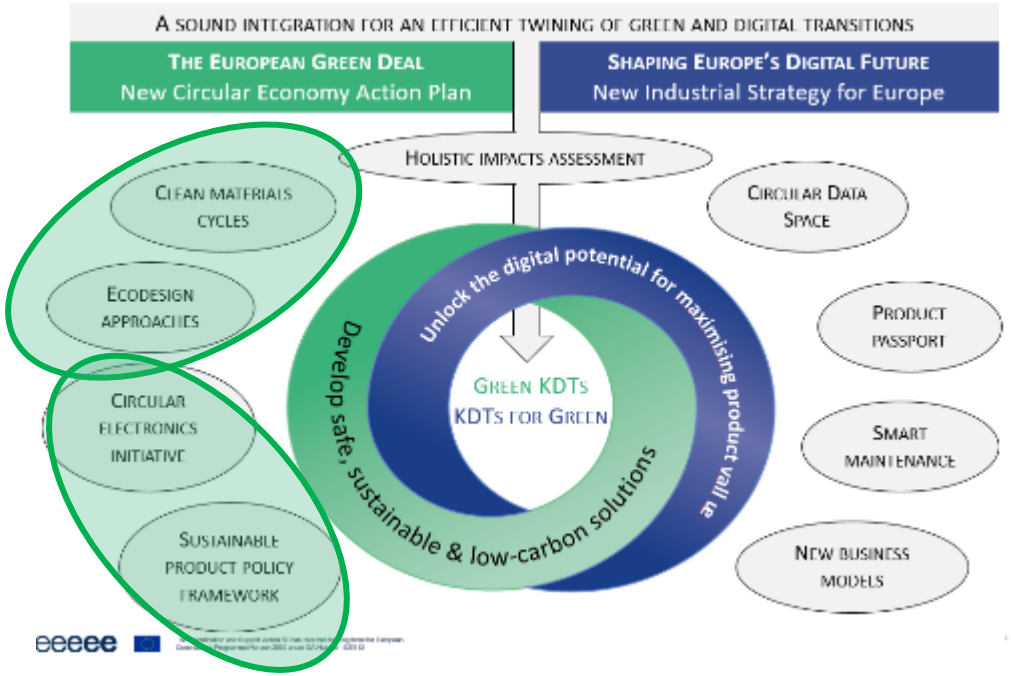
Ensuring sustainability is put at the heart of all electronics containing solutions

Accompany the transition by a proper and meaningful regulatory and legislative framework.



1. **Sustainable sourcing of** primary or secondary raw **materials** (such as substitutes to critical or scarce raw materials, produced **from more energy-efficient manufacturing processes**, generating less waste like net-shape processing)

2. **Optimised resource use** (such as low and smart energy consumption); **environmentally sound and safe product use** (such as alternative to Volatile Organic Compounds)

3. **Enhance repair** (incl. self-healing), **remanufacturing**, **recovery**, **reuse** and **recycling** (minimizing the use of hazardous and/or persistent substances, facilitating sorting and/or disassembly) of materials and products. Stakeholders must be able to rely on the intrinsic safety of the materials from a health and environmental point of view

4. **Improve traceability and transparency during product lifetime**, allow manufacturers **to monitor**, control, analyse **and optimise materials quality and products performance** (digital product passport);

5. **Enhance end-of-life management practices**, **predictive and condition-based maintenance**. Maintaining the value of materials and products for as long as possible;.

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ECODESIGN

CIRCULAR ECONOMY 1

Public and private RDI efforts should **concentrate on the progressive substitution of critical raw materials, hazardous substances and the recycling of all materials, in general**, for the benefit of citizens and the environment.
Research organisation, Academia, education and industry should collaborate in establishing centres for knowledge transfer of best practice into all relevant sectors and domains, including the general public. They should proceed in close **international cooperation**, aligned with the objectives of the Horizon Europe and the Digital Europe Program, and based on additional private investment.

RIA and IA actions would be appropriate in order to **tackle technological challenges associated to designing eco-friendly products and processes** to support this progressive substitution inside the **different classes of materials**: *basic 'raw'* materials; *artificial* materials; and *industrially produced/processed* materials (as defined by EMCC). Progressive substitution should be envisioned from a product **eco-design standpoint**, without compromising products performance, market emergence and eventual economic value. Alignment with user expectations and market needs must be considered. Also, cross-fertilisation and **transferability across electronic sectors and functionalities** have to be taken into account.

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SUSTAINABLE PRODUCT POLICY FRAMEWORK

CIRCULAR ECONOMY 2

Industry, especially producing and manufacturing enterprises should follow strictly the commonly accepted regulatory and standardisation measures to better address user perspective and achieve broad acceptance. There is a need to **better address the user perspective, specifically "acceptance", flanked by correlated regulatory and standardisation measures** to set a **legal framework for the development, testing and use of lower footprint electronics as well as novel uses of electronics enabling a more circular economy**, in general. This could be the base for a general accepted and adopted set of successive updates of policies and standards currently in place in, or even new measures, to be designed in priority around products cases & usage of acknowledged high environmental footprint but with high economic impacts.

CSA, RIA and IA actions would be appropriate in order (1) to mobilise all necessary EU stakeholders to prepare the field for a **radical change in policies & standardisation wherever relevant and urgent** (CSA); (2) to design future measures & recommendations towards policies and standardisation bodies, **including product eco-design**, for emerging products & uses (RIA); and (3) update existing policy framework and standardisation on products & uses about to reach their markets (IA).

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FAQ on CIRCULAR ECONOMY

CIRCULAR ECONOMY FAQ

Is energy Consumption and low power included?

- Yes. More generally, sustainable electronics in any energy systems (PV, batteries,…) and electronics solutions for a sustainable production & use of energy are necessary (e.g. smart energy management)

What about energy consumption of the electronic components?

- Must be addressed in a holistic manner establishing the overall benefits of electronics components vs. Their use of resource & energy

Everything seems covered but not in deep?

- The Vision Papers cover the topic in more details compared to the presentations: https://5e-project.eu/vision-papers/

Is the CO2 topic included?

- Carbon footprint is not a topic as such here, but rather a direct and major consequence from the foreseen dual-transitions

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Energy

Elise Saoutieff, CEA

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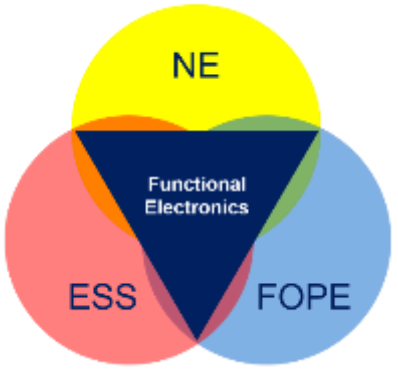
Functional Electronics enabled energy solutions for the digitalisation of European industries and societies



Power electronics

Power converter

Electronics for energy

Energy management system

Wireless power transmission

New functions for **safe operation** and **secure energy supply**

FUNCTIONAL ELECTRONICS AND ENERGY

Optimization of energy consumption

Power management circuit

Energy harvesting

Powering Electronics

Energy Storage

Low power electronics

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Power management circuit

ENERGY 1

Real-time computing sector

Public and private R&D effort should concentrate on edge vs cloud computing, calculation resources, latency and storage requirements. Manufacturing, suppliers, marketers & service providers for e.g. virtual reality techniques will be impacted.

- **RIA and IA actions** would be appropriate in order to (1) tackle technological challenges (2) consider alignment with user expectations and market needs and (3) cooperate with HEU / DEP, incl. Areas of intervention from the clusters in pillar 2.
- **CSA actions** would be appropriate to mobilize all necessary EU stakeholders to prepare the field for a change in paradigm in policies & standardisation wherever relevant and urgent.

This topic is addressed in the opportunity referenced in 5E catalogue under B1.

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High-efficiency energy harvesting approaches for replacing or reducing primary energy uses

ENERGY 2

Public and private R&D effort should concentrate on the high system / product integration level (energy vector, energy scale, reliability, lifetime & cost) and on multi-energy harvesting integration opportunities.

- **RIA and IA actions** would be appropriate in order to (1) tackle technological challenges (2) consider alignment with user expectations and market needs, e.g. energy autonomy for remote or low-accessibility needs and to (3) cooperate with HEU / DEP, incl. Areas of intervention from the clusters in pillar 2. Manufacturing, suppliers, marketers & service providers need to increase competitive position.
- **INFRA actions** would be appropriate for Research organisation, Academia, education and industry cooperation in establishing centres for knowledge transfer of best practice into all relevant sectors and domains, including the general public.

This topic is addressed in the opportunity referenced in 5E catalogue under N1.

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ENERGY 3

High-density storage technologies

Public and private R&D efforts should concentrate on the selection of the best energy storage technology for a given application with high system / product integration level (storage capacity, energy scale, low power management, reliability, lifetime & cost) and on safety and recyclability challenges.

- **RIA and IA actions** would be appropriate in order to 1) tackle technological challenges (2) align with user expectations and market needs, e.g. energy autonomy for remote or low-accessibility needs, (3) to cooperate with HEU / DEP, incl. Areas of intervention from the clusters in pillar 2. Manufacturing, suppliers, marketers & service providers need to increase competitive position.

This topic is addressed in the opportunities referenced in 5E catalogue under I2, N1 and N2.

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Power electronics

High-performance & compact power electronics for grid connection of distributed resources and storage, based on wide-band Gap components (SiC and/or GaN)

ENERGY 4

Public and private R&D effort should concentrate on new material investigation for power electronics by guaranteeing high reliability of power components, converters design (topology, selection of the active power components, sizing of passive components) and specifications (Increase the switching frequency/speed).

- **RIA and IA actions** would be appropriate in order to (1) tackle technological challenges (2) align with user expectations and market needs, and (3) cooperate with HEU / DEP, incl. Areas of intervention from the clusters in pillar 2.
- **INFRA actions** would be appropriate to match with EU electronics strategy to develop sector for power components.
- **CSA actions** would be appropriate to mobilize all necessary EU stakeholders to prepare the field for a change in paradigm in policies & standardisation wherever relevant and urgent. They should proceed in close international cooperation, aligned with the objectives of the Horizon Europe and the Digital Europe Program, and based on additional private investment.

This topic is addressed in the opportunity referenced in 5E catalogue under N3

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Smart energy management & smart solutions for ubiquitous and reliable energy supply: harvesting technologies, digital twin and AI

ENERGY 5

Public and private R&D effort should concentrate on Smart solutions combining monitoring, control and diagnostics for optimal operation of energy systems and smart grids.

They should concentrate on Digital twin and Artificial Intelligence for the development of e.g. optimal predictive control algorithms; production and consumption power forecasting; diagnostic/prognostic algorithms; cloud solutions.
Need to develop new strategies products and software solutions for optimal operation of grids (mix planning (hydrogen, energy harvesting), dynamic reconfiguration, frequency/voltage regulations…) and for grid reliability / robustness in a context with high share of intermittent generation.

- **RIA and IA actions** would be appropriate to (1) tackle technological challenges, (2) align with user expectations and market needs, (3) cooperate with HEU / DEP, incl. Areas of intervention from the clusters in pillar 2.
- **INFRA actions** would be appropriate to match with EU electronics strategy to be developed e.g. in smart grid.
- **CSA actions** would be appropriate to mobilize all necessary EU stakeholders to prepare the field for a change in paradigm in policies & standardisation wherever relevant and urgent.

This topic is addressed in the opportunities referenced in 5E catalogue under N2, N4, B2 and M1.

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FAQ on ENERGY

ENERGY FAQ

Is the topic of wireless transmission for healthcare applications, especially for implantable devices, included?

- Addressed in Sensing recommendation 4. We can imagine that all development done in wireless transmission for smart energy management (recommendation 5) could be transposed to this particular application.

Where does the energy come from (green / blue / grey)?

- Mix planning depending on your country. The best would be the one(s) with the lower Co2 impact.

Is energy harvesting really the thing users want / need?

- Energy harvesting is relevant in remote sites, harsh environments, and whenever full energy autarchy is needed, where the use of conventional battery is complex or prohibited. Some users already ask and invest in this technology.

What is the priority between increasing energy scavenging and reducing power consumption? Most of the time, is easier to procure energy savings in electronics than increasing energy harvesting…

- Both are not incompatible. In some cases the power consumption is already very low and the use of battery is complex, energy harvesting is an alternative.

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Autonomous Operation of Machines

Stephan Karmann, Hahn-Schickard

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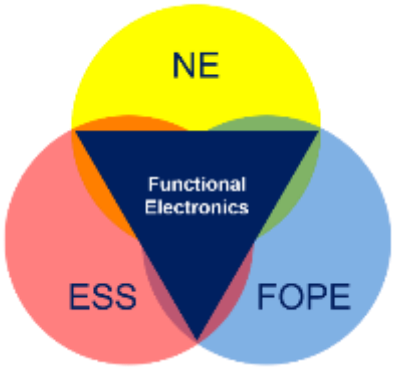
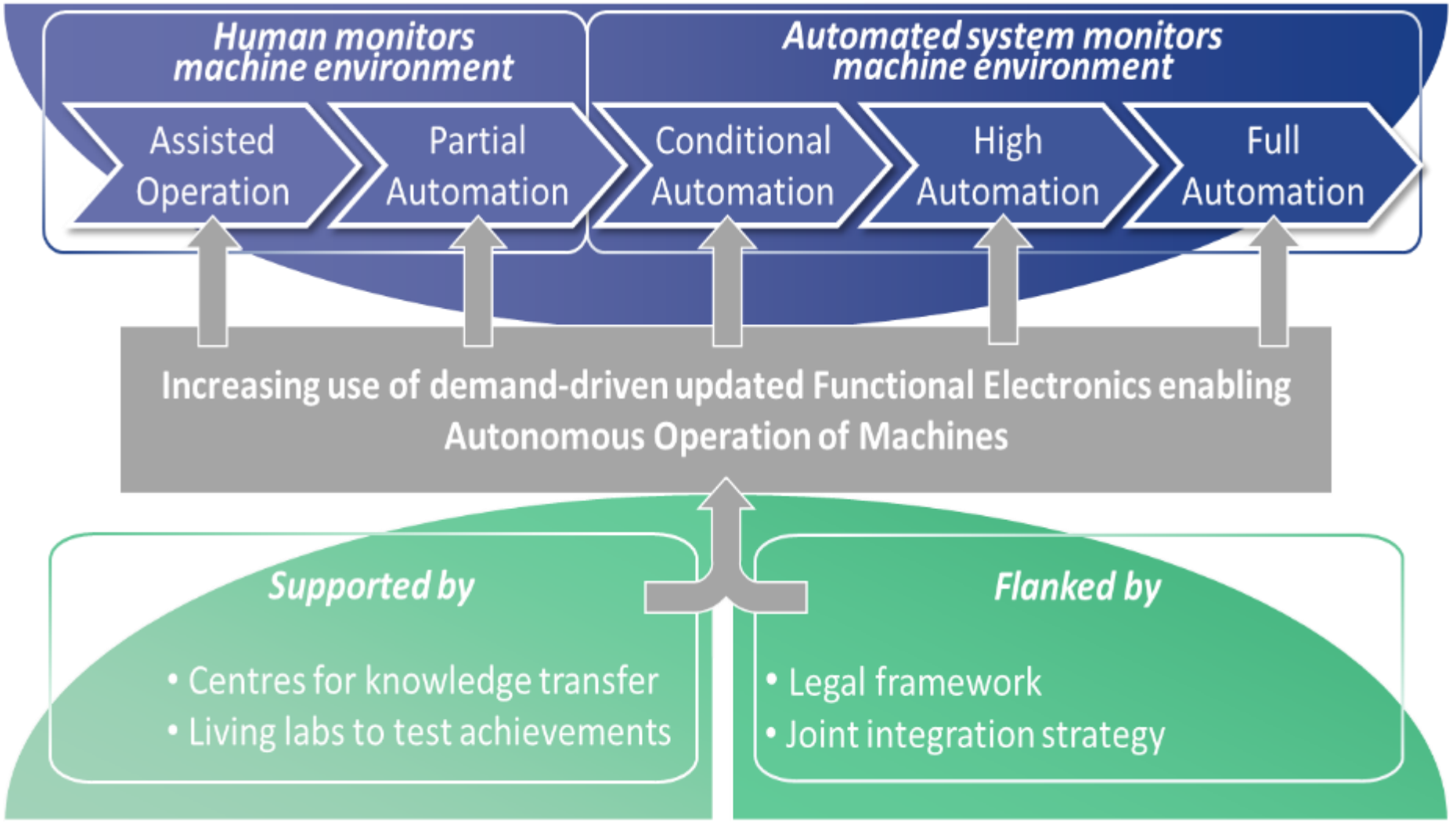
Functional Electronics as Enabler for Autonomous Operation of Machines





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AUTONOMOUS OPERATION 1

Novel sensor systems to act on quickly changing situations

Public and private R&D efforts should concentrate on novel sensors and multisensory systems that recognise and react on quickly changing situations.

- **RIA and IA actions** would be appropriate in order (1) to tackle technological challenges and (2) to consider alignment with user expectations and market needs.

- **CSA actions** would be appropriate to mobilize cross-fertilisation and transferability across electronic sectors and functionalities.

This topic is addressed in the opportunity referenced in 5E catalogue under T4.

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AUTONOMOUS OPERATION 2

AI liability issues

Multipliers and intermediaries like Clusters, Associations, Chambers or Consultants should take the lead in a public discussion about AI-related liability issues with the stakeholders (industry, academia, public authorities etc.).

- **CSA actions** would be appropriate to better address the user perspective, specifically “acceptance”, flanked by correlated regulatory and standardisation measures to set a legal framework for the development, testing and use of autonomously operating machines. This could be the base for a general accepted and adopted set of successive autonomy levels (as already established for self-driving cars) for the future autonomous operation of any plant, machinery or equipment.

This topic is addressed in the opportunity referenced in 5E catalogue under A1, C4, D2, D3, S1, T4, T6.

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AUTONOMOUS OPERATION 3

Edge AI for Autonomy Levels 1 and 2

Industry, especially producing and manufacturing enterprises should improve suitability for daily use of AI in general and especially edge AI supporting the autonomous operation at the currently up-to-date autonomy levels 1 and 2.

- **RIA and IA actions** would be appropriate in order (1) to better address user perspective, especially user needs and user friendliness (2) to achieve broad acceptance / adoption (3) to optimise the cost / benefit balance and (4) to improve regulatory or standardisation measures.

This topic is addressed in the opportunity referenced in 5E catalogue under T6.

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Transverse

AUTONOMOUS OPERATION 4

Centres for knowledge transfer

Research organisations, Academia, education and training centres should cooperate in establishing centres for knowledge transfer of best practice into all relevant sectors and domains, including the general public.
In parallel the establishment of Living Labs is necessary to provide manifold "test before invest" possibilities as already proven successfully in the pan-European DIH-network.

- **RIA, IA and CSA actions** would be appropriate, flanked by **public and private investments in infrastructure**
  The addressed stakeholders should proceed in close international cooperation, aligned with the objectives of the Horizon Europe and the Digital Europe Program, and based on additional Public-Private-Partnership.

This topic is addressed in the opportunity referenced in 5E catalogue under A1, C4, D2, D3, S1, T4, T6.

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FAQ on AUTONOMOUS OPERATIONS

AUTONOMOUS OPERATION FAQ

Is explainable AI included?

- Yes: recommendations #2 and #4 cover this important issue

Is power consumption of AI included?

- Not directly: #3 addresses the optimised cost / benefit ratio which might include reduced power consumption as one factor

Is the combination of data-driven modelling and physically based modelling included? (Hybrid modelling, meta-modelling)

- No: The 5E project concentrates on hardware issues

How to effectively address crucial issues such as regulatory, legal, ethical as well as acceptance of customers and insurance companies?

- These are main issues of recommendation #2 and also covered by #4

Are there on-going collaborations with application sectors (agriculture, space, health)?

- Yes: they are addressed by the 5E opportunities catalogue

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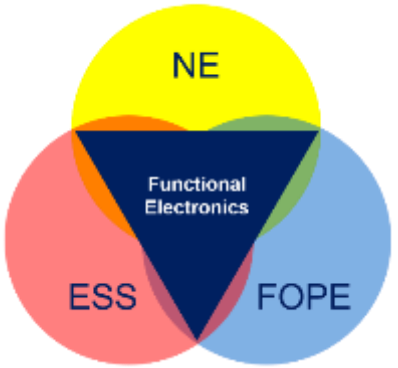
Sensing

Corné Rentrop, TNO

The Coordination and Support Action 5E has received fun
Community's Programme Horizon 2020 under GA Number: 825

Sensing the Future: Sensors Development and the Role of Advanced sensing solutions for the digitalisation of European industries and societies



Sensing Landscape

- Re-active towards pro-active
- Fast changing conditions
- Fast changing occurrences

Distributed Sensing

- High density monitoring
- Large area coverage
- Product integrated

Cross-Sectoral Application

- Safety
- IoT
- Urban monitoring
- Smart grid
- Infrastructure
- Self driving cars

Technical Challenges

- Beyond algorithms
- Reliable
- Accurate
- Situation based
- Awareness
- Long lifetime products
- Remote fatigue monitoring

Electronics Roadmap

- AI
- Big data
- Smart systems
- Sensor Swarms
- A trillion sensors

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SENSING THE FUTURE

❑ Issue

- Sensors are enablers for novel (IoT) products, new paradigms (Industry 4.0) and data driven (societal, AI) approaches
- Approaches often require « swarms » of connected devices of which manufacturing (speed, costs, reliability size) and functionality (5G, accuracy, sensing capacity, data points) is not trivial
- Convergence between other functionalities, such as actuating, signaling will define the usage. A critical aspect will be to ensure that the consumers trust can be maintained through transparent but strict privacy regulation.

❑ Need & Opportunity

- Electrification and digitation of cars with the help of sensor nodes
- Medical wearable and wellness products require sensors in new (on the body) form factors allowing home care and improved wellness for the aging society through big data
- Monitoring changing conditions and occurrences in real time will allow for proactive actions to be undertaken as a much larger scale than before
- Multiplexing systems able to simultaneously monitor numerous parameter in a single system enable augmented sensing through sensor fusion (IoT)

❑ Vision / Positioning

- **Sensors in self driving cars**
- **Sensors in medical applications**
- **Sensors to monitor fast changing conditions (smart cities)**
- **Sensors for IoT applications**

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Smart sensing systems to monitor fast changing conditions in self driving cars

SENSING 1

Next generation sensors need to be developed going beyond the sensing algorithm, including multi-model, AI, proximity. There are 2 major topics in this subject:

1. **Novel sensors that go beyond the algorithm of existing sensors. (TRL 3-5)**
2. **Upscaling and integrating novel sensors and adjust these to the automotive specifications. (TRL6-7)**

Research organisation, Academia, education and industry should for knowledge transfer of best practice into all relevant sectors and domains, including the general public. They should proceed in close **international cooperation**, aligned with the objectives of the Horizon Europe and the Digital Europe Program, and based on additional private investment.

Primary target:

- **For topic 1 (low TRL), can be addressed through Research and innovation actions (RIA)**
- **For topic 2 IA (high TRL) actions** would be appropriate

In order to **tackle technological challenges associated to designing upscaling and low TRL products and processes** to support this progressive substitution inside the **different classes of materials.**

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Environment monitoring sensing systems

SENSING 2

High density monitoring for fast changing conditions in situation based awareness (Big data sensing)

Sensor networks are set up including **large area monitoring** of e.g. weather conditions, air quality, in a very **detailed** matter. This is requiring sensors deployed in **large numbers (e.g. 1.000.000 sensors) and large area** (e.g. remote fatigue monitoring in hard to reach equipment). Both set ups require novel sensors and production methods thereof. Flexible electronics and smart systems can be the technologies to provide this.

RIA and IA actions would be appropriate in order to mobilise all necessary EU stakeholders to prepare the European manufacturing and sensor deployment.

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Sensors in Medical applications

SENSING 3

Beyond algorithms sensor development
(re-active towards pro-active, AI, product integration)

New sensors are needed to monitor persons health and support the transition from monitoring to prediction and prevention. Thereto on body sensors are needed that are either applied to the skin or integrated in wearables like clothing. The sensors need to be improved and standardised thus integrating these in existing products.

RIA and IA actions would be appropriate in order (1) to mobilise all necessary EU stakeholders to prepare the European manufacturing and (2) allow industrial uptake of developed technologies.

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Data acquiring sensors for IoT applications

SENSING 4

Large area, high density monitoring sensing platforms

New sensors are needed to monitor fast changing conditions, people management, crowd control etc. following e.g. the smart cities paradigm. These sensors are integrated in products that act in an autonomous matter, remote and hard to reach areas systems exploited in large numbers. The sensing systems are mutually connected forming sensor swarms requiring a new approach/ technology platform for data storage and communication.

Primary target:

- **For topic 1 (low TRL), can be addressed through Research and innovation actions (RIA)**
- **For topic 2 IA (high TRL) actions** would be appropriate

In order to **tackle technological challenges associated to designing upscaling and low TRL products and processes** to support this progressive substitution inside the **different classes of materials.**

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FAQ on SENSING

SENSING FAQ

Are issues such as data quality, data security and privacy addressed?

- Yes, certainly. Sensing and privacy / data-protection need to go hand-in-hand.

Only wearable sensors are mentioned, is it also valid for implantable sensing devices for medical applications?

- Yes, on and in the body

Are sensors for smart home / consumer applications included?

- Yes

Do you address the topic of power consumption of sensors?

- Not per-se in the sensing module, but in combination with the module dedicated to energy

Is AI at the edge in the sensors included?

- No

Are legal and ethical aspects of sensing covered, especially for medical?

- Yes, in combination with the privacy / security issues

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Workshop part & Discussion on Meta-Roadmap

All delegates

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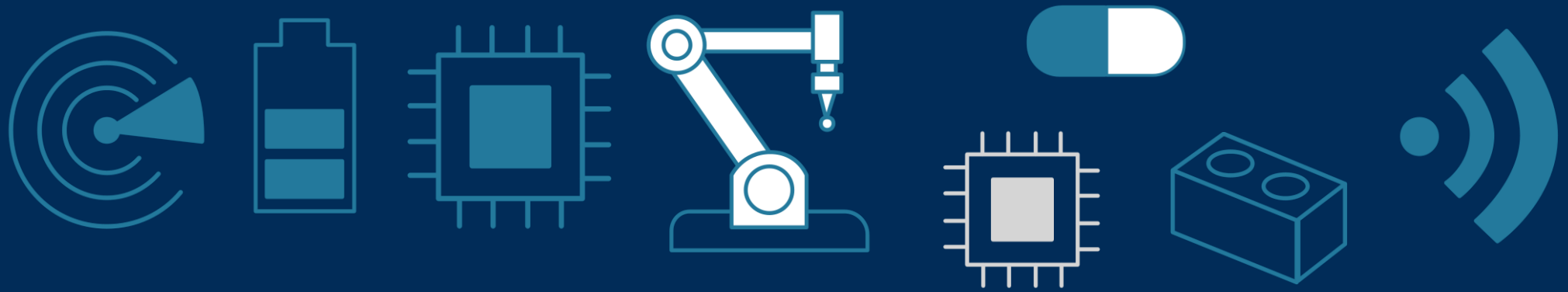
5E Digital Showcase Quiz

Serena Zerbinati, MESAP



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5E DIGITAL SHOWCASE

- Online platform to **increase visibility** of innovative European electronics products that combine → Nano-Electronics
  → Flexible, Organic & Printed Electronics
  → Electronic Smart Systems
- Registration opens door to the **5E Contest** and award ceremony
- Discover the Showcase at **https://5e-project.eu/showcase/**

NE ESS

GRIPHI GRIPPERS

Aerospace - IoT/Smart Connected Objects - Medical/Pharmaceutical/Life Science - Packaging/Logistics

FOPE ESS

MADRAS

IoT/Smart Connected Objects - Packaging/Logistics - Safety/Security

ESS

METIS

IoT/Smart Connected Objects - Safety/Security - Transport/Mobility/Automotive

FOPE ESS

PERSONAL ACTIVITY METER

Digital Manufacturing - IoT/Smart Connected Objects

FOPE ESS

ELASTIC WEARABLE ECG SKIN PATCH

IoT/Smart Connected Objects - Medical/Pharmaceutical/Life Science

FOPE ESS

SENSYS: THE ELECTROCHROMIC FISH

Digital Manufacturing - IoT/Smart Connected Objects

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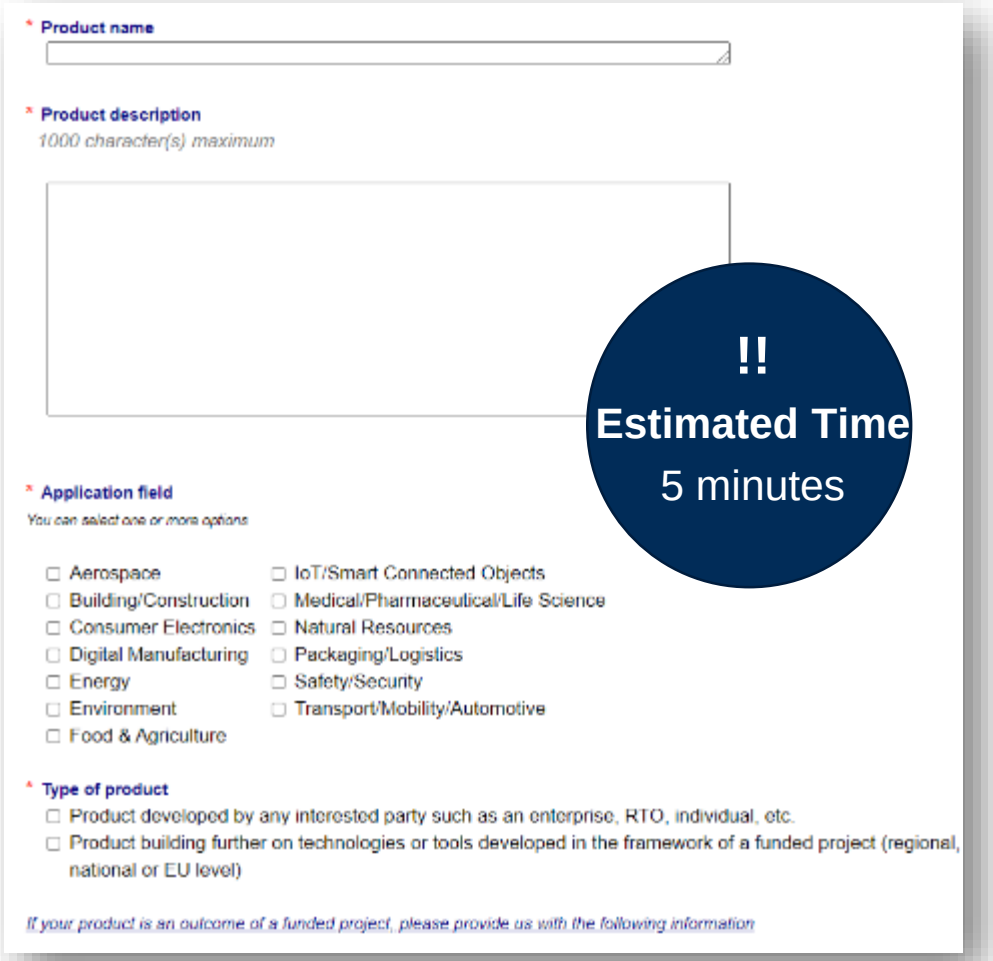
REGISTER FREE OF CHARGE

https://ec.europa.eu/eusurvey/runner/5Edigitalshowcase



* **Product name**

* **Product description**

1000 character(s) maximum

!!
Estimated Time
5 minutes

* **Application field**

You can select one or more options

- ☐ Aerospace
- ☐ Building/Construction
- ☐ Consumer Electronics
- ☐ Digital Manufacturing
- ☐ Energy
- ☐ Environment
- ☐ Food & Agriculture
- ☐ IoT/Smart Connected Objects
- ☐ Medical/Pharmaceutical/Life Science
- ☐ Natural Resources
- ☐ Packaging/Logistics
- ☐ Safety/Security
- ☐ Transport/Mobility/Automotive

* **Type of product**

- ☐ Product developed by any interested party such as an enterprise, RTO, individual, etc.
- ☐ Product building further on technologies or tools developed in the framework of a funded project (regional, national or EU level)

If your product is an outcome of a funded project, please provide us with the following information

PRODUCT CATEGORIES

1 **Product developed by any interested party**

enterprise, RTO, etc.

Owner: Adgenera Srl

Country: Italy

VISIT WEBSITE →

DISCOVER MORE

2 **Product developed in the framework of a funded project**

regional, national or EU level

AMANDA

The world in your hands

PRODUCT DEVELOPED IN THE FRAMEWORK OF A FUNDED PROJECT

Project Acronym and Title: AMANDA Project

Funding source: H2020

Grant Agreement Number or Funding reference: G.A. 825464

DISCOVER MORE

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Wrap-up & Closing of the Workshop

Petra Weiler, VDI/VDE-IT

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Further Reading & Contact

5E Website
https://5e-project.eu

Catalogue of 39 Opportunities
https://5e-project.eu/library/download-area/

Joint Vision
https://5e-project.eu/joint-vision/

Functional Electronics
https://5e-project.eu/functional-electronics/

Vision Papers
https://5e-project.eu/vision-papers/

Digital Showcase
https://5e-project.eu/showcase/

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THANK YOU

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