

# Chapter Long Term Vision

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*Strategic Research and  
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Aeneas

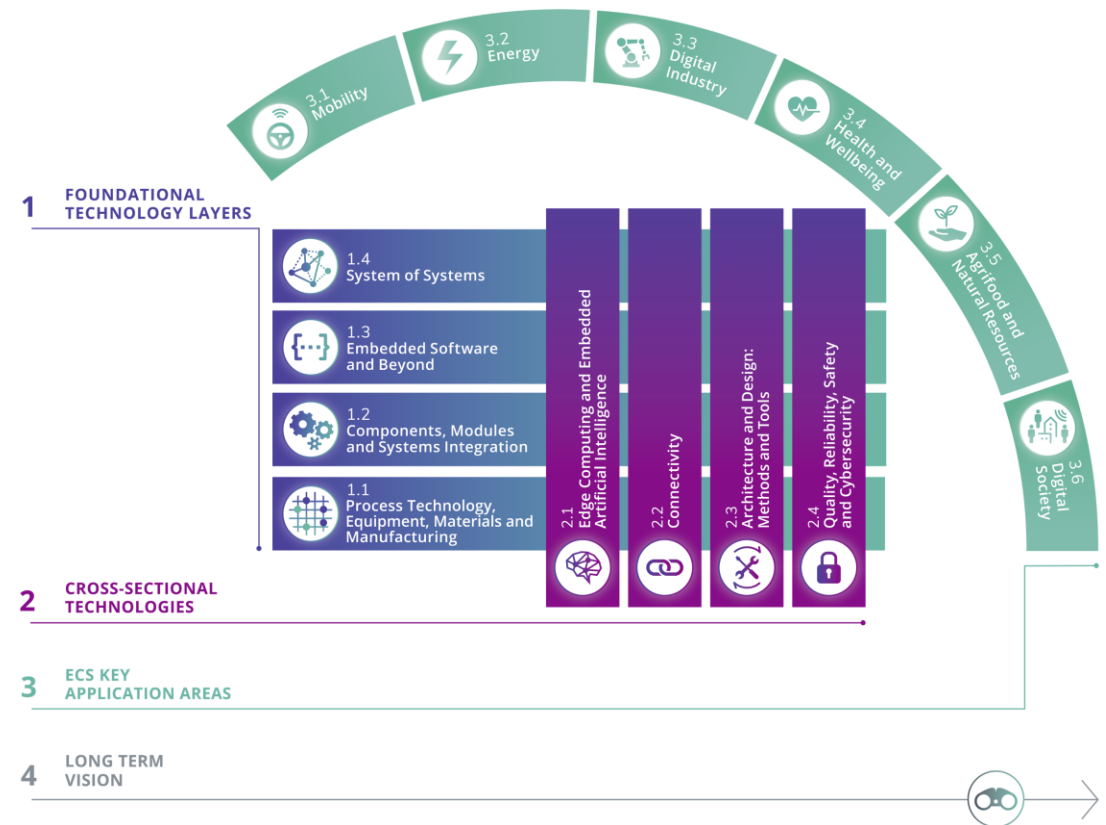


# Scope

- Identify the research subjects (now at low TRL) that need to be addressed in order to enable the realisation of the European industrial roadmap in the medium (5–10 years) and long term (>10 years)
- 3 time periods
  - Short term (2025–2029): The industry has a precise idea of what will be achieved during that timeframe
  - Medium term (2030–2034): There is still reasonably good knowledge of what can possibly be achieved
  - Long term (2035 and beyond): Expected achievements are more of a prospective nature

# Approach

- Common objectives
- Boost industrial competitiveness through interdisciplinary technology innovations
- Ensure EU digital autonomy through secure, safe and reliable ECS supporting key European application domains
- Establish and strengthen sustainable and resilient ECS value chains supporting the Green Deal
- Unleash the full potential of intelligent and autonomous ECS-based systems for the European digital era



# Major challenges

- Energy, power, water in chemical processes
- Recyclable devices
- Quantum (sensing, computing, industrialization)
- Distributed Intelligence (coherent with proposal in 3A workshop)
  - Includes "Distributed AI", "Embedded AI", etc.
- Connectivity
  - Information transfer, connectivity for system integration, security issues
- Autonomous Systems
- Resilient (Robotic) Applications
- Supply chain issues
- Sustainability
- Environmental aspects

# Technology long-term challenges/vision

- Process technology, equipment, materials and manufacturing
  - Low power, new materials, ultimate processing technologies, nanodevice architectures, advanced sensors, nanowires, NCFETs, TFETs, low voltage NEMS-FET, CNT-FETs
- Components, modules and systems integration
  - Diverse component integration (fast, efficient, robust), accommodate flexible/stretchable substrates/components, electronic/photonic integration, self-powering and energy harvesting, modelling and simulation, characterization and reliability, tools (3D place-and-route)
- Embedded software and beyond
  - Testing (model-based, fuzzing), verification, software engineering, short development cycle, maintenance, lifecycle management, extensibility, composability, interoperability, digital twins, quantum computing, approximate computing
- System of systems
  - Distributed AI, connected and interacting domains, predictability, controllability, monitoring, diagnosis, model-based engineering, automated and autonomous engineering, machine interpretable content

# Technology long-term challenges/vision

- Artificial intelligence, edge computing and advanced control
  - Accelerators, low power, quantum computing, biocomputing, device manufacturing, dynamically configurable systems, system architecture/interface discovery, self-\* systems, explainable AI, certifiable AI, AI-based embedded systems
- Connectivity
  - 5G/6G/..., dynamic configuration, SoS connectivity, virtual networks, dynamic networks, energy-efficiency
- Architecture and design: methods and tools
  - Hw/sw co-design, power-aware scheduling, AI/ML coprocessors, trusted platforms, ...
- Quality, reliability, safety and cybersecurity
  - Security/safety-by-design, runtime verification, security monitoring, model-checking methods, trusted platforms, ...

# Application evolution and long-term challenges

- Mobility
  - Electric mobility, H2-based mobility, synthetic fuel mobility, user-friendly secure and fast infrastructure, safe embedded software, software-enabled vehicles, IoV, vehicle component reliability/cost/safety, system complexity management, autonomous vehicles, mobility related sensors, reliable vehicle-to-cloud connectivity
- Energy
  - Energy generation/conversion/storage systems, flexible and reliable grids, HV transmission technologies, community/regional energy management, AI & cybersecurity for resilient energy systems, control and management of end-to-end systems
- Digital industry
  - Digital twins, continuous operation, runtime monitoring, life cycle assessment, predictive maintenance, advanced control, operative decision making, ...
- Health and wellbeing
  - Healthcare cost reduction, improving well-being diagnoses and therapies, real-time local disease detection, personalized treatment (medicine, etc.), medical data security/safety/privacy, health digital twins, organ-on-chip, 3D-bioprinting, cyborgisation
- Agrifood and natural resources
  - Food security, food safety, environmental protection and sustainable production, water management systems, biodiversity enablement and management
- Digital society
  - Ubiquitous connectivity, inclusion, continuous "online"

# Conclusions

- Looking to the future
- Materials, structures, components, architectures, system software, applications
- AI, edge computing, advanced control, connectivity, quality, security, safety, reliability, methods and tools
- Comprehensive approach
- Improved integration
- Open to suggestions, additions, edits