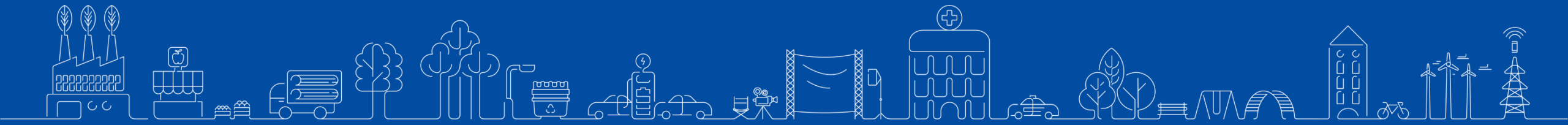
EIT DEEP TECH TALENTS FOR EUROPE INITIATIVE (DTTI)

EIT DEEP TECH DEFINITIONS

JANUARY 2023



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INTRODUCTION TO THE DEEP TECH TALENT INITIATIVE

The Deep Tech Talent Initiative is a pioneering programme that will skill one million people within deep tech fields over the next three years. Deep tech innovations – cutting-edge technology solutions combining fields of science and engineering in the physical, biological and digital spheres – are indispensable in creating solutions to the most pressing global challenges.

As Europe's largest innovation ecosystem, the EIT is best placed to mobilise its network of 3 400+ partners and 70+ hubs across Europe to develop state-of-the-art deep tech education programmes. The new initiative will not only ensure the development of a skilled labour force, but also the retention of high-growth companies active in the deep tech fields to maintain and expand their operations in Europe.

The Pledge of the Deep Tech Talent Initiative will serve as a vehicle to form the EIT deep tech partnerships with public and private organisations, industry representatives and champions, academia partners and education providers, Member States and other EU Agencies to support the development and roll out of associated training programmes committed to support the aim of the Deep Tech Talent Initiative.

https://www.eitdeeptechtalent.eu/the-initiative/

WHAT IS DEEP TECH?

Deep technology or **Deep Tech** is a classification of an institution, an organisation or a start-up company, with the expressed objective of providing advanced and emerging technology solutions to deep societal challenges. They present scientific or engineering challenges requiring lengthy research and development, and large capital investment before successful commercialization. Their primary risk is technical risk, while market risk is often significantly lower due to the clear potential value of solution to society. The underlying scientific or engineering problems being solved by deep tech companies generate valuable intellectual property and are hard to reproduce. Moreover, the solutions provided by deep technology and applications are critical for solving the complex global challenges that humanity faces, including climate change, sustainable energy or health.

https://www.eitdeeptechtalent.eu/the-pledge/what-is-deeptech/

DEEP TECH TECHNOLOGIES [REVISED]

In order to provide a simpler and more coherent classification of technologies for the benefit of EIT DTTI participants, we suggest revising the list as follows. Examples are shown in Part II of this presentation.

1. Advanced Computing / Quantum Computing
2. Advanced Manufacturing
3. Advanced Materials
4. Aerospace, Automotive and Remote Sensing
5. Artificial Intelligence and Machine Learning, including Big Data
6. Biotechnology and Life Sciences
7. Communications and Networks, including 5G
8. Cybersecurity and Data Protection
9. Electronics and Photonics
10. Internet of Things, W3C, Semantic Web
11. Robotics
12. Semiconductors (microchips)
13. Sustainable Energy and Clean Technologies
14. Virtual Reality, Augmented Reality, Metaverse
15. Web 3.0, including Blockchain, Distributed Ledgers, NFTs

THE DEEP TECH MATRIX

The following matrix illustrates the scope for Deep Tech course selection, where Deep Tech technologies are applied within Applications to Global Challenges. The are not prescriptive: further technologies and sectors can be defined as needed and agreed. There may be an overlap observed between technology areas and applications, which is understandable given their rapid development. This initial matrix correlates the sectors with the main focus of the EIT KICs.

	DeepTech Applications to Global Challenges									
DeepTech Technologies	EIT Climate	EIT Culture & Creativity	EIT Digital	EIT Energy	EIT Food	EIT Health	EIT Manu-facturing	EIT Raw Materials	EIT Urban Mobility	EIT Water
Advanced Computing / Quantum Computing										
Advanced Manufacturing										
Advanced Materials										
Aerospace, Automotive and Remote Sensing										
Artificial Intelligence, Machine Learning, Big Data										
Biotechnology and Life Sciences										
Communications and Networks, including 5G										
Cybersecurity and Data Protection										
Electronics and Photonics										
Internet of Things, W3C, Semantic Web										
Robotics										
Semiconductors (Microchips)										
Sustainable Energy and Clean Technologies										
Virtual Reality, Augmented Reality, Metaverse										
Web 3.0, Blockchain, Distributed Ledgers, NFTs										

ETHICS AND DEEPTECH

All education and training courses that will be selected for inclusion in DTTI should include a commitment to European values and ethics, and should not violate EU relevant policies.

For example:

- All big data, AI and other courses should respect the fundamental tenets of privacy, including ePrivacy and GDPR;
- All biotechnology and life science courses should respect ethical limits on use of human embryos;

The EIT will not support Deep Tech training courses which are directly related to and involve gambling, military technology, surveillance technology, tobacco, firearms or related areas.

All education and training courses must respect existing intellectual property rights and related patents and trademarks.

All education and training courses and participants must respect relevant sanctions notices.

Participants that have been found guilty of fraud, criminal activities, corruption, human rights abuses and equivalent crimes will not be eligible for involvement in DTTI.

TRANSVERSAL DIMENSIONS

In addition to the purely technological, scientific or sectoral priorities for Deep Tech, the EIT has identified three transversal dimensions for Deep Tech. These are innovation and entrepreneurship, gender and inclusion, and the Global Challenges / Sustainable Development Goals (SDGs). Education and training programmes which include these three dimensions within the Deep Tech space will be eligible for participation.

INNOVATION AND ENTREPRENEURSHIP

This dimension refers to programmes that address the risks of investing in disruptive innovation and entrepreneurship. This can be approached from multiple directions, ranging from education and training in terms of ideation, market validation and verification, business planning and financial forecasting, risk assessment, financing and more. In each case, these will only apply if there is a robust Deep Tech focus included.

GENDER AND INCLUSION

This dimension refers to the balanced integration of male and female scientists and researchers as well as innovators and entrepreneurs in Deep Tech. It also refers to other forms of inclusion, e.g. youth, disadvantaged groups, minorities and related groups. Specific aspects of EIT DTTI are open to participation by youth at the secondary level, for example Girls go Circular, while other related initiatives, for example in womens' entrepreneurship, will also be included.

GLOBAL CHALLENGES / SDGs

The European Union is committed to addressing the Global Challenges expressed as the four broad Sustainability Development Goals: People, Planet, Prosperity and Partnership. These priorities form an integral part of the EIT DTTI. Education and training projects which address these goals are eligible for inclusion as long as there is a strong Deep Tech focus on included.

DEEP TECH COURSES BY EDUCATIONAL LEVEL

In addition to the complexity of describing Deep Tech by technology and sector, it is important to differentiate the educational level. The EIT DTTI Flagship addresses younger demographics (secondary levels); as well as tertiary education and continuing / professional education. Any Deep Tech course matching these criteria operating as of 01 January 2023 is eligible for inclusion in DTTI.

Tertiary Education Level (Degrees): EQF Levels 6-8 | **Continuing / Professional Education & Skills (hybrid or online learning)**

(2 ETCS or equivalent minimum)

DeepTech Degree/Course Specialisation (e.g. Artificial Intelligence)
DeepTech Transversal Specialisation (e.g. Innovation)
DeepTech Specialist Knowledge (e.g. Python, ML Studio)
DeepTech Foundation Knowledge (e.g. data science)

Secondary Education Level (In-School): EQF Levels 3-5

(1 ECTS equivalent minimum)

DeepTech Concept Intro (e.g. Intro to VR)	DeepTech Foundation Skills (e.g. php, SQL)	DeepTech Technical Skills (e.g. R, Python)	Digital Entrepreurial Skills (e.g. Girls go Circular)

Societal Challenges

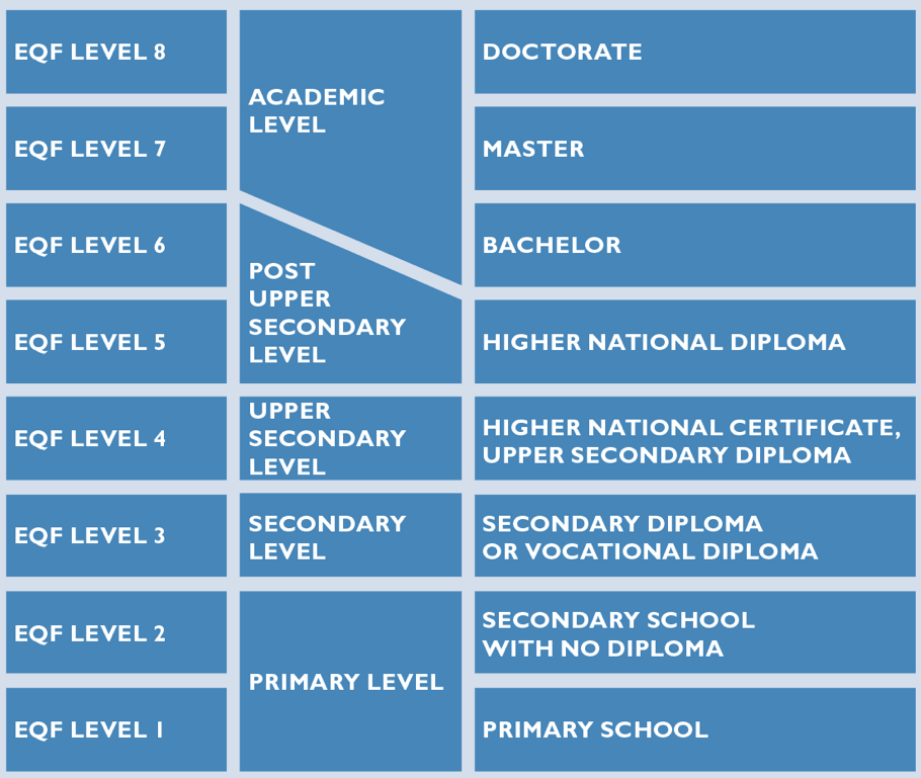
SAMPLE COURSE TYPES: ARTIFICIAL INTELLIGENCE

In the AI field, an example of course eligibility at different levels can be seen below. At the tertiary or continuing professional level, a Foundational Course for AI would present the theoretical as well as applied knowledge that is a key precursor for an Artificial Intelligence degree or certificate. A specialisation course would comprise a deep dive into a technological programme, application or methodology that is within the AI specialisation, for example, using Google Data Studio. These can be offered as part of a degree programmes or part of (or the sole focus of) certificate programmes.

PART OF A DEGREE PROGRAMME		PART OF OR FOCUS OF A CERTIFICATE PROGRAMME	
TensorFlow	Google Data Studio	AI Solutions for Language Interpretation	SPECIALISATION COURSE
Cognitive Theory	Sensoring & Analytics	Data Analytics using Python	FOUNDATIONAL COURSE
Innovation & Entrepreneurship in AI			TRANSVERSAL COURSE

TERTIARY OR CONTINUING PROFESSIONAL EDUCATIONAL LEVEL

COURSES BY EDUCATIONAL LEVEL: EQF



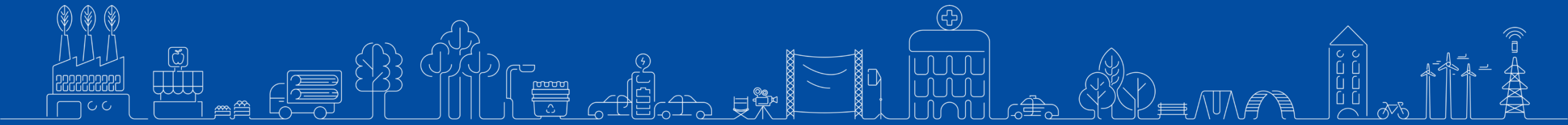
https://www.maintworld.com/R-D/Application-of-European-Qualification-Framework-EQF-in-Maintenance

As a reference to EQF, it is useful to consult this image (from Maintenance World), which illustrates the relationship between EQF Levels and degree programmes.

EIT DEEP TECH TALENTS FOR EUROPE INITIATIVE (DTTI)

DETAILED DEEP TECH DEFINITIONS BY TECHNOLOGY

JANUARY 2023



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ADVANCED COMPUTING / QUANTUM COMPUTING

These technologies refer to advances in high performance computing technology to deal with challenges of speed and scale of data processing and operations. This technological area is also linked to Semiconductors, as well as to the massive increase in Big Data generated by IoT, 5G, and other operations. An indicative list of technologies in this area includes:

- Quantum Computing: Using subatomic particles (electrons, photons) and qbits to store and process information in a multidimensional state. Technological applications here include fundamental research in quantum computing, including superposition, coherence and entanglement; prototype development; applied research in sectors such as climate, healthcare; and other technologies.

- Edge Computing: Processing and analyzing data closer to the point of generation. Technological areas include methods of storing and processing data; data fusion from a large number of sensors and/or high data streams; predictive analytics; solving latency and bandwidth issues, and others. Applications include managing and utilizing data streams from IoT sensors in manufacturing or energy; financial data from trading or banking; retail; and others.

- Cloud Computing: Technologies to improve the processing speed, security and performance of data operations hosted on the internet. The technologies included here include research and optimisation of hardware and software, data storage, network speed and security, databases, analytics, and intelligence, as well as other issues.

- Other Technologies: Other research and innovation into novel computer architectures, computer systems and languages, software and software issues (runtimes, energy, etc.), next-generation high performance computing, and more.

ADVANCED MANUFACTURING

The technologies in this area are diverse and include, but are not limited to, the following categories. There are also overlaps with other technologies listed separately, including Robotics, AI/ML; VR/AR; 5G; Digital Twins; Robotics; Edge Computing and more:

- Industry 4.0: Emerging technologies located at the intersection of robotics, artificial intelligence, biotechnology, IoT, 5G, 3D printing, nanotechnology, advanced computing and more.
- Robotics: Automation at the industrial level, including robots and cobots deployed around a range of industrial and related applications; robotic swarms; factory floor innovation; AI/ML; IoT; and more.
- Rapid Prototyping: This includes 3D and 4D printing; industrial 3D printing; and related areas.
- Circular Manufacturing: Technologies and solutions for green manufacturing; recycling; repurposing; energy efficiency; and low-carbon emissions in industry and manufacturing.
- Digital Twins: Application of digital technology to mirroring and modelling manufacturing workflow and productivity.
- IoT and Sensoring: Application of Internet of Things, data fusion and sensoring for manufacturing workflow as well as durability, traceability, performance, quality systems and more.

ADVANCED MATERIALS

The research, development, engineering and production of advanced materials with engineered properties, including ceramics, high value-added metals, electronic materials, composites, polymers, and biomaterials. The technologies are diverse and include the following:

- Polymers: Including polymeric membranes with specific functions such as gas separation, reverse osmosis, nanofiltration, ultrafiltration, microfiltration, pervaporation; applications in smartphones, medical devices, etc.
- Nanostructure Advanced Materials: Including carbon and other composites, carbon tubes, etc.
- Synthetic Fabrics and Wearable Technology: Engineering and production of intelligent or smart fabrics with technological functions, thermal or water-resistant properties, and other functions.
- High Value-Added Metals and Materials: Metals and other substances with specific properties, including high resistance, enhanced conductivity and others, often applied to extreme environments such as space, subsurface exploration, and others. These include ceramics, cermet, cubic boron nitride, diamond and other tool materials.
- Biomaterials: Biological or synthetic substances engineered for use in medicine or biological function.
- Other Innovative Materials: These include composites, polymers, enhanced wood-based products, etc.

AEROSPACE, AUTOMOTIVE & REMOTE SENSING

This technological area focusses on new methods of transport and mobility and space technology as well as the sensoring, data and telecommunications processing systems required for successful innovation. These include, but are not limited to:

- Automotive Technology: Innovations in driverless vehicles; sensoring and AI systems for driverless vehicles; clean energy / alternative energy; decarbonisation; new energy storage systems; intelligent transport applications for cities; new materials; other transport solutions.

- Aviation Technology: Innovations in new aviation systems, including drones, self-piloting vehicles, vertical take-off and landing craft; clean energy for aviation; decarbonisation; data fusion and AI in aviation platforms; new materials; other aviation transport solutions.

- Space Technology: New forms of satellite or spacecraft technologies; micro-satellites; new methods for satellite launch and recovery; space-based remote sensing; methods for managing space debris; new materials; application of gases and cryogenic technology to electronics, circuits and semiconductors for use in space; space exploration and more.

- Sensoring and Data: Advanced methods in sensoring, data collection and decision-making; laser- or camera-based systems; AI applications in transport; image enhancement, recognition and interpretation.

ARTIFICIAL INTELLIGENCE / MACHINE LEARNING

This technological areas focusses on the interaction between data science, Big Data and data mining as well as the methods used to process data via algorithms and other learning methods into specific use cases. Examples include, but are not limited to:

- Big Data: The collection, storage, processing / cleaning and analytics of large quantities of data collected from large-scale transactions (for example, in retail or financial sectors); data collected from IoT sensors; or other applications.
- Data Mining: Processing large volumes of data to identify data anomalies, patterns, and correlations in order to predict outcomes.
- Machine Learning: Learning algorithms developed and applied to data based on supervised, unsupervised or reinforced learning; computational statistics; neural networks; and technologies or prototypes that derive from this.
- Artificial Intelligence: Utilising algorithms simulating human intelligence for natural language processing, data analytics, expert systems, machine vision, creativity, image rendering, gaming and a wide variety of other technological applications.

Deep Tech applications here include fundamental or applied research as well as solutions or prototypes involving pattern recognition, algorithmic learning, automation, predictive analytics, voice recognition, language and learning issues, and more.

BIOTECHNOLOGY AND LIFE SCIENCES

Biotechnology and life sciences represents cutting edge Deep Tech technology in terms of natural and synthetic materials and research, including genetic therapies and digital technologies. A list of non-exclusive examples includes:

- Data intensive science; health bioinformatics;
- Advanced clinical research;
- Cellular and gene analysis, research and therapies;
- Biosimilars; biomanufacturing; public procurement and related areas;
- Patient health tracking and biodata; improved use of medical data;
- Improving medical and pharmaceutical delivery systems using data and technology; precision medicine;
- Minimally-invasive surgery; nanotechnology in medtech;
- Engineering and improving medical implants, including health bioinformation; neural implants;
- Circular bioeconomy; including organic recycling solutions for plastic and other materials;
- Open source medical innovation;
- Solutions for the agri-tech food chain and human health impacts (see also Agrifood);

All technologies and training must respect European ethical guidelines for the use of human embryos, stem cells, clinical testing and equivalent protocols.

COMMUNICATIONS & NETWORKING TECHNOLOGIES

Communications and connectivity in terms of Deep Tech refers to research and innovation in areas such as the following:

- 5G / 6G Networks: High speed / high capacity telecom data transmission networks capable of handing massive data loads through video or AR transmission or edge computing; lower latencies.
- Other Communications Technologies: Advances in high-bandwidth communications, including fiber optics, laser-based systems, microwave technologies, radio frequency spectrum management, and more.
- Navigation Systems: Development of navigation systems, ranging from inertial navigation to new or enhanced standards in satellite navigation; underwater navigation systems; marine navigation.
- Telematics and Materials: Smart antennas; distributed antenna systems; signal boosting technologies; circuit board technologies; vehicle-to-vehicle communications, power amplifiers; phased array systems; and more.
- Communications Security: Development of new forms of communications security, including encryption keys, quantum keys and more; intrusion testing and cybersecurity; radio emissions monitoring; and more.

CYBERSECURITY AND DATA PROTECTION

This area focusses on the application of Deep Tech technologies to network and data security and protection. This includes the trustworthiness and certification of ICT products:

- Internet of Things (IoT) and 5G: Assuring the safety and proper functioning of IoT devices and data; communications systems and networks and other critical infrastructure;
- Machine Learning (ML) and Artificial Intelligence (AI): Deploying ML and AI for encryption, intrusion detection, data security and related applications;
- Encryption Systems and Methods: Developing and testing new forms of encryption as well as encryption-breaking software; use of quantum computing keys; etc.
- Intrusion Detection Systems and Methods: Technologies and methods for signature-based; anomaly-based; hybrid intrusion detection; and other emerging solutions.
- Privacy-Enhancing Technologies and Methods: Including GDPR and ePrivacy applications.

ELECTRONICS & PHOTONICS

The Deep Tech technological dimension of electronics and photonics typically refers to technology used in Quantum Computing as well as Semiconductor manufacturing. There are a wide range of technological applications that include, but are not limited to:

- Quantum Computing: Using subatomic particles (electrons, photons) and qbits to store and process information in a multidimensional state; development of multidimensional components for quantum computing arrays and technologies.

- Microelectronics / Circuit Board Engineering: Continual innovation in advanced circuit board engineering and manufacturing to achieve better outcomes in terms of processing capacity, memory, and speed; application of cryogenic technologies, high purity gases and advanced materials and methods to production; application of nanomaterials and nano-dimension technologies to circuit boards and semiconductors; complex 3D memory structures; and more.

- Photonic Engineering: Continual innovation in technologies including hardware and software ranging from laser systems and sensors; scanning and imaging systems; communication and data transmission; screens and displays; lighting; photovoltaic energy production and energy distribution; and others.

- Haptic, AI and VR/AR Engineering: Using haptic engineering, Artificial Intelligence, VR/AR and other technologies to support electronic and photonic engineering on a micro-scale or in a safe environment.

- Power Management: Continual innovation in terms of power requirements needed by electronics, photonics and associated hardware.

INTERNET OF THINGS (IOT) – W3C – SEMANTIC WEB

This Deep Tech technological area focusses on the physical and network systems for Internet of Things; the communications protocols and data structure for embedded and interconnected devices and systems. There are a wide range of technologies that include:

- Internet of Things: Connected / intelligent devices that are capable of data communication and sensoring within a specific communications protocol. IoT-enabled devices and systems.
- Communications Protocols for IoT: The communications protocols needed for communications interoperability and common standards, including Bluetooth, 5G, Matter, Thread and others.
- Mesh Computing / Distributed Computing / Embedded Systems: Development of wireless and wired mesh communications networks; computing using distributed problem-solving and messaging; use of embedded systems for sensoring or digital signal processing, GPS, etc.
- Automation and Sensoring: Engineering and deploying sensoring systems in a home/office environment or an industrial environment for enhanced control of various functions, including building automation.
- W3C / Semantic Web: Systems for classifying internet data and devices, including W3C and machine-readable internet data.

ROBOTICS

Robotics includes development of hardware and software solutions for process and machine automation. A non-exclusive list of technologies includes the following:

- Robotic Process Automation (RPA): Research and innovation into intelligent automation of human tasks, often interpreted through software usage or software business processes and logic.

- Factory Robots / Cobots: Research and development into functional robots / cobots designed to automate and implement a range of repetitive or generic tasks ranging from welding and assembly to warehouse storage tasks to transport to mining and energy and other functions;

- Humanoid/Artificial Intelligence Robot/Cobot: Development of humanoid or similar robots / cobots with full or partial artificial intelligence and movement which are intended for more complex service or manufacturing tasks which require problem solving or decision-making; technological development of vision, object recognition, touch, grip, mobility, navigation, reasoning, task implementation and more.

- Drones and Transport Solutions: Innovation in the field of transport robotics, including drones; fully-autonomous vehicles; underwater vehicles; aerial vehicles; other automated delivery options either within a single building environment or over longer distances.

SEMICONDUCTORS

In addition to the scientific frontiers of semiconductor research, recent policy concert re-onshoring or security of supply of semiconductor production. Deep Tech areas of interest include, but are not limited to:

- Advanced Microchip Manufacturing Methods: Addressing the challenges of miniaturisation and Moore's Law; Next Generation Manufacturing; additive processes; development of nano-scale chip development; approaching the 3-5 nm frontier; lithography; epitaxy / heteroepitaxy and multidimensional substrates and materials; new materials and composites; cryogenic cooling and/or helium and other gases.
- Other Microchip Applications: Focus on mobile communications chips; gaming; optoelectronic integration including sensoring systems, encryption and security; survivability in harsh environments.
- Non-Conventional Computing Systems and Semiconductors: Developing highly parallel computing / distributed computing, swarm platforms, spin-based memory and computation, quantum architecture and more.
- Haptic, AI and VR/AR Engineering: Using haptic engineering, Artificial Intelligence, VR/AR and other technologies to support electronic and photonic engineering and production at the micro-scale or in a simulation environment.
- Power Management: Continual innovation in terms of power requirements needed by semiconductors and associated hardware.
- Environmental Health and Safety / Circularity: Assuring best practise in occupational health and safety and circularity of production.

SUSTAINABLE ENERGY AND CLEAN TECH

This subject encompasses a number of technological fields and applications; the following subjects are not exclusive:

- New Energy Production Technologies: Focus on fusion technologies, hydrogen fuel cells, electrolysers, and related technologies.
- Advanced Renewable Energy Systems: Focus on breakthrough technologies and innovation in photovoltaics (including energy conversion rates, solar cell lifecycles, new materials); wind energy (including blade design); hydro and related fields;
- Energy Storage System Innovation: Focus on lithium-ion and other battery technologies needed for energy storage; additional solutions for intermittence in renewable energy production.
- Advanced Energy Efficiency Systems: Focus on new materials, building / energy control, and related innovation.
- Sustainability and Cleantech Solutions: Including circular economy applications, sensoring, big data, data fusion, automation, etc.
- Climate Change and Decarbonisation Solutions: This includes CO_2 emissions reduction and management; carbon capture, tracking, trading and reduction, including carbon upcycling technologies as well as innovations designed to help policy objectives;
- Energy Supply / Demand / Distribution Forecasting and Optimisation: Focus on improving energy losses, overproduction, black-outs, transmission supply growth and other key challenges by using AI, Big Data, advanced materials, and others.

VIRTUAL REALITY, AUGMENTED REALITY, METAVERSE

This technological area focusses on the creation and application of digital information and content, either in a partial or fully-immersive environment. Examples include, but are not limited to:

- Augmented Reality: Deploying digital information in a real-world visual and data context, using multimedia and 3-D modelling, real-time tracking, intelligent interaction, data sensing and additional technologies. Applications are widespread and include learning and education, manufacturing support, gaming and more. Interaction takes place through smartphones; wearables (such as glasses); smartphones; helmets / head-up displays; and other media.
- Virtual Reality: Development and use of fully digital virtual environments where interaction takes place through virtual headsets or equivalent devices. Technologies include those from AR as well as gyroscopes and motion sensors for tracking eye, head, hand and body positions; HD screens; sound integration; haptic integration; and others. A key issue is the speed, weight and duration of the computer processors used to drive the interaction.
- Metaverse: Development of either a single, global virtual environment or walled variations of this (e.g. Facebook-Meta), where immersive, 3D virtual spaces drive human interaction, commerce and experience.
- Other Advanced Digital Applications and Hardware: This can include the engineering and use of digital twins or high fidelity digital simulations and models; wearable technologies; HD screens; haptic sensors such as gloves; head-up displays (HUD) and more.

WEB 3.0, BLOCKCHAIN, DISTRIBUTED LEDGERs, NFTs

This technological area focusses on Web 3.0 applications insofar as these relate to solving a major societal challenge. Examples include, but are not limited to:

- Web 3.0: Third generation internet with a focus on decentralisation, artificial intelligence, blockchain and related utilities, including token-based economics and other systems of decentralised finance.
- Blockchain: Development and application of highly distributed, public/private ledger of records (blocks) that facilitate transactions, ownership or other functions. Different versions of distributed ledger systems and technologies can be involved in DTTI. Applications such as digital ownership and traceability, carbon emission issue and trading, various ownership rights and other use cases can be explored via DTTI.
- NFT: Development or application of non-fungible tokens, unique digital identifiers on a blockchain.