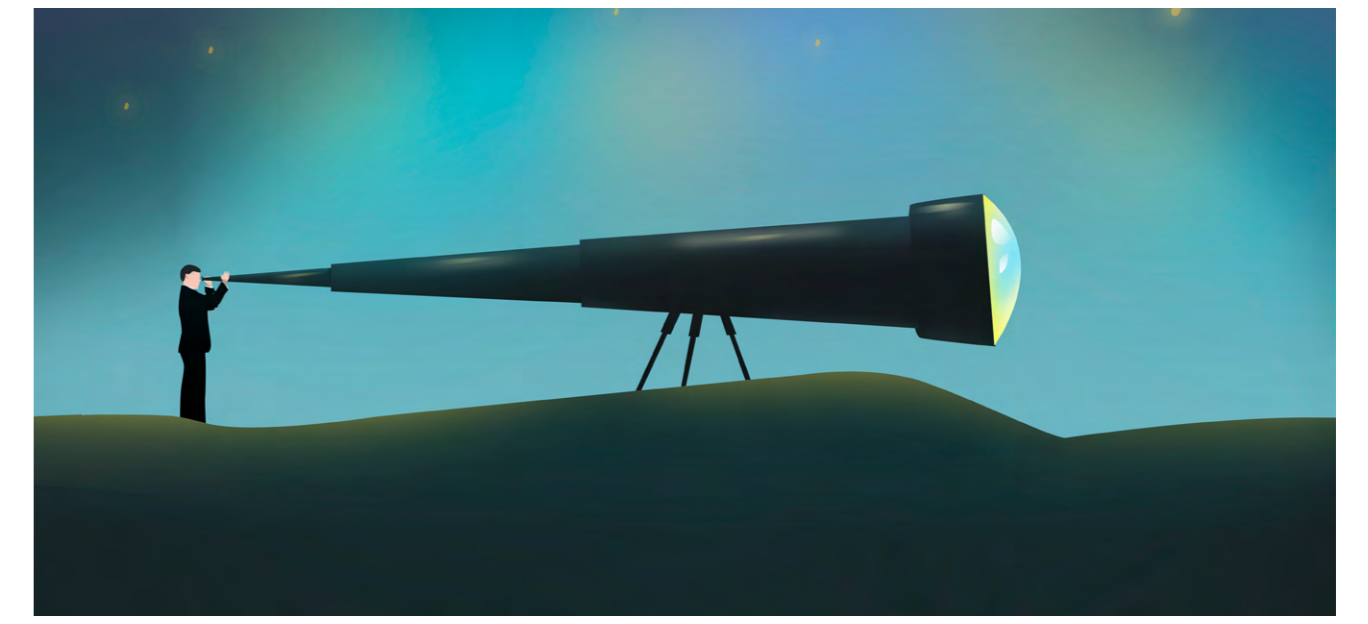


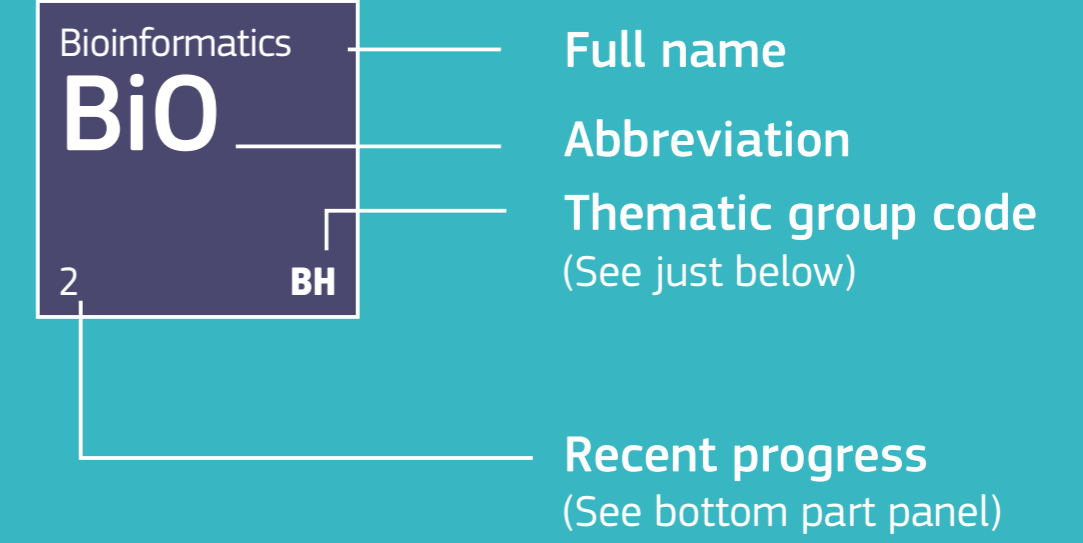
# TABLE OF RADICAL INNOVATIONS BREAKTHROUGHS

A dashboard of 100 emerging developments offering strong impact on global value creation and potential solutions to societal needs

										Underwater living <b>UL</b> 86 BR												Harvesting methane hydrate <b>HmH</b> 87 EC	
												Marine and tidal power <b>MtP</b> 81 EN		3D Printing of food <b>3DF</b> 82 PM		Bioplastic <b>BiPl</b> 83 BR		Chatbots <b>CB</b> 84 AI		Lab-On-A-Chip <b>LoC</b> 85 BH			
Artificial photosynthesis <b>AP</b> 74 EN				Geoengineering: landscapes <b>Geo</b> 75 BR				Microbiome <b>Mic</b> 76 BM		Splitting carbon dioxide <b>ScD</b> 77 BR		Quantum cryptography <b>QCr</b> 78 EC				Driverless <b>DrL</b> 79 AI		Neuromorphic chip <b>NmC</b> 80 HM					
Spintronics <b>SpT</b> 64 EC		Humanoids <b>Hu</b> 65 AI		High-precision clock <b>HpC</b> 66 EC		Holograms <b>Ho</b> 67 AI		Brain machine interface <b>BMI</b> 68 HM		Drug delivery <b>DD</b> 69 BM		Regenerative medicine <b>RM</b> 70 BM		Precision farming <b>PF</b> 71 AI		Blockchain <b>BC</b> 72 AI		Gene editing <b>GE</b> 73 BM					
Aluminium-based energy <b>Ae</b> 54 EM		3D Printing of glass <b>3DG</b> 55 PM		Microbial fuel cells <b>MfC</b> 56 EN		Smart tattoos <b>ST</b> 57 HM		Self-healing materials <b>ShM</b> 58 PM		Carbon capture & sequestration <b>CCS</b> 59 BR		Molecular recognition <b>MR</b> 60 BH		Touchless gesture recognition <b>TG</b> 61 AI		Hyperspectral imaging <b>Hypl</b> 62 AI		Speech recognition <b>SpR</b> 63 AI					
Airborne wind turbine <b>AW</b> 44 EN		Control of gene expression <b>CGE</b> 45 PM		Antibiotic Susceptibility <b>ASu</b> 46 BM		Desalination <b>Ds</b> 47 BR		Soft robots <b>SR</b> 48 AI		Quantum computers <b>QuC</b> 49 EC		3D Printing of Large Objects <b>3DL</b> 50 PM		Emotion recognition <b>ER</b> 51 HM		Biodegradable sensors <b>BiS</b> 52 BH		Swarm Intelligence <b>SIn</b> 53 AI					
Plant communication <b>PC</b> 34 BH		Bioelectronics <b>BiE</b> 35 BH		Neuroscience of creativity <b>NsC</b> 36 AI		Brain function mapping <b>BF</b> 37 HM		Metamaterials <b>Mm</b> 38 PM		Disaster preparedness <b>Dp</b> 39 BR		Artificial intelligence <b>AI</b> 40 AI		Computational creativity <b>Cc</b> 41 AI		Augmented reality <b>AR</b> 42 AI		Exoskeleton <b>Ex</b> 43 AI					
Asteroid mining <b>AM</b> 26 BR				Plastic eating <b>PE</b> 27 BR		Bionics (medicine) <b>BiN</b> 28 HM		Epigenetic change <b>Ec</b> 29 BM		Carbon Nanotubes <b>Cn</b> 30 EC		Smart windows <b>SW</b> 31 EN		Wastewater nutrient <b>Ww</b> 32 BR				Flexible electronics <b>FE</b> 33 EC					
Artificial synapse/ brain <b>AsB</b> 17 HM		Targeting cell death pathways <b>TcD</b> 18 BM		2D Materials <b>2DM</b> 19 PM		Hyperloop <b>HyL</b> 20 BR		Hydrogels <b>Hy</b> 21 PM		Water splitting <b>WS</b> 22 EN		Nanowires <b>NW</b> 23 EC		Warfare drones <b>WD</b> 24 AI				Nano-LEDs <b>NL</b> 25 EC					
Flying car <b>FC</b> 9 AI		Hydrogen fuel <b>HyF</b> 10 EN		Bioprinting <b>BiPr</b> 11 BM		Graphene transistors <b>GT</b> 12 EC		Optoelectronic <b>OE</b> 13 EC		4D Printing <b>4DP</b> 14 PM		Genomic vaccines <b>GV</b> 15 BM		Gene therapy <b>GeT</b> 16 BM									
Bioinformatics <b>BiO</b> 2 BH		Molten salt reactors <b>MsR</b> 3 EC		Reprogrammed human cells <b>RhC</b> 4 BM		Thermoelectric paint <b>TP*</b> 5 EN		Energy harvesting <b>EH</b> 6 EN				Computing memory <b>CM</b> 7 EC		Automated indoor farming <b>AiF</b> 8 AI									
														Bio-luminescence <b>Bil</b> 1 EN									



## HOW TO READ ENTRIES



## THEMATIC GROUPS

- AI** Artificial Intelligence and Robots
- HM** Human-Machine Interaction & Biomimetics
- EC** Electronics & Computing
- BH** Biohybrids
- BM** Biomedicine
- PM** Printing & Materials
- BR** Breaking Resource Boundaries
- EN** Energy
- SI** Social Innovations

## LIKEHOOD OF SIGNIFICANT USE / EXPANSION BY 2038 → STRONG

Local food circles <b>Lf</b> 88 SI	Basic income <b>BI</b> 89 SI	Owning & sharing health data <b>Osh</b> 90 SI	New journalist networks <b>Nj</b> 91 SI	Alternative currency <b>AC</b> 92 SI	Life caching <b>LC</b> 93 SI	Car-free city <b>CF</b> 94 SI	R/W culture diversifying <b>RwC</b> 95 SI	Access/commons economy <b>AE</b> 96 SI	Reinventing education <b>Re</b> 97 SI	Collaborative R&I spaces <b>CS</b> 98 SI	Body 2.0 & the quantified self <b>B2</b> 99 SI	Gamification <b>Gm</b> 100 SI
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- 1 Glowing plants, Visualization of gene expression
- 2 Biohybrid
- 3 Waste-burning with lithiumfluoride/thoriumfluoride material, Collaborative efforts in Canada, Prototypes in China
- 4 Destruction of cancer cells, Macrophages to kill the Tuberculosis pathogen
- 5 (\*No value for European position) - Thermoelectric paint, Harvest of electricity from waste heat
- 6 Biological motion, Other sources (wind, heat, radio, chemical)
- 7 In-memory algorithms, Faster phase-shifting computer memory
- 8 Techno farming in extreme conditions
- 9 Personal autonomous drones and rockets, Coordinated flying taxi services
- 10 Production, Storage, Hydrogen-powered vehicles
- 11 Bones, tissue, skin, blood vessels and other human parts, 3D-printed models
- 12 Microprocessors, Neuromorphic chips, Next-generation electronics
- 13 Optical computing, 5D optical data storage, Photonic chips
- 14 Exposure to heat, Water contact
- 15 Clinical trials, DNA vaccines for animals, Better delivery pathways
- 16 Disease areas, Treatments
- 17 Atomistors, ENODE, Junction-based artificial synaptic device, epiRAM
- 18 Targeting new pathways to trigger cell death
- 19 2D Semiconductors, 2D Magnets, Black phosphorous ink
- 20 Section of Hyperloop Track finalised in NL, Further tests under way at several sites
- 21 Regenerative medicine, Soft robots, Biothreat detection devices, Optogenetics
- 22 New Catalysts, Fertilizers
- 23 Batteries, Nanosensors, Electrochromic devices, FET, Heat dissipators
- 24 Intelligence, Fuel autonomy, Microdrones, Defense against drones
- 25 Multitasking LED displays, Deep UVC, Optical Data Communication
- 26 Asteroid detection, Examination and mining technologies
- 27 Plastic-colonizing fungi, Micro-to-macro: plastic-munching worms
- 28 Exoskeleton, Upper limbs, Internal organs
- 29 Epigenetic technologies for diagnosis and other technologies
- 30 Nanotubes with fullerenes, On-chip light sources, Liquid biopsy chip
- 31 Electrochromic materials, Liquid crystal sandwich, Nanocrystals
- 32 Nutrient recovery from wastewater, Biological phosphate removal
- 33 Transistors, Displays, Energy storage, Sensors, Health monitoring, 3D printing
- 34 Senses of plants, Parasites involved in plant communication
- 35 Biochip, Biological computer, Biological computer parts, Bio interface
- 36 Testing and Influencing imagination and creativity
- 37 Brain electrical activity and biomarker mapping, Improving cognitive functions
- 38 Cloaking devices, Photovoltaic devices, Medical imaging
- 39 Submarine (smart-)cable network, Robots & AI emergency response
- 40 Duelling Networks, Capsule Networks, One Shot Image Recognition
- 41 Computational Creativity
- 42 Synchronization with the physical world, Live instructions, Therapy
- 43 Medical applications, Military applications, Industrial applications
- 44 Ground- and flying Generator Airborne Energy Systems
- 45 Epitranscriptomics, Embryo development
- 46 AST Micro-assay, Lab-on-a-Stick, Microfluidic devices, AST Gadget
- 47 Nanofiltration, New distillation solutions
- 48 Pneumatic, Living muscle tissue, Hydrogel, Mechanical
- 49 Quantum systems, Quasiparticle control
- 50 Energy: 3D-printed turbine prototype, 3D-printing robots for building
- 51 Interpreting facial expressions and text, voice, heartbeat, breathing
- 52 Medical uses, Food/medication tracking, Environmental sensing
- 53 The Swarm-Organ project, Unmanned Aerial Vehicles
- 54 Aluminium-ion batteries, Aluminium-air batteries
- 55 Fused filament fabrication, Stereolithography
- 56 New catalysts, Cheap material for electrodes, Wearable energy devices
- 57 Medical technologies, Environmental monitoring, Marketing
- 58 Civil engineering, Protective clothing, Energy storage, Soft robotics
- 59 Exploring new storage solutions, New uses for CO<sub>2</sub>
- 60 Portable diagnostic devices, Electrodiagnosis, Screening (medicine)
- 61 Ultrasonic gesture sensing, Optical cameras and sensors, Gesture decoding equipment
- 62 Medical imaging, Food quality, Mining,
- 63 Dedicated chipsets and algorithms, Systems and devices
- 64 Spin relaxation and spin transport, Combination with Claytronics
- 65 Mimicking humans, Application demonstrators, Control
- 66 Attophysics, Ultra-precise time measurement for GPS applications VoIP
- 67 Acoustic holograms, Touchable/printable holograms
- 68 Electroencephalography (EEG, ECoG, fNIRS, fMRI)
- 69 Breaking the Blood-Brain-Barrier, New- and nano-materials, Genetically-engineered devices
- 70 Cellular therapies, Tissue engineering and artificial tissues or organs
- 71 Agrobots, Internet of Things in precision farming, In-field devices
- 72 Trust, Notarization, Smart contracts, Corporate blockchain networks
- 73 CRISPR as revolution in health, CRISPR in agriculture
- 74 Drug production, Fuel processing, Renewable energy, Air purification
- 75 Changing landscapes and climate, Climate Engineering: greenhouse gas removal
- 76 Gut bacteria and immunotherapy and gene activity, Probiotic bacteria and depression
- 77 Low-cost carbon dioxide splitting
- 78 Quantum key distribution from orbit, Faster data rates, Blockchain
- 79 New-generation sensors, Man-machine synergy, Legislation, Connectivity
- 80 Neuromorphic chips for object recognition
- 81 New technologies for tidal and wave energy harvesting
- 82 Soup with 3D printed twist, Technology to help people with dysphagia
- 83 Bioplastics for Skin contact, Wound repair, electronics
- 84 Unscripted chatbots, Reuse & integration with major platforms, Enterprise & Customer Service Applications
- 85 Sepsis detection, Lab-on-a-stick, Cheap lab-on-a-chip manufacturing
- 86 Aquanaut technologies for hotels, Entering a sustainable underwater future
- 87 Methane Hydrate Gas in China, Energy from methane hydrate gas on a large scale
- 88 Community and indoor Gardening, Localised Food Systems, Permaculture
- 89 Unconditional Minimum Basic Income, National Referendum on unconditional basic income
- 90 Healthbank for Health information, Sharing scientific health data for money
- 91 Large-scale investigative journalism
- 92 Crypto-currencies traded world-wide, Giving up cash
- 93 Live caching as an industry, Scrapbooking
- 94 Banning cars from cities, New cities without cars
- 95 Breakdown of established gatekeepers, Ownership disruption
- 96 Online mediated sharing, Rise of the Commons, Based-peer production
- 97 Increase in diversity of actors in and forms of education
- 98 Makerspaces on the rise
- 99 Tools for tracking common devices, Body 2.0 – monitoring at the workplace
- 100 Data generation combined with participation via gaming, Physical Education and Health