



مؤسسة دبي للمستقبل
DUBAI FUTURE FOUNDATION

MEGATRENDS

REPORT

FUTURE OPPORTUNITIES REPORT

THE GLOBAL 50

2025



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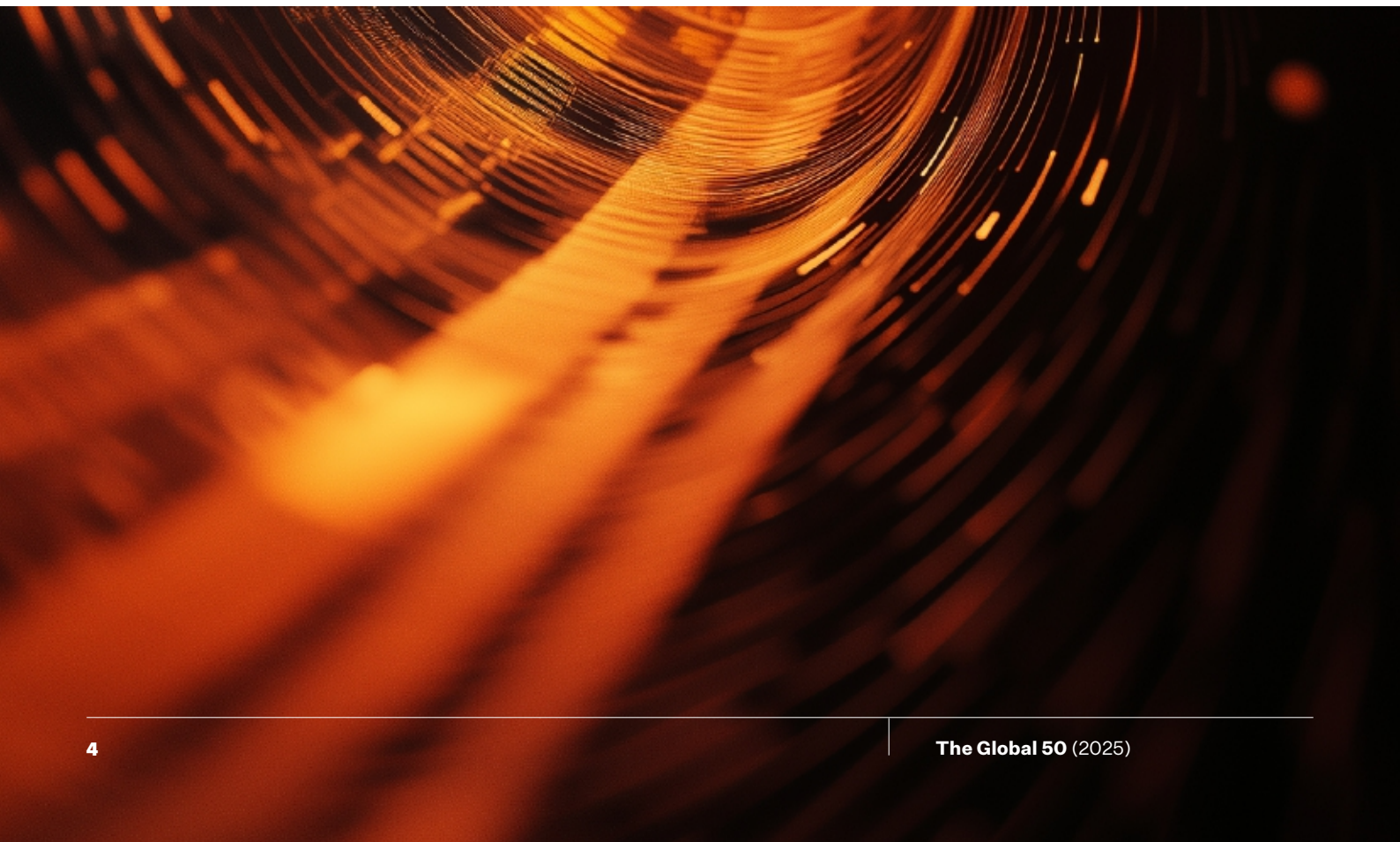


Introduction

Our understanding of progress will continue to evolve.

We will need to reflect on and adapt to what we think meaningful progress looks like. However, as the world moves towards more complexity, and in an era of quantum shifts, change is happening very quickly, making foresight both increasingly more challenging and more important.

In its fourth edition, The Global 50 continues to focus on the future through the lens of growth, prosperity and well-being. Megatrends are one of the key pillars of our view of the future, and as researched thematic paths relevant for a decade or so, megatrends are interrelated and both shape, and are shaped by, day-to-day signals across all aspects of work and life.





Navigating the Megatrends

The nature of megatrends is that they are dynamic and may evolve, especially when they intersect with uncertainties. Approaching The Global 50 from a strategic foresight perspective is about exploring and monitoring signals, trends, disruptions, megatrends, and scenarios to extract insights. It is also about translating these insights into actionable decisions and policies.

Using the megatrends, organisations can establish a starting set of signals or areas of review to scan the environment and explore scenarios relevant to their specific sector or domain or objectives. The megatrends can also be used to stress-test strategies and support future-oriented impact evaluations. While assumptions and uncertainties shape our long view of the future, the megatrends provide guidance for the near- to medium-term outlook.

Readers can develop or inform strategies and initiatives that focus on the future, benefitting from the opportunities and mitigating associated risks relevant to their strategic vision and mission. This can be part of their strategic, operational or risk management plans. Each megatrend includes a brief summary along with keywords readers may use to search for related signals. In addition, for each megatrend we have included signals of what might gain momentum in 2025 and three areas of future opportunity that may be relevant over the next decade. The megatrends are a result of an annual metareview alongside on-going monitoring of relevant signals.

This is an extract of the megatrends section of The Global 50 (2025).

To access the complete report, and other Global 50 related reports, please visit the Dubai Future Foundation website.

dubaifuture.ae/the-global-50



MEGATREND 1

Materials Revolution

KEYWORDS

- Biomimetic Materials
- Biomimicry
- Clean Energy
- Critical Minerals
- Magnets
- Quantum Communication
- Quantum Computing
- Quantum Materials
- Rare Earth Elements
- Superconductors

Materials are fundamental to all products, foods, medicines and drinks that we consume on a daily basis. Driven by extensive progress in advanced machine intelligence, nanotechnology and materials science, as well as interdisciplinary research and innovation, new opportunities are arising in the use of materials in almost all industrial, technological and consumer sectors.

THREE THINGS TO LOOK OUT FOR IN 2025 ↘

TRANSPARENT WOOD

Biodegradable, natural wood can be processed into a transparent wood composite with a honeycomb structure, which is stronger than glass and plexiglass. Transparent wood insulates five times better than glass, enhancing building efficiency.¹ However, its environmental impact will need to be assessed and improved before widespread adoption.

COOLING CERAMICS

Cooling ceramic is durable and made with an alumina coating that resists ultraviolet degradation and withstands temperatures above 1,000°C.² With 99.6% solar reflectivity, it is energy-efficient and offers potential for numerous cooling applications.³ It could serve as a new type of roof shingle.

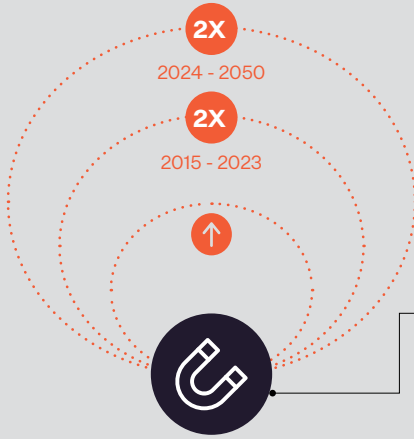
BIOFILTRATION

Smart biological filters coated with enzymes have been seen to remove 97% of toxic bisphenol A and 94% of pesticides from water using special proteins that block, trap and break down harmful chemicals.⁴ These filters can be reused multiple times and have applications in bioreactors, water treatment, in food processing and as biosensors.



AREAS OF FUTURE OPPORTUNITY ↘

PERMANENT MAGNETS



Permanent magnets – as rare earth elements – contribute to efforts towards the clean energy transition and to reaching net zero.⁵ Permanent magnets convert energy from turning wind turbines into electricity.⁶ Permanent magnets in electric vehicles convert energy from batteries into torque in motors⁷ and can save 20–40% of energy versus non-magnet motors.⁸ In fusion energy power plants, strong magnetic fields can regulate plasma at temperatures higher than the Sun’s core.⁹ Magnets are also used in healthcare (e.g. magnetic resonance imaging (MRI),¹⁰ transcranial magnetic stimulation¹¹) and consumer electronics.¹² Eighty-five per cent of magnet mining is concentrated in China.¹³

However, the demand for permanent magnets doubled between 2015 and 2023¹⁴ and is expected to nearly double between 2024 and 2050.¹⁵ To meet this demand, alternative materials will be needed. For example, researchers are exploring rare-earth-free permanent magnets, such as those using iron nitride (FeN), as long as – in the case of electric vehicles – motor performance is maintained.¹⁶ Using artificial intelligence (AI), King’s College London has developed an iron-based superconducting magnet, which could be a significant breakthrough in creating cost-effective MRI machines.¹⁷

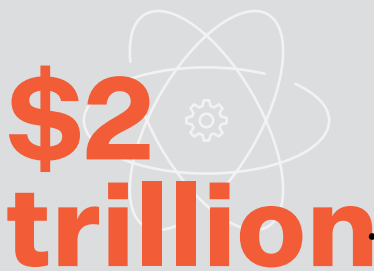
BIOMIMETIC MATERIALS



Biomimetic materials are materials that are made by humans but inspired by nature, either in their properties or how they function.¹⁸ Biomimetics is currently contributing to advances in various fields, including science, engineering and medicine.¹⁹ Nature – resilient over billions of years²⁰ – offers efficient and sustainable approaches to the challenges we face.

From wind turbine blades inspired by the tubercles (bumps) on humpback whale fins, which reduce drag by 32%,²¹ to the Namib Desert beetle’s hydrophilic shell inspiring materials used in fog harvesting in arid regions,^{22,23} innovations inspired by nature can generate considerable economic benefits²⁴ up to \$1.6 trillion by 2030.²⁵

QUANTUM MATERIALS



Quantum materials have unique properties that are integral to advancing quantum technology.²⁶ Materials such as superconductors and semiconductor quantum dots (such as those made of silicon and germanium)²⁷ help stabilise quantum bits (qubits), enhancing quantum computing capabilities.²⁸ Similarly, materials such as spin qubits and diamond nitrogen-vacancy centres underpin quantum sensing technologies.²⁹

Key players, such as Amazon Web Services, IBM and IonQ, are leading advances in this field, achieving significant progress in quantum error correction.³⁰ Advances in quantum communication are enabling ultra-secure networks resilient to cyber threats.³¹ The potential applications of quantum technologies span multiple sectors, including finance, healthcare and defence. These advances are not only poised to revolutionise industries but could also generate over \$2 trillion in global economic value by 2035.³²



MEGATREND 2

Boundless Multidimensional Data

KEYWORDS

- Carbon Emissions
- Cross-border Data Flows
- Data Analytics
- Data Latency
- Data Storage
- Digital Twins
- IoT Connectivity
- Multimodal AI
- Real-Time Analytics

As technology advances – quantum computing, blockchain, the Internet of Things (IoT), edge computing, automation, digital realities, and more – data will become both more constant and more multidimensional. Data will become more available within, and for, governments, businesses and society, in larger volumes, and at greater speeds. Enhanced by 5G, 6G and uninterrupted connectivity through multiple networks, including satellites, access to real-time analytics and insights will improve. Solutions will be developed to minimise the environmental impacts of data capture, transmission and storage.

THREE THINGS TO
LOOK OUT FOR IN 2025 ↴

EXPANDING CONNECTIVITY

In 2023, 97 million people accessed the internet for the first time. This brought the total number of people connected to the internet in 2024 to 5.35 billion – 66% of the global population.³³ The continuing roll-out of 5G,³⁴ efforts to improve the affordability of mobile internet connectivity, and increasing digital inclusion³⁵ are initiatives to watch.

DATA SOVEREIGNTY

Data sovereignty is evolving as cross-border data flows grow amid differing approaches to artificial intelligence (AI) regulation.³⁶ Countries and regions continue to evolve their own data protection laws for managing data throughout various stages of the data life cycle. Cloud computing and the IoT will add complexity to data sovereignty, pushing the demand for data localisation and storage,³⁷ while raising important questions about whether data can truly be sovereign anymore.

GREEN CONNECTIONS

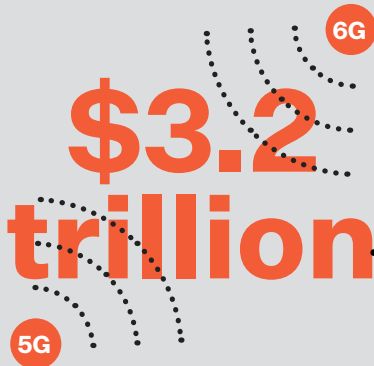
Organisations that provide services over the internet will continue to take steps to reduce – or be expected to disclose – their environmental impact. For example, as video streaming makes up 65% of global data traffic, and total data traffic contributes 3.7% of global greenhouse gas emissions.³⁸ Netflix aims to reduce its emissions by half by 2030⁹ and is investing in climate solutions to offset its remaining emissions.³⁹

⁹ From a 2019 baseline.



AREAS OF FUTURE OPPORTUNITY

PREPARING FOR 6G

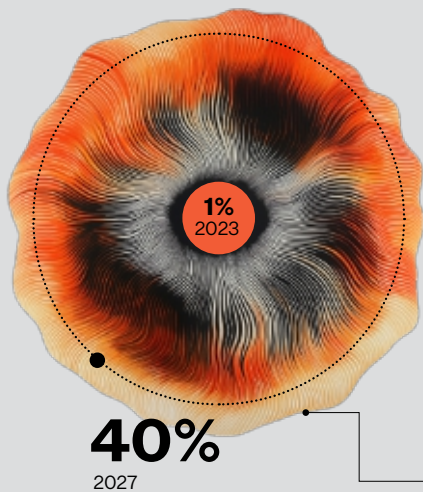


6G will have far-reaching impacts across sectors.⁴⁰ From enabling remote surgery and real-time health monitoring⁴¹ to advanced automation and digital twins,⁴² 6G will create new market opportunities across telecommunications, manufacturing and transportation.⁴³

With low latency (i.e. quick response times),⁴⁴ 6G can theoretically increase speeds from 5G's peak data rate of 20 gigabits per second⁴⁵ to around a terabit (1,000 gigabits) per second.⁴⁶ It is also capable of handling up to 10 times more IoT-connected devices than 5G, with the total number of IoT devices expected to reach 500 billion devices by 2030.⁴⁷ **5G- and 6G-enabled activities combined are projected to create \$3.2 trillion^h in global growth by 2030.**⁴⁸ The development of new optical components and transmission techniques will be critical for achieving the speeds that 6G promises.⁴⁹

From curved light rays and metamaterials⁵⁰ to spiral plates that twist and stretch light beams,⁵¹ reconfigurable intelligent surfaces are being developed to enhance signal propagation and networks and actively control electromagnetic waves to improve coverage and reduce energy consumption.⁵²

MULTIMODAL EXPLAINABLE ARTIFICIAL INTELLIGENCE



Important decisions in healthcare and finance – for example, relating to diagnoses and treatment⁵³ and fraud detection⁵⁴ – may be made together with AI-based support systems using diverse (i.e. multimodal) data inputs, including text, images, audio and, one day, haptics. Multimodal AI will also impact other industries, including education, media, manufacturing, and consumer packaged goods.⁵⁵ Multimodal explainable AI (MXAI) focuses on explaining how, why and what AI delivers,⁵⁶ which is important for building trust in AI.⁵⁷

With capabilities ranging from natural language processing and image processing to multi-input analysis and fast processing in real time,⁵⁸ MXAI is complex. Its complexity lies not just in its handling of data inputs but also in how those inputs are combined to produce an output. ChatGPT now accepts voice and image prompts,⁵⁹ foreshadowing how increasingly multimodal generative AI is likely to look in the future. **While around 1% of AI use was multimodal in 2023, by 2027 the figure is expected to be 40%,⁶⁰ a significant jump that reflects potential rapid adoption of the technology.**

SPORTS ARTIFICIAL INTELLIGENCE



Sports analytics has already had an impact, from improving the identification of talent through statistical modelling and coaching to performance optimisation, fan engagement, and refereeing.⁶¹ Companies such as Catapult⁶² and SportVU⁶³ are reinventing the sports industry with space for more opportunity in the future.⁶⁴

At the 2024 Summer Olympics in Paris, NBC used AI to analyse 5,000 hours of coverage to deliver over 7 million combinations of daily recaps to fans in a personalised way.⁶⁵ The Paris Olympics also used AI to track and analyse athletes' performance, safeguard athletes from abuse on social media, provide multilingual and multi-format personalised content for both audiences and athletes, and optimise energy management through the use of digital twins to simulate energy requirements, as well as camera placement needs and accessibility issues.⁶⁶

The value of AI in sports is set to reach nearly \$30 billion by 2032, expanding at a compound annual growth rate of 30% from \$2.2 billion in 2022.⁶⁷

^h Based on the EUR:USD exchange rate of 16 November 2024.



MEGATREND 3

Technological Vulnerabilities

KEYWORDS

- Cross-border Security
- Cyberbiosecurity
- Cybercrime
- Cyber-physical Threats
- Data Breach
- Identity Theft
- Interoperability
- Risk Mitigation
- Security Protocols
- Threat Detection

Together with technological advances in biotechnology and gene editing, precision agriculture, widespread digitalisation and automation, multimodal artificial intelligence (AI), and the spread of wearables and the Internet of Things (IoT), there inevitably arise new technological vulnerabilities and threats. Some become more severe, frequent and complex, crossing technological, industrial and geographical boundaries, and some, as with biotechnology, also cross biological boundaries. Cybercriminals are more organised, using AI to coordinate and perpetrate crimes. More innovative approaches to identifying, assessing and addressing vulnerabilities will be key.

THREE THINGS TO LOOK OUT FOR IN 2025 ↴

CYBERSECURITY A PRIORITY FOR LEADERS

CEOs are increasingly concerned about cybersecurity in the AI era, with nearly half of CEOs surveyed by the Oliver Wyman Forum ranking it as a top risk.⁶⁸ Industry data confirm the scale of this challenge. The Commonwealth Bank of Australia detects 85 million potential cyberfraud events daily,⁶⁹ with global average data breach costs of \$4.88 million.⁷⁰

BORDERLESS MISINFORMATION AND DISINFORMATION

Combating misinformation and disinformation will be a priority.⁷¹ Whereas misinformation is unintentional, disinformation is meant to mislead.⁷² Fifty-four per cent of those surveyed in the World Economic Forum Global Risks Perception Survey 2023–2024 said that dealing with misinformation and disinformation will require multistakeholder cooperation.⁷³ As global cooperation decreases and misinformation and disinformation are AI generated, the risk will only be higher, potentially deepening social and political divides.⁷⁴ This would be further complicated by reduced efforts and declining investments in content verification and fact-checking across organisations.⁷⁵

TRUST THROUGH TRANSPARENCY

The demand for consumer protection in the digital economy⁷⁶ and in relation to public infrastructure⁷⁷ will continue to rise.⁷⁸ Robust user protection policies are a critical part of building public trust,⁷⁹ particularly in country-run digital systems such as payment platforms and data exchanges, and the millions – if not billions – of public digital records.⁸⁰ This will require transparency, public awareness, and public engagement.⁸¹



AREAS OF FUTURE OPPORTUNITY ↘

INCORPORATING PSYCHOLOGY INTO CYBERSECURITY



Cybercrime significantly impacts victims⁸² and their mental health.⁸³ For example, one survey found that 60% of fraud victims reported mental health struggles, with 55% experiencing anxiety, 48% depression, and 69% sleep problems.⁸⁴ In 2023, 349 million people were affected by data breaches, with 2.6 million fraud reports and over 1 million cases of identity theft, demonstrating the vast scale of cybersecurity challenges.⁸⁵

While current barriers include leadership gaps, resource constraints, and the absence of widely accepted principles and standards, incorporating psychology into cybersecurity can deepen our understanding of why cyberattacks occur⁸⁶ and improve how we reduce cybersecurity threats. This can also enhance our mitigation strategies, encouraging interdisciplinary approaches and a focus on root behaviours.⁸⁷ Addressing these challenges can advance the integration of psychology within cybersecurity strategies.⁸⁸

CYBERBIOSECURITY AWARENESS AND EDUCATION



Besides data privacy risks, there are two major threats unique to cyberbiosecurity. One is cyber-physical (i.e. sabotage of machines and equipment used in biological research, or theft of data) and the other is the creation of dangerous biological materials using digital information.⁸⁹ This is particularly relevant in biobanks⁹⁰ and other repositories of genetic samples and data where genetic information can be accessed and manipulated digitally, making it possible to create synthetic DNA and even reconstruct dangerous pathogens using published sequences.⁹¹

Awareness of cyberbiosecurity remains low around the world and some regions are less prepared than others, particularly the countries of Southeast Asia.⁹² Irrespective of regulations, it is essential to raise awareness of cyberbiosecurity threats among biotechnology companies, research institutions, and policymakers through education and training, ensuring that researchers and practitioners from all relevant disciplines are involved.⁹³ One initiative to note is the Biological Security Research Centre at London Metropolitan University,⁹⁴ which established the International Biological Security Education Network in 2024.⁹⁵

BALANCING INTEROPERABILITY WITH CYBERSECURITY



Cybersecurity is a global, cross-border challenge, and interoperability (the ability of systems to work together) can be both a challenge for, and a solution to, cybersecurity. As the world becomes more interconnected, particularly when it comes to data flows,⁹⁶ innovative approaches to cybersecurity are increasingly needed.

In 2023, the average time to identify and contain a breach was 258 days.⁹⁷ This time could be reduced by improving interoperability (often through common security standards and protocols), enhancing overall security and embracing collaborations between entities and nations.⁹⁸ For example, on an international scale, Estonia's cross-border electronic governance system X-Road is used in other countries (including several of the Nordics) to deliver security, services and economic benefits,⁹⁹ capturing both interoperability and cybersecurity benefits.



MEGATREND 4

Energy Boundaries

KEYWORDS

Carbon Neutrality
Catalysts
Clean Energy Mix
Electrolysers
Energy Storage
Game Theory
Hydrogen Production
Materials
Net Zero
Platinum

Energy has been at the heart of progress for thousands of years,¹⁰⁰ and energy-driven growth has been a major factor in economic progress.¹⁰¹ Energy is imperative to everyday life. As we move towards new and alternative sources of clean energy, we will also need to focus on the key enablers that will make this possible. From novel materials and advanced machine intelligence to pushing the boundaries of the energy ecosystem between space and Earth, this megatrend is critical to growth, prosperity and well-being.

THREE THINGS TO LOOK OUT FOR IN 2025 ↘**FUNDING FOR ENERGY ACCESS**

Sustainable Development Goal 7 aims to ensure that everybody has access to affordable and clean energy.¹⁰² The World Bank and the African Development Bank have announced joint plans to bring electricity to 300 million people in Africa by 2030 through \$30 billion in public sector investment and \$9 billion in private sector investment.¹⁰³

DRIVE FOR ENERGY SELF-SUFFICIENCY

Energy self-sufficiency is becoming even more important as technology advances, increasing the demand for energy.¹⁰⁴ Six Flags Magic Mountain amusement park in California is installing a new solar system that will offset 100% of the park's energy usage.¹⁰⁵ China will have the first onshore commercial small modular reactor (SMR) in 2025,¹⁰⁶ and technology companies Amazon¹⁰⁷ and Google¹⁰⁸ are both supporting their own SMR projects.

OPTIMISING THE BIOFUEL VALUE CHAIN

The worldwide biofuel market is expected to double between 2023 and 2033 to \$243 billion.¹⁰⁹ While biofuels such as palm oil and sugarcane ethanol generally reduce emissions,¹¹⁰ biodiesel production using palm oil farms in Indonesia and Malaysia can have 3 to 40 times higher greenhouse gas (GHG) emissions than diesel.¹¹¹ Redirection of agricultural products to biofuel production has led to challenges ensuring sufficient sustainable feedstock, leading to indirect environmental impacts.¹¹²



AREAS OF FUTURE OPPORTUNITY ↘



GAME THEORY FOR THE GLOBAL PATH TO NET ZERO

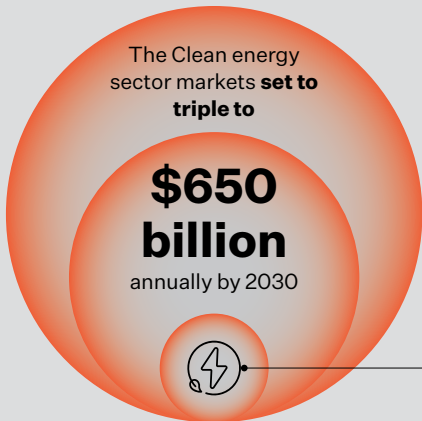
The global net-zero economy is targeting carbon neutrality by 2050 and it is estimated that this will require approximately \$275 trillion in capital spending, with an average annual investment of \$9.2 trillion and reaching a peak of 8.8% of global gross domestic product between 2026 and 2030.¹¹³ However, reaching this goal is not straightforward as many aspects come into play.

Game theory is a model for interactive decision-making where the outcomes depend on anticipating the strategies and associated decisions of others.¹¹⁴ The use of game theory in relation to energy is not new; it has been used to model and optimise interactions between stakeholders within the complex energy system.¹¹⁵ Applied to net zero, game theory can help – together with climate models – to influence interactions and decisions within multiple scenarios aiming towards net zero.¹¹⁶

ONSHORING THE MANUFACTURING OF CLEAN ENERGY TECHNOLOGIES

Clean technologies focus on reducing or eliminating pollutants or waste. From renewable energy, electric vehicles, and biofuels to advanced recycling and waste management systems, these technologies are redefining energy generation and transmission so that they help rather than harm the environment.¹¹⁷

Only four countries, along with the European Union (EU), are manufacturing 80–90% of the world’s solar photovoltaic panels, wind turbines, batteries, electrolyzers and heat pumps.¹¹⁸ Australia, Chile and China account for more than 90% of global lithium production.¹¹⁹ Others may start considering onshoring as a viable strategy through the clean energy transition.¹²⁰



The clean energy sector presents an extraordinary growth opportunity, with markets set to triple to \$650 billion annually by 2030 as nations fulfil their climate commitments. This expansion is driving strategic diversification of manufacturing capabilities and supply chain resilience across regions.¹²¹ The sector promises to create 8 million new manufacturing jobs globally by 2030.¹²²

HYDROGEN AND THE SEARCH FOR A PLATINUM ALTERNATIVE



While not the most significant, hydrogen is part of the future clean energy mix. In 2023, the use of hydrogen in new clean energy applications rose by 40% but still accounted for less than 1% of global hydrogen demand, which is expected to continue growing, driven by new applications in power and transport.¹²³ At the same time, by 2030, demand for low-emissions hydrogen is expected to reach only 10% of what is needed for net zero by 2050,¹²⁴ requiring significant advances in hydrogen fuel cells and infrastructure.¹²⁵

Electrolysers, essential for hydrogen production, rely on materials such as platinum. In 2023, only 22% of installed capacity used the more efficient platinum-based proton exchange membranes,¹²⁶ a technology that has the potential to provide 11% of the global carbon dioxide emissions reductions required by the Paris Agreement by 2030.¹²⁷ However, platinum is hard to find.¹²⁸ While South Africa supplies over 70% of global platinum, its mining sector faces challenges, exacerbating future supply risks.¹²⁹ **Promising alternative materials that maintain efficient energy conversion and storage capabilities include noble metal alloys, transition metals (e.g. nickel, cobalt), and carbon-based catalysts.**¹³⁰



MEGATREND 5

Evolving Ecosystems

KEYWORDS

- Acoustics
- Biodiversity
- Climate Change
- Internet of Underwater Things (IoUT)
- Marine Conservation
- Noise Reduction
- Ocean Health
- Regeneration
- Sustainability
- Wildlife

Driven by resource scarcity, climate change, and shifts in social values, environmental impact management will increasingly move towards a focus on ecosystems as opposed to the environmental impact of specific processes, products or services. Approaches will be more interdisciplinary, with a focus on future impact. They will also take into account both societal and environmental factors, with the primary goal of regenerating or conserving biological and ecological services and resources while providing for basic human needs.

THREE THINGS TO LOOK OUT FOR IN 2025

SUSTAINABILITY OF GENERATIVE ARTIFICIAL INTELLIGENCE (GENAI)

By 2026, over 80% of organisations will use GenAI in production settings, compared to less than 5% today.¹³¹ While GenAI enables fast content creation (or recreation) across industries, its environmental impact is a growing concern. ChatGPT is thought to consume the same amount of energy as 33,000 average homes in the United States, and global water demand for cooling data centres used for AI may reach half the annual water consumption of the UK.¹³² Mitigating these effects through advanced computer chips for energy-efficiency and the adoption of renewable energy sources will be important.¹³³

INCREASED VOLUNTEERISM FOR THE ENVIRONMENT

Globally, 53% of people surveyed for the Peoples' Climate Vote 2024 were more concerned about climate change than they had been in the previous year.¹³⁴ In 2022, nearly 15% of people aged 15 and over volunteered at least once per month. As awareness of environmental risks and need for action increases,¹³⁵ environmental volunteering (e.g. tree planting, river clean-ups, and habitat restoration) may increase.¹³⁶

CLIMATE TECH START-UPS IN AFRICA

Climate tech start-ups in Africa may be key to driving transformative change. Africa holds great potential for clean energy, responsible mineral extraction, ecosystem restoration, and – through climate tech start-ups – youth engagement.¹³⁷ Since 2019, African climate tech start-ups have raised over \$3.4 billion, a number expected to rise given the need for \$277 billion annually¹³⁸ to meet the Paris Agreement climate goals by 2030.¹³⁹



AREAS OF FUTURE OPPORTUNITY ↘

ALL THINGS REGENERATIVE



The concept of regeneration became increasingly popular in the 1990s in urban development as an innovative response to climate change looking beyond making buildings green.¹⁴⁰ Since then, regeneration has become the new sustainability.¹⁴¹ [While sustainability focuses on balancing human needs with environmental protection,¹⁴² regeneration takes efforts further by focusing on restoring natural resources, enhancing biodiversity, and rejuvenating damaged ecosystems.¹⁴³](#)

As a result, the idea of regeneration has spread to other domains.¹⁴⁴ For example, in medicine, there is increasing recognition that the human body can heal itself.¹⁴⁵ In agriculture, farmers are rehabilitating the soil, respecting animal welfare, and building healthier communities while improving their yields.¹⁴⁶ Making efforts to restore and improve ecosystems in day-to-day living,¹⁴⁷ regenerative tourism, long-term community, and environmental enrichment are increasingly prioritised over immediate returns.¹⁴⁸

ACOUSTIC ARTIFICIAL INTELLIGENCE FOR ECOSYSTEMS



AI with acoustics holds potential in understanding and improving marine, wildlife, urban and other ecosystems. Underwater sound travels further than visual signals or scents and is critical for marine life communication, migration and interaction with the environment.¹⁴⁹ [AI has already been successfully used to monitor whale vocalisations, improving species detection and marine conservation strategies.¹⁵⁰](#)

Recent studies on AI and wildlife have focused on birds (48%) and mammals (22%),¹⁵¹ but issues include insufficient datasets, high background noise, lack of standardisation, and complex sound classifications. While maintaining wildlife welfare and being aware of potential AI bias, AI may provide valuable real-time insights for conservation.¹⁵²

AI is also helping to optimise room acoustics, urban noise monitoring, studio recordings, and speech clarity in educational environments.¹⁵³ From workplaces to healthcare, AI and acoustics can boost productivity and creativity, with Internet of Things (IoT) integration and advanced signal processing enhancing auditory experiences and immersive sound environments.¹⁵⁴

INTERNET OF UNDERWATER THINGS (IoUT)

In 2021, the **IoT** was expected to unlock up to

\$12.6 trillion

in value by 2030

[In 2021, it was estimated that the IoT is expected to unlock up to \\$12.6 trillion in value by 2030 from applications in factories \(26%\), human health \(10–14%\), and others.¹⁵⁵](#)

Achieving this will depend on advanced connectivity through 4G and 5G networks, as well as balancing affordability with interoperability, cybersecurity and deployment complexity.¹⁵⁶

Oceans face critical pressures from climate change and unsustainable use of ocean resources, affecting ecosystems and human societies.¹⁵⁷ The United Nations Decade of Ocean Science for Sustainable Development (2021–2030)¹⁵⁸ promotes interdisciplinary research and global collaboration to improve the health of the oceans.¹⁵⁹ As interest in marine sciences increases and with devices that monitor and support applications underwater, the Internet of Underwater Things (IoUT) provides future opportunities for environmental monitoring, exploration, and disaster prevention.^{160,161} Challenges related to harsh water conditions and data collection and transmission will need to be overcome.¹⁶²



MEGATREND 6

Borderless World – Fluid Economies

KEYWORDS

AI Personhood
Cryptocurrency
Digital Assets
Education
Energy
Environment
Regulation
Stablecoin
Tokenisation
Water

Increasingly, unmediated transactions in finance, health, education, trade, services and even space lead to the blurring of jurisdictional boundaries, shifting liabilities and creating increased numbers of cross-border communities and networks. Advances in communications, computing, and advanced machine intelligence will accelerate a borderless world that will change the way we work, live and communicate.

THREE THINGS TO LOOK OUT FOR IN 2025 ↻**GLOBAL DATA ACCESS AND USER CONSENT FOR AI TRAINING**

Spending on artificial intelligence (AI) is expected to rise to \$632 billion by 2028.¹⁶³ Existing social media,^{164,165} technology,¹⁶⁶ and network¹⁶⁷ platforms, which are global in nature, are turning to user data to train their own AI models. While some companies have denied or expressed no interest in doing this,¹⁶⁸ others are providing their users with updated user terms or the ability to opt out. The need for common global standards for data management and sharing may increase.¹⁶⁹

CROSS-BORDER PHILANTHROPY FOR GLOBAL CHALLENGES

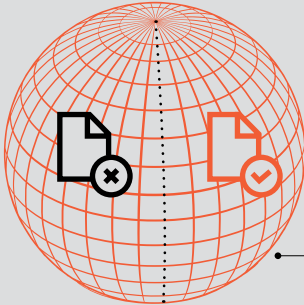
In 2022, 40 private philanthropies reported \$11 billion in development support to the Organisation for Economic Co-operation and Development (OECD), although contributions have stagnated since 2021.¹⁷⁰ Reported in the 2023 Global Philanthropy Tracker, global cross-border philanthropy reached \$70 billion across 47 high-income countries in 2020, representing 85% of global GDP.¹⁷¹ While domestic philanthropy grows,¹⁷² cross-border giving remains crucial for addressing natural disasters and global crises such as COVID-19.¹⁷³ However, barriers persist, including taxation issues, limited legal recognition for foreign foundations, and misaligned legal protections.¹⁷⁴

INTELLECTUAL PROPERTY IN A BORDERLESS DIGITAL WORLD

AI, especially large language models and generative AI (GenAI), is trained primarily from public sources, including copyright-protected text, and visual and auditory works.¹⁷⁵ The growing outputs from GenAI will continue to raise questions about its role in the inventive process. The World Intellectual Property Organization runs multiple events and discussion forums on this topic,¹⁷⁶ and the Centre for the Fourth Industrial Revolution in the UAE has published a report touching on intellectual property, AI and the creative industries.¹⁷⁷

AREAS OF FUTURE OPPORTUNITY ↘

GLOBAL COOPERATION FOR CROSS-BORDER DIGITAL ASSET REGULATION



Overall tokenised market capitalisation, excluding Bitcoin and Tether, could hit approximately \$2 trillion by 2030 due to the increased use of these currencies in mutual funds, bonds, exchange-traded notes, loans, securitisation, and alternative funds.¹⁷⁸

However, digital assets lack a universal definition¹⁷⁹ despite the fact that two-thirds of 86 jurisdictions surveyed by the World Economic Forum already regulate or are planning to regulate digital assets.¹⁸⁰ **These differences create regulatory challenges because a digital asset that is legal in one jurisdiction may be illegal in another.** The Financial Stability Board¹⁸¹ and the International Organization of Securities Commissions¹⁸² are working on providing universal definitions,¹⁸³ and the Principles of the International Institute for the Unification of Private Law offer a framework connecting digital assets to existing legal structures.¹⁸⁴ However, gaps persist. The UAE is a leader in the Middle East and North Africa region in regulating digital assets. Several organisations have published regulatory frameworks, including Dubai’s Virtual Assets Regulatory Authority,¹⁸⁵ Abu Dhabi Global Market,¹⁸⁶ the Dubai International Financial Centre,¹⁸⁷ and the Digital Assets Oasis in Ras Al-Khaimah.¹⁸⁸

EXPLORING ARTIFICIAL INTELLIGENCE PERSONHOOD FOR LEGAL BOUNDARIES



AI personhood would introduce new legal and ethical challenges about rights, responsibilities and accountability

AI has the potential to add as much as \$15.7 trillion to the worldwide economy by 2030.¹⁸⁹ As AI becomes ubiquitous, highly autonomous AI systems may eventually warrant legal status like corporate entities, particularly if impacting international decision-making and cross-border interactions.

Granting legal status to non-corporate entities is not a new issue; many have argued for legal rights for nature.¹⁹⁰ However, **AI personhood would introduce new legal and ethical challenges about rights, responsibilities and accountability and would require a debate around whether AI entities fit into the existing (or future) legal structures.**¹⁹¹ Considering legal personhood for AI could raise critical questions about moral responsibility, economic efficiency, and legalities, especially as AI’s capabilities continue to evolve. Giving AI legal personhood would mean it could face sanctions, fines and deactivation resulting from unlawful actions.¹⁹² However, the perceived accelerated advances in AI make this a challenge,¹⁹³ and as an emerging concept it is an area of opportunity for coordination in the larger global context.¹⁹⁴

TRANSDISCIPLINARY EDUCATION FOR GLOBAL INNOVATION



The next 10 years will see many environmental, societal, technological and economic global risks that cannot be solved by individual countries alone.¹⁹⁵ Between 2030 and 2040, global water and energy demands are expected to rise by 40% and 50%, respectively,¹⁹⁶ impacting food and water systems, economies and supply chain systems, and many other areas of work and life that could lead to increased global tensions.¹⁹⁷ Meanwhile, climate change is affecting global socio-economic systems, such as food, physical assets, infrastructure, natural capital, and migration,¹⁹⁸ triggering an interconnected set of social and environmental risks.¹⁹⁹

In a borderless, interconnected world, addressing such complex cross-border and cross-sectoral issues requires a transdisciplinary approach. By combining insights from multiple fields, we can develop unique and innovative solutions that address both the technical challenges and the societal implications of emerging and future technologies. Universities and training institutions can promote transdisciplinary education programmes that combine law, technology, ethics, and international relations, encouraging cross-sector understanding and collaboration. These programmes can be co-developed by academic and industry leaders to ensure that they address practical, real-world challenges. Some institutions, such as the University of Twente in the Netherlands,²⁰⁰ have already set up programmes that focus on transdisciplinary education, but more are needed.



MEGATREND 7

Digital Realities

KEYWORDS

- Augmented/Virtual Reality
- Headsets
- Digital Theatre
- Immersive Experiences
- Life Satisfaction
- Performing Arts
- Real-Virtual Divide
- Self-esteem
- Self-expansion
- User Acceptance
- Virtual Identities

Digital natives – those who have grown up with digital forms of entertainment, education and communications – will naturally usher in increasingly virtual worlds where many ‘real-world’ tasks and behaviours can be replicated and potentially even improved in 3D and 4D environments. The emergence and spread of 5G and 6G networks will enhance autonomous applications as they offer more reliable, cost-effective and secure high-speed connectivity that enables real-time analytics and decision-making. As quantum technologies, such as quantum computing, communications and sensors, become scalable and reliable, immersive experiences will start to feel like reality.

THREE THINGS TO LOOK OUT FOR IN 2025 ↘

METaverse CALLS

The metaverse, specifically virtual reality (VR), was expected to replace smartphones by 2035, but its widespread adoption has seen a series of challenges,²⁰¹ including the loss of \$13.7 billion by Meta’s Reality Labs in 2022,²⁰² cybersickness,²⁰³ mental health problems caused by cyberbullying, identity theft, and financial exploitation,²⁰⁴ as well as regulatory obstacles, cultural resistance, and security concerns.²⁰⁵ However, considering the Dubai Metaverse Strategy,²⁰⁶ South Korea’s \$177 million investment fund for the metaverse,²⁰⁷ ongoing efforts by the World Economic Forum,²⁰⁸ and Mohamed bin Zayed University of Artificial Intelligence’s Metaverse Lab,²⁰⁹ the metaverse may yet be widely adopted.

DIGITAL CONTACTLESS EXPERIENCES

Augmented reality (AR) adoption through smartphones, particularly given the spread of 5G,²¹⁰ shows promising growth.^{211,212} There are now over 2,000 spatial apps for Apple Vision Pro,²¹³ and, as generative artificial intelligence (AI) continues to make it quicker and cheaper to build spatial environments and experiences,²¹⁴ examples such as IKEA’s home visualisation tool, L’Oréal’s ModiFace AR tool, and Google Maps Live View²¹⁵ may become increasingly common.

ARTIFICIAL INTELLIGENCE POWERING EXTENDED REALITY

AI is expected to contribute nearly \$20 trillion (3.5%) of global gross domestic product by 2030.²¹⁶ Within extended reality, AI enables personalised interactions and manages data flows, driving user engagement.²¹⁷ With results showing 75% improved learning retention and 275% increased confidence in learned topics,²¹⁸ extended reality powered by AI may have the potential to increase engagement and collaboration.



AREAS OF FUTURE OPPORTUNITY ↘



The **home entertainment and cinema markets** were worth

\$100 billion

in 2023

GROWING THE DIGITAL THEATRE

The home entertainment and cinema markets continue to grow, with an estimated worth of \$100 billion in 2023 and an expected increase of 8% annually between 2024 and 2030.²¹⁹ The impact of technology has also been transformative in drama and the arts. With technological advances, new forms of theatre have emerged that encourage viewers to actively participate and interact within narratives.²²⁰ Some are calling for technology to be used for analysis of productions to document knowledge for use in drama education in the future.²²¹

Many performing arts theatres, some of which had never previously offered digital broadcasts, made their performances available online during the COVID-19 pandemic.²²² For example, National Theatre at Home,²²³ launched during the pandemic, attracted over 15 million viewers from 170 countries within just four months of launch.²²⁴ Facing challenges bringing back audiences to pre-COVID levels,²²⁵ digital realities can enhance access and enable distant audiences to attend live performances or feel like they are part of a live performance.



THE VIRTUAL-REAL SELF DIVIDE

The boundary between our real and virtual identities continues to be blurred. People may maintain multiple identities across various platforms, raising philosophical and ethical questions about what it means to be human and what physical existence or being present or conscious means.²²⁶ Key questions include what information can be shared in the virtual self, how to ensure privacy, who is accountable for errors or decisions in the virtual life that may or may not impact real-life experiences, and how to balance regulation to promote both trust and freedom in the virtual world.²²⁷

How virtual and real identities influence each other remains a crucial area of research,²²⁸ building on previous studies that have focused on the relationship between the actual and idealised self²²⁹ and how they can enhance societal prosperity and well-being. For example, participating in virtual environments can have positive effects when virtual and real identities are aligned. However, it can also create the feeling of being disconnected if the virtual self is seen as superior, negatively impacting self-esteem and life satisfaction.²³⁰

EVOLVING ACCEPTANCE OF AUGMENTED/VIRTUAL REALITY HEADSETS

Sales of AR/VR headsets have gone down by

40% ↘



Start-up funding has dropped by

50% ↘

Immersive experiences have expanded across disciplines and domains, mimicking real-life spaces, events and social interactions.²³¹ From health and climate to gaming and education, digital realities are increasingly enabled by AR/VR. However, despite a jump in popularity during the COVID-19 pandemic,²³² the growth of AR/VR-powered experiences remains uncertain and unpredictable.

While sales of AR/VR headsets have gone down by 40% since 2022, and start-up funding has dropped by 50%,²³³ shipments of AR/VR headsets started to grow again in the third quarter of 2024 and are expected to rebound in 2025, with an expected compound annual growth rate (CAGR) of nearly 86% by 2028.²³⁴ However, this optimistic outlook is not universal, as Apple has reduced its production of Apple Vision Pro.²³⁵

Despite efforts to make devices more user-friendly, AR/VR headsets continue to be considered experimental, with a focus on testing the functionality and viability of the technology.²³⁶ Innovativeness, perceived benefits, and system quality are key to user acceptance, as are user-friendliness and potential societal impacts if more widely adopted.²³⁷ There is an opportunity to develop new acceptance models based on standardisation and validation across applications and environments.²³⁸



MEGATREND 8

Life with Autonomous Robots and Automation

KEYWORDS

- Additive Manufacturing
- Biomimicry
- Collaborative Robots (Cobots)
- Drones
- Humanoids
- Human-Robot Interaction
- Materials
- Sea Drones
- Soft Robotics
- Trust

Driven by advances in mechanical engineering design, materials science, advanced machine intelligence, and advanced communication networks, robots will increasingly expand into other industries beyond the automotive, manufacturing, and supply chain logistics sectors. The use of robots²³⁹ and automationⁱ will provide greater opportunities for efficiency and innovation while presenting us with ethical and societal challenges around autonomy, decommissioning, and the future of work. The growing numbers of robot-to-robot, human-to-robot, and human-to-machine interactions will raise questions about intellectual property and robot rights.

THREE THINGS TO LOOK OUT FOR IN 2025 ↴

HUMANOID ROBOTS TO DISRUPT ALL ROBOTS

In 2023, there operated around 4.28 million robots in factories worldwide²⁴⁰ and 4.31 million service robots in other industries, especially consumer service.²⁴¹ However, humanoid robots may disrupt both sectors. The global market for humanoid robots, which was \$2.43 billion in 2023, is expected to reach \$66 billion by 2032,²⁴² with application particularly in healthcare, manufacturing, and supply chain logistics.²⁴³ RoboFab in Oregon, United States, is the first factory for humanoid robots.²⁴⁴

BREAKTHROUGHS IN ROBOT DEXTERITY

Robots are becoming more versatile due to configurational advances,²⁴⁵ materials science, and sustainable robotics.²⁴⁶ Generative artificial intelligence is expected to enable better sensing and adaptability in varied environments.²⁴⁷ For example, Google's ALOHA Unleashed demonstrates advanced dexterity, carrying out complex tasks such as tying shoelaces and repairing other robots, while Google's DemoStart, also dexterous, uses simulation training to improve performance.²⁴⁸

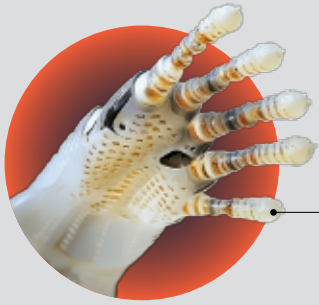
DRONE EVOLUTION

The capabilities of commercial drones are expected to expand, with a global sea drone market of nearly \$20 billionⁱ by 2030²⁴⁹ and an electric vertical take-off and landing drone market of \$160 billion by 2040.²⁵⁰ China's first global certified air taxi, the EHang EH216-S, can carry two passengers,²⁵¹ and Dubai has started building a flying taxi station for up to 170,000 passengers annually.²⁵²

ⁱ Includes drones, software, autonomous cars, exoskeletons, unmanned ground vehicles, smart appliances, and so on. While there is no harmonised definition used across organisations, these types are all included in the definitions used by the International Organization for Standardization, the Institute of Electrical and Electronics Engineers, and ASTM International.

^j Based on EUR:USD exchange rate 17 December 2024.

AREAS OF FUTURE OPPORTUNITY



BIOMIMICRY FOR SOFT ROBOTICS

Biomimicry draws inspiration from nature to enhance quality and functionality across domains and offer innovative solutions to global challenges. **Soft robotics, a high-potential application of biomimicry, focuses on the development of adaptable robots made of materials that feel like biological tissue.** Bionic multi-legged robots with flexible bodies outperform rigid robots in speed, stability, and terrain navigation,²⁵³ and gecko-inspired robots can achieve an adhesion force of 180N, allowing them to climb and operate in microgravity environments.²⁵⁴

The development of bio-inspired soft robots requires several elements to be considered, including materials, actuation mechanisms, and design. Highly interrelated, as they are in biological systems,²⁵⁵ bio-inspired soft robots are key in medical applications, where precision and reliability can be critical to the preservation of life.²⁵⁶ Interdisciplinary collaboration between biologists and engineers will drive future innovation, deepening understanding of biological systems while advancing robotics capabilities to produce more sophisticated, versatile and lifelike robotic solutions.

BETTER UNDERSTANDING OF HUMAN-ROBOT INTERACTION

Robots are increasingly used in manufacturing, scientific research, agriculture, and food service. The development of larger numbers of collaborative robots (cobots) and humanoid robots signals a shift towards more adaptable robots that can work alongside humans in varied environments.

Trust in human-robot interaction is not just about reliability.



However, widespread adoption faces several obstacles. Safety concerns, regulatory requirements, the impact on jobs, and resource constraints make scalable adoption challenging.²⁵⁷ Most importantly, there is the fundamental issue of trust,²⁵⁸ especially as artificial intelligence (AI) becomes increasingly integrated with robotics.²⁵⁹ **Trust in human-robot interaction is not just about reliability. It is about humans intentionally depending on robots despite the inherent risks and vulnerabilities.**²⁶⁰ This relationship must be founded on positive impacts while acknowledging uncertainties, introducing an emotional dimension beyond technical reliability.²⁶¹ As the industry evolves, establishing trust between humans and robots will become crucial for successful integration. This challenge encompasses both technical reliability and the more complex emotional aspects of human-robot collaboration, setting the stage for future developments in the field.

BETTER MANUFACTURING MEASURED THROUGH ROBOT COLLABORATION

Evolving from rapid prototyping, additive manufacturing is distinct from traditional linear manufacturing. Similar to 3D printing, objects are built layer by layer,²⁶² enabling the manufacture of more complicated designs²⁶³ and without retooling.²⁶⁴ Materials, including polymers, metals, ceramics, sand and composites,²⁶⁵ will be critical in scaling additive manufacturing.²⁶⁶



Cooperative robots²⁶⁷ could be the catalyst for widespread adoption of additive manufacturing.²⁶⁸ They could enhance printing capabilities, assist throughout the printing process, and enable real-time information capture and feedback beyond the limitations of single robotic systems.²⁶⁹ Their effectiveness would rely on sophisticated planning, collision avoidance technology, and enhancement of the properties of relevant materials, augmented by AI and machine learning technologies.²⁷⁰ Beyond technical capabilities, the key to success will lie in how the quality of the collaboration is assessed in real time.²⁷¹ In this way, the use of cooperative robots in additive manufacturing may reveal a new frontier in manufacturing innovation.



MEGATREND 9

Future Humanity

KEYWORDS

- AI Dispute Resolution
- Arts Education
- Creative Economy
- Cross-border Disputes
- Digital Media
- Generation Z
- Legal Aid
- Organisational Values
- Study Tracks
- Talent

With advanced machine intelligence, brain-computer interfaces, technological breakthroughs, advances in science and medicine, and an increasingly borderless world, people’s understanding and expectations of self-realisation – including work, education and what it means to thrive – will shift. Personal development, how individuals and communities innovate and communicate, and new definitions of self-esteem, autonomy and stability will bring forth new ideas about parenting, care, love, belonging, inclusion and community. The traditional boundaries between self, society and institutions will evolve.

THREE THINGS TO LOOK OUT FOR IN 2025 ↴

WOMEN IN ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

While data varies by source,²⁷² the share of women in AI engineering increased to approximately 35% in 2024,²⁷³ and several initiatives aim to close this gap. For example, the international Women in Data Science project enables women to be fully represented and empowered in data science.²⁷⁴ Similarly, Women in AI Benelux (Belgium, Netherlands and Luxembourg) focuses on empowering women to become AI and data experts and leaders,²⁷⁵ while the UAE’s Abdulla Al Ghurair Foundation has launched its own Women in AI programme.²⁷⁶

BRIDGING THE TECHNOLOGY-HUMAN GAP IN CUSTOMER SERVICE

In 2025, 85% of customer service leaders are expected to explore or pilot customer-facing conversational generative AI.²⁷⁷ However, while technology is meant to enhance the customer digital experience, there is a growing disconnect²⁷⁸ between businesses and customers, as technology alone is not improving customer loyalty.²⁷⁹ Businesses will need to balance technological advancement²⁸⁰ with authentic human connection.²⁸¹ Companies may look at strategically deploying technology as an enabler while prioritising relevance, genuine customer needs, and customers’ ability to control the experience.²⁸²

ARTIFICIAL INTELLIGENCE AND HUMANITY – AN EVOLVING NARRATIVE

In a cross-disciplinary survey of experts in 68 countries in 2024, 34% expected to see a substantial acceleration in how AI would impact daily life and society within the next year.²⁸³ As people’s ways of communicating and connecting continue to change, reshaping relationships and social interactions,²⁸⁴ AI will evolve to more increasingly reflect what is important to diverse human cultures, ethical frameworks, and region-specific approaches to ensure AI serves society’s values and best interests.²⁸⁵



AREAS OF FUTURE OPPORTUNITY



The creative economy contributed

3.1%

of global GDP in 2022 and 2023

NEED FOR THE ARTS

Based on UNESCO data in 2022 and 2023, the creative economy generates \$2.3 trillion annually, contributing 3.1% of global gross domestic product (GDP) and employing 6.2% of the global workforce.²⁸⁶ This sector, encompassing both traditional arts and digital media,²⁸⁷ is projected to reach 10% of global GDP by 2030.²⁸⁸ Driven by digitalisation, this makes it one of the world's fastest growing sectors.²⁸⁹ However, funding remains a challenge – heavily depending on traditional fundraising, grants and sponsorship, which are vulnerable to economic downturns – and is often overlooked in policy and investment discussions.²⁹⁰ Besides funding, dropping enrolments in arts education is also a challenge.

Fundamental to the creative sector, arts education also supports the development of cross-disciplinary skills that can be used to address complex global challenges.²⁹¹ It plays an essential role in mental health, education and navigating social change,²⁹² and can enable a deeper understanding of life,²⁹³ which will be especially valuable as society navigates the challenges of AI and other technological advances.²⁹⁴



The global justice crisis affects at least

5.1 billion people

LAB FOR ONLINE DISPUTE RESOLUTION ACROSS LEGAL SYSTEMS

AI-powered dispute resolution shows promising potential for increasing access to justice globally. The global justice crisis affects at least 5.1 billion people around the world.²⁹⁵ For example, in the United States, low-income Americans receive little to no legal help in 92% of civil cases.²⁹⁶

As mediators for dispute resolution,²⁹⁷ large language models (LLMs) have demonstrated impressive capabilities, outperforming or matching human mediators in the selection of appropriate intervention types (62%) and creation of effective intervention messages (84%).²⁹⁸ A cross-border online dispute resolution lab could further advance AI-enabled tools for handling disputes across jurisdictions and languages. The University of Cambridge has proposed standards for such an initiative, although there remain challenges related to bias, privacy and worldwide coverage.²⁹⁹ Several innovative initiatives are already underway to pilot or roll out LLMs for legal aid. Suffolk University Law School and the American Arbitration Association have launched an online innovation clinic for dispute resolution in family law matters.³⁰⁰ Other examples are the British Columbia Civil Resolution Tribunal, which handles small claims and motor vehicle disputes online,³⁰¹ and Queen's University Conflict Analytics Lab, which acts as an incubator for legal technology start-ups.³⁰²



Gen Z will represent

27%

of the workforce in 2025

UNDERSTANDING TALENT RETENTION

Meaningful work and job alignment are important factors in talent retention. However, alignment with organisational values plays a more significant role.³⁰³ This alignment is crucial for Generation Z (Gen Z), who make up 25% of the global population and will represent 27% of the workforce in 2025.³⁰⁴

The concerns and preoccupations of this demographic – and others – present unique opportunities for organisations to reimagine workplace culture and retention strategies, particularly as Gen Z prioritise job security over frequent job changes.³⁰⁵ However, assessing organisational value alignment – including corporate social values³⁰⁶ – is not easy, particularly if an employee's level of self-knowledge is limited³⁰⁷ and organisational values are unclear.³⁰⁸ Along with clear organisational values³⁰⁹ and ensuring genuine commitment to them,³¹⁰ this is best achieved from the hiring decisions that benefit both the organisation and the employee.³¹¹ Organisations can adopt forward-looking strategies that include diverse hiring panels to reduce bias and ensure better cultural fit.³¹² Prioritising alignment with values strengthens employee loyalty and positions companies as employers of choice contributing to a more productive workplace culture that meets the demands of an ever-changing job market.



MEGATREND 10

Advanced Health and Nutrition

KEYWORDS

- Air Quality Epigenetics
- Biochar
- Carbon Sequestration
- Genomic Data Diversity
- Genomic Studies
- Particulate Matter (PM)
- Personalised/Precision Medicine
- Soil Health
- Sustainable Agriculture
- Sustainable Development Goals (SDGs)

Progress in advanced machine intelligence, nano- and biotechnology, additive manufacturing, and the Internet of Things (IoT) will change our understanding and experience of health and nutrition. Driven by unprecedented developments and response to climate change, resource scarcity, and the desire for longevity, this megatrend will improve health across all age groups. It will reduce, if not eradicate, some communicable and non-communicable diseases and enhance the sustainable use of, and access to, water and food.

THREE THINGS TO LOOK OUT FOR IN 2025 ↴

THE GROWING CLIMATE-HEALTH LINK

Climate change is threatening health worldwide, pushing 132 million people into extreme poverty, including 44 million from the impacts of ill health.³¹³ In 2023, people experienced 50 more days per year of health-threatening temperatures, and 48% of global land faced extreme drought.³¹⁴ Food insecurity affects 151 million more people today compared with the levels seen between 1981 and 2010.³¹⁵

HEALTHCARE SYSTEM BOTTLENECKS AROUND THE WORLD

Healthcare bottlenecks around the world vary from a lack of guidelines, supervision, training and cleanliness for women during childbirth in Pakistan³¹⁶ to the cost and voluntary nature of the private insurance system of the United States, which leaves millions of people uninsured.³¹⁷ Despite gaps in data,³¹⁸ overcrowding and long waiting times in emergency departments are already common in the OECD³¹⁹ and around the world,³²⁰ as are access barriers for mental health care.³²¹

MEAT TRADE ALONGSIDE REGULATORY, CLIMATE AND DEMOGRAPHIC SHIFTS

By 2033, the global meat trade is expected to grow by 12% driven by rising demand in sub-Saharan Africa and Asia.³²² Exports from North and South America are also expected to grow, accounting for just over half of global meat exports.³²³ This is alongside the European Union's ban on food imports linked to deforestation,³²⁴ growing concerns over the impact of meat production on the climate,³²⁵ as well as ageing populations and changing consumer preferences in high-income countries.³²⁶

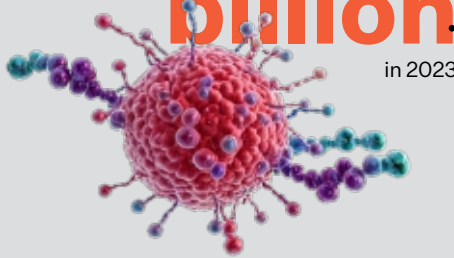


AREAS OF FUTURE OPPORTUNITY

AIR QUALITY EPIGENETICS

The global epigenetics market reached a value of

\$14.6 billion
in 2023



The environment influences epigenetics, which studies the processes that activate or deactivate specific genes, influencing not only individual health but also the health of future generations.³²⁷

Particulate matter (PM) in the air may include organic and inorganic compounds that have epigenetic effects linked to poor health. Current research on PM's epigenomic impact is limited, with future opportunities to identify biomarkers and develop interventions that could mitigate PM-related health risks, especially in vulnerable populations.³²⁸

The global epigenetics market reached a value of \$14.6 billion in 2023 and is expected to increase by nearly 15% annually up to 2030.³²⁹ Eight epigenetic therapies have been approved by the US Food and Drug Administration (FDA) and are currently on the market, with six being used to treat haematological malignancies and two approved for solid tumours.³³⁰

EXPANDING PRECISION MEDICINE THROUGH DIVERSE GENOMIC RESEARCH

Precision/personalised medicine is transforming approaches to genetic diseases.³³¹ In 2023, precision medicines made up 38% of the FDA's new therapeutic drug approvals and over a quarter of all approvals since 2015.³³² While combined use of magnetic resonance imaging scans with genetic testing has improved diagnostics for neurological disorders such as cerebral palsy³³³ and autism,³³⁴ the impact of precision medicine has not been fully realised.³³⁵

For example, epilepsy affects 50 million people globally, with 80% living in low- or middle-income countries.³³⁶ While 70% of people could be seizure-free with proper treatment – once diagnosed – 50% of cases have unknown causes.³³⁷ Benefiting from personalised medicine in this case requires addressing current limitations, particularly in genomic data presentation.

With nearly 94.5% of current genomic data in genomic studies coming from European ancestry, followed by nearly 4% Asian, 0.9% Hispanic and 0.6% African,³³⁸ expanding research to include diverse populations is a future opportunity. From a growing emphasis on data sharing³³⁹ across demographics and geographical regions to efforts to overcome cultural barriers³⁴⁰ and stigma^{341, 342} associated with genetic testing, these steps are crucial for developing more effective, targeted therapies and ensuring broader access to the benefits of precision medicine.



Current genomic data in genomic studies come from

94.5%
European ancestry

4% Asian

0.9% Hispanic and other

0.6% African

BIOCHAR FOR CROPS

Biochar, a carbon-rich charcoal, is produced through pyrolysis of biomass at high temperatures (500°C).³⁴³ A by-product of bioenergy production, which currently makes up 55% of global renewable energy and must grow by 8% annually until 2030 if net-zero targets by 2050 are to be met,³⁴⁴ biochar as a future opportunity powers a circular approach to biomass.

With biochar, crop yields can increase by

10%



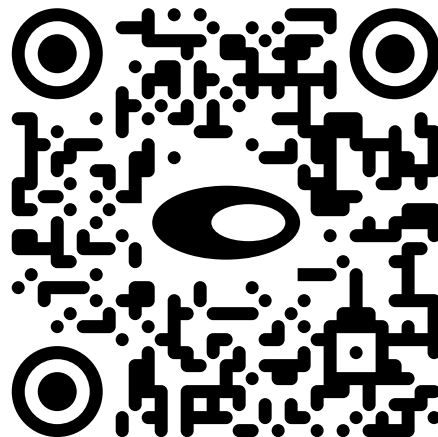
Biochar offers multiple benefits, including enhanced soil health, improved water retention, and carbon sequestration.³⁴⁵ Biochar can aid composting,³⁴⁶ water filtration,³⁴⁷ carbon capture,³⁴⁸ and agricultural yields,³⁴⁹ contributing to some of the Sustainable Development Goals (SDGs): SDG 6 (clean water), SDG 13 (carbon capture), and SDG 15 (soil health).³⁵⁰ Its role in soil health is particularly significant for sustainable agriculture and climate mitigation strategies, as it enhances soil's structure, water retention, and microbial health while reducing acidity.³⁵¹ With biochar, crop yields can increase by 10%, as it enhances nutrient absorption and retention, deters pathogens and pests, and makes plants more resilient to environmental impacts.³⁵²



This research was undertaken by the Dubai Future Foundation's Dubai Future Institute. The Dubai Future Foundation produces insights and foresight reports using evidence-based analysis and imagination that enable stakeholders to anticipate and better navigate the future.

Our publications can be found at dubaifuture.ae/insights/

Bibliography



dubaifuture.ae/bibliography-global-50-2025



About The Dubai Future Foundation

Dubai Future Foundation aims to realise the vision of His Highness Sheikh Mohammed bin Rashid Al Maktoum, Vice President and Prime Minister of the UAE and Ruler of Dubai, for the future of Dubai and consolidate its global status as a leading city of the future. In partnership with its partners from government entities, international companies, startups and entrepreneurs in the UAE and around the world, Dubai Future Foundation drives joint efforts to collectively imagine, design and execute the future of Dubai.

Under the supervision and with the support of His Highness Sheikh Hamdan bin Mohammed bin Rashid Al Maktoum, Crown Prince of Dubai, Chairman of the Executive Council of Dubai and Chairman of the Board of Trustees of Dubai Future Foundation, DFF works on a three-pronged strategy: to imagine, design and execute the future. It does this through the development and launch of national and global programmes and initiatives, preparing plans and strategies for the future, issuing foresight reports and supporting innovative and qualitative projects. These contribute to positioning Dubai as a global capital for the development and adoption of the latest innovative solutions and practices to serve humanity.

Dubai Future Foundation focuses on identifying the most prominent challenges facing cities, communities and sectors in the future and transforming them into promising growth opportunities by collecting and analysing data, studying global trends and keeping pace with and preparing for rapid changes. It is also looking at future sectors, their integration and the reshaping of current industries.

Dubai Future Foundation oversees many pioneering projects and initiatives, such as the Museum of the Future, Area 2071, The Centre for the Fourth Industrial Revolution UAE, Dubai Future Accelerators, One Million Arab Coders, Dubai Future District, Dubai Future Solutions, Dubai Future Forum, Dubai Metaverse Assembly. Its many knowledge initiatives and future design centres contribute to building specialised local talents for future requirements and empowering them with the necessary skills to contribute to the sustainable development of Dubai.



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Any Arabic translation of The Global 50 is solely for convenience. While efforts have been made to ensure accuracy, the English version shall prevail in case of any discrepancies or inconsistencies between the two translations.



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