مؤسسة دبي للمستقبل
DUBAI FUTURE FOUNDATION

NAVIGATING
MEGATRENDS
SHAPING OUR
FUTURE IN 2024

FOREWORD

The journey towards the future is never straightforward. Agility, flexibility, and resilience are needed. Paying attention to signals that tell us something throughout our journey; where opportunities arise, we capture them; where challenges arise, we manage them; and always with a vision for the future.

In this second edition of the Dubai Future Foundation's (DFF) trends report, we share some signals to watch in 2024. Serving as signposts for those interested in innovation and future growth, prosperity, and well-being, the signals are neither exhaustive nor predictions. They are signals to consider while navigating the 10 megatrends that form DFF's view of the future.

From plastic pollution and upcycling, repairability and nanoscale printing, the role of biomaterials and novel materials is evident. The rise of explainable AI (XAI), GenAI, advances in the Internet of Things (IoT), and the evolving landscape of finance through unified ledgers and decentralisation, are also areas to watch. Unsurprisingly, nature and sustainability also have a place. With the associated skills and narratives, including the advancement of next-generation technologies for solar and geothermal energy, they are coupled with the growing need for demonstration of climate technologies. The future of work and workplace, well-being and mental health – both online and in our daily lives – are also areas to watch in 2024.

Trends reports are not comprehensive; instead, they serve as windows of insight. It is through diverse views that we can better understand the world we live in and create the future we want. As always, our message is clear: within innovation lies hope and promise, and by capturing the opportunities, mitigating the challenges, and being aware of the world around us, the future will be prosperous.

KHALFAN BELHOUL

Chief Executive Officer
of Dubai Future Foundation

INTRODUCTION

In its Global 50 reports, the Dubai Future Foundation (DFF) outlines megatrends as research-led thematic paths expected to significantly influence future growth, prosperity, and well-being over a decade or more. These megatrends, characterised by their complexity and – although presented individually – interconnectedness, form part of DFF's view of the future. They are distinct from uncertainties and assumptions because of their shorter duration. They offer decision-makers and foresight professionals valuable insights across sectors, and they present themselves as areas of future opportunity.

Megatrends are dynamic and subject to evolution, particularly when they intersect with uncertainties. For instance, compared with 2022 and 2023, Megatrend 2 – previously known as 'Devaluation of Raw Data' – has evolved to 'Boundless Multidimensional Data'. This change reflects the broader transformation in data capture and analytical capabilities together with faster rates of technological adoption compared with those seen just a decade ago,[1] which were already unprecedented.

For each of the megatrends, we share signals together with relevant facts today and future outlooks, as we did in 2023. We also share keywords the reader could use in their foresight efforts and imagine some of the ways a megatrend may evolve.

The signals presented are non-exhaustive. And each reader will draw their own unique conclusions, possible opportunities and challenges, influenced by their individual circumstances.

The data mentioned in this report are non-exhaustive and were based on information available at hand at the time of publication.

Ideas and content within this report are by the DFF. GenAI was used to aid in grammar, copyediting, and translation, with human editorial oversight. Where opportunities were inspired by GenAI, these are indicated by an asterisk. All images in this report were created using GenAI with human design oversight based on specific prompts inspired by the report's content. Images do not represent real photographs and are for illustrative purposes only.

MEGATREND 01

MATERIALS REVOLUTION

Materials are fundamental to everything we use and consume on a daily basis. Advancements in materials science is being driven by machine intelligence and nanotechnology, as well as increased research activity amid recognition of the massive potential in improving what things are made of — and how. Sectors spanning industry, technology, and consumer goods will experience a material transformation.

BIO-BASED MATERIALS   CIRCULAR ECONOMY   ECODESIGN   NANOROBOTICS

PLASTIC POLLUTION   PRODUCT REPAIR   UPCYCLING   NANOSCALE 3D PRINTING

Material science is key to tackling global plastic pollution. Along with upcycling, manufacturers turn to accessible repair methods and novel materials. Nanoscale 3D printing is set to transform microelectronics, nanorobotics, and sensor industries.

MEGATREND IN ACTION IN 2024

SIGNAL 1

Addressing the ongoing global challenge of plastic pollution will depend on innovation in materials.

Solutions such as biopolymers, biorefineries, and chemical recycling are at the forefront. Alongside artificial intelligence (AI), these solutions facilitate the development of high-value products from biological materials[2] and the discovery of novel materials that compete with the appeal of plastics in terms of affordability, durability, and versatility.[3]

Found in many products worldwide from automotive, construction, packaging, textiles, and electronics,[4] and despite efforts to address the global challenge of plastic pollution, global exports of plastics hit a peak of $1.2 trillion in 2021[5] and accounted for 1.8 billion metric tonnes of greenhouse gas emissions, i.e. 3.4% of the global total (2019).[6]

Globally, only 9% of plastic waste is recycled while 71% is poorly managed or end up in landfills.[7]

Globally only

9%

of plastic waste is recycled while

71%

is poorly managed or end up in landfills

Many societies have historically excelled in **maximising material use.** The ancient Japanese practice of

Kintsugi

is one such example.

Emirates airline is transforming over **14,000 kg of A380** and **777 materials** from

refurbished aircraft into

travel accessories.

Upcycling will expand beyond fashion and into other sectors, materials will enable it.

Despite a rise in upcycling businesses in recent years[8], upcycling still primarily occupies a niche market[9]. Upcycling transforms waste or used materials into higher-value items through creative repair, reuse, refurbishment, and remanufacturing.[10]

Historically, this has been engrained in human culture.[11] Many societies in Africa, for example, have historically excelled in maximising material use,[12] and the ancient Japanese practice of Kintsugi[13] is today being increasingly adopted in the jewellery industry.[14]

While upcycling has mostly caught on in the fashion industry, where over $100 billion worth of materials is wasted and less than 1% is recycled into new clothing,[15] it is also appearing in other industries and will continue to be of interest. For example, upcycling in the food industry is set to generate more than $80 billion within the decade.[16] Annually, nearly $10 billion worth of electronic waste (e-waste) – comprising computer equipment and devices, screens, and small electronic appliances – is discarded in the United States alone,[17] and global e-waste is expected to double by 2050, but only 20% will be recycled.[18] Another example of upcycling is within the airline industry – Emirates airline is transforming over 14,000 kg of A380 and 777 materials from refurbished aircraft into travel accessories.[19] Even flowers are upcycled into incense, paper, perfume, flower arrangements,[20] and leather.[21]

SIGNAL ③

Worldwide, manufacturers will focus on more accessible product repair that will entail product re-design, new materials and new components.

70%

of greenhouse gas emissions are linked to the **materials handling from manufacturing** through to end use

Currently only 8.6% of the global economy is circular and 70% of greenhouse gas emissions are linked to the handling of materials, from manufacturing through to end use.[22] Transitioning to a circular economy necessitates the repair of products to be is a central business strategy. However, challenges like legal barriers – particularly intellectual property laws[23] – and consumer attitudes hinder repair-based business models.[24]

Product design significantly impacts repairability.[25] While the European Union (EU) ecodesign requirements do not cover all products and do not address software updates over a product's lifetime leading to irreparable failures,[26] the upcoming EU 'Right to Repair' directive is meant to be rolled out in 2024, emphasising repairability in product design.[27] This will not doubt influence both the EU's and the global attitudes towards repair.[28]

SIGNAL ④

Nanoscale 3D printing and nanoimprints will gain attention. Together, they will transform industries like microelectronics, nanorobotics, and sensor technologies.

Nanoimprints create very tiny 10 nanometer patterns particularly relevant for the growing photonics industry, valued at about

$1.4 trillion

and expected to reach nearly

$2 trillion

by 2025.

Fast-charging nanoscale batteries that can potentially charge 1000 times faster than today will transform technologies reliant on efficient energy storage and use.[29]

Nanoimprint lithography (NIL) creates very tiny patterns – recently demonstrating the capability to print down to only 10 nanometers with high precision[30] – thousands of times thinner than a human hair.[31] It is particularly relevant for the growing photonics industry, which includes telecommunications, data lasers, laser-based medical procedures, data networks, and consumer electronics, together valued at about $1.4 trillion and expected to reach nearly $2 trillion by 2025.[32]

MEGATREND 02

BOUNDLESS MULTI-DIMENSIONAL DATA[A]

An evolution of the Megatrend 'Devaluation of Raw Data' in 2022 and 2023, the rise of quantum computing, blockchains, the IoT, edge computing, automation, and digital realities, are all contributing to a data environment that is both constant and multi-dimensional. There is unprecedented volume and speed when it comes to the data available today. Enhanced by 5G, 6G, and advanced connectivity through multiple networks, and with an expected increase in the number of multilateral agreements focused on information interoperability, raw data will continue to increase in both quantity and variety. Under the right conditions, widespread access to immediate insights and real-time analysis will become commonplace.

A. Amended from 2023

ADVANCED CONNECTIVITY   BLACK-BOX AI   DIGITAL STORYTELLING   EXPLAINABLE AI (XAI)

INTERNET OF THINGS (IOT)   MULTIMODAL GENERATIVE AI (GENAI)   RESPONSIBLE AI   SMART CITIES

MEGATREND IN ACTION IN 2024

Businesses increasingly adopting explainable AI, enhancing AI model quality and customer experience.

Multimodal generative AI reshapes digital storytelling, giving way to a new understanding of cultural evolution and forming new mythologies.

Growth continues in the IoT market.

Governments are adopting more

# similar

than different strategies for AI.

Across

1,000

AI policy initiatives from 69 countries, territories, and the EU, strategies for AI are **shifting from understanding and growing AI to shaping AI.**

SIGNAL (1)

Businesses will look to adopt explainable AI (XAI) in order to meet emerging regulatory standards,[33] enhancing the quality, robustness and perception of their models.[34]

The AI industry is increasingly emphasising responsible and ethical AI use, with a particular focus on data governance, equity, and fairness covering at least 1000 AI policy initiatives from 69 countries, territories, and the EU, including some countries in the Middle East and North Africa (MENA) region.[35] Across these initiatives, governments are adopting – more similar than different – strategies for AI and establishing common foundations as they also shift from understanding and growth of AI to shaping AI.[36]

A rapidly evolving field, XAI includes processes that enable users to understand and trust the outputs of AI algorithms, which can take many shapes,[37] including annotations and labels. XAI includes diverse and comprehensive explanations, communicating uncertainties and data quality.[38] XAI explains how decisions are made and as AI becomes more complex, it becomes both essential and challenging to comprehend the decision-making processes of algorithms, often referred to as a 'black-box'. This complexity is such that even the creators of AI algorithms may find it difficult to explain how the AI algorithm arrived at a specific result.[39]
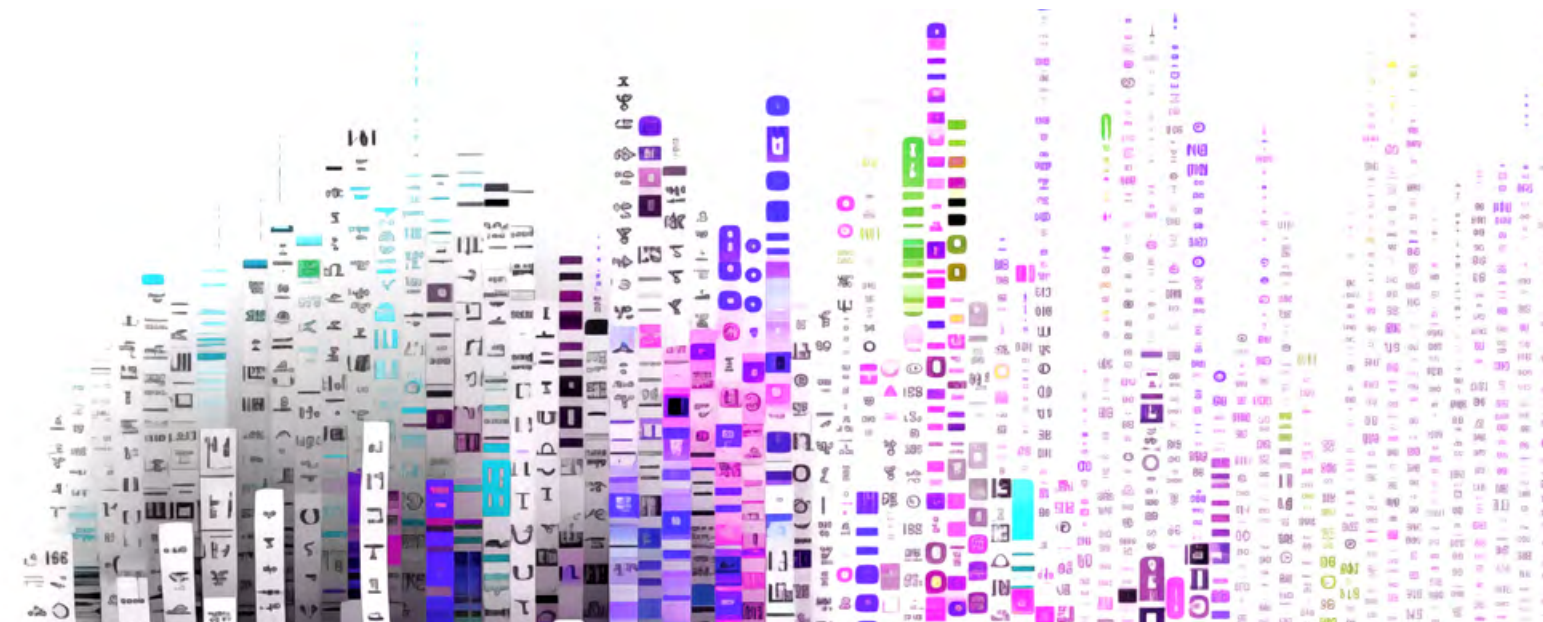
SIGNAL ②

The rise of multimodal GenAI – enriched by data from online communities – reflects the evolving digital storytelling landscape. Such data – with participant consent – will enable the exploration and documentation of cultural evolution, creating opportunities for the formation of new mythologies or histories.

Mythology, with its deep roots in storytelling, plays a crucial role in societal development by transmitting values, traditions, and history across cultures.

This evolving landscape of storytelling and cultural expression is reflected in social media use, with over 1 billion 'stories' are posted daily across Facebook's applications.[40] Furthermore, 62% of users anticipate making increased use of Facebook and Instagram stories in the future.[41] Just under 5 billion people around the world use social media, accounting for 61% of the global population.[42] The average user visits over six different platforms a month and spending nearly 2.5 hours daily on social media or about 15% of their waking hours.[43] Around 12 billion hours[44] are spent globally on social media each day, equivalent to over 1.37 million years of human life.

In five countries of the MENA region, social media adoption rates are among the highest in the world compared to the global average of 61.4%[45]: the UAE (100%), Bahrain (98.7%), Qatar (96.3%), Lebanon and Oman (both 90.5%).[46] Users aged 16–64 years access an average of 7.7 platforms monthly (Egypt, Saudi Arabia, Turkey, and the UAE), slightly above the global average of 7.2.[47] Thirty-five percent of Egyptian internet users (16–64 years) and 31% of Moroccans (16–64 years) prefer Facebook.[48] Turkey is 5th globally in Instagram use.[49] In the UAE, WhatsApp is used by more than 8 in 10 of the population, ahead of Facebook Messenger (64%).[50]

Just under

5 billion

people around the world
use social media
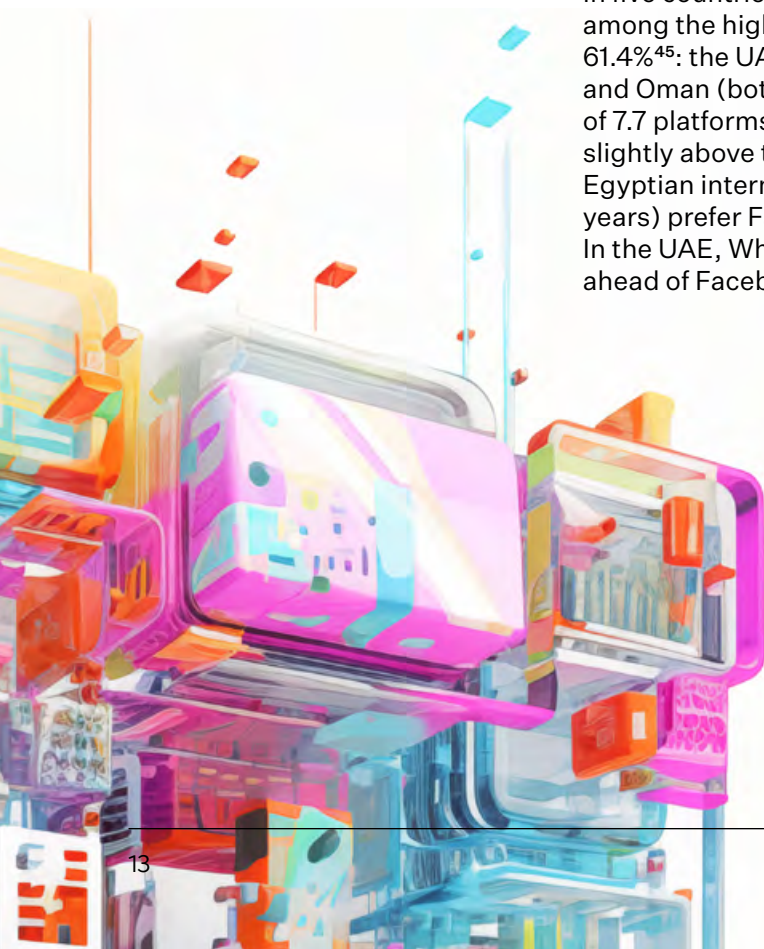
SIGNAL ③

IoT technology will continue to connect everyday objects to the internet, transforming healthcare, agriculture, and smart cities, but will keep facing challenges in security and privacy.[51]

IoT (like smart homes and industry) connected to 4G/5G accounts for over half of all cellular IoT (like wearables and smart agriculture) connections, with the total number of connections expected to have reached 3 billion by the end of 2023.[52] Meanwhile, 2G/3G IoT devices are declining, with a negative CAGR of -20% forecasted up to 2029.[53]

As examples, many national healtcare systems have defined and/or implemented a digital strategy[54] with budgets exceeding $1 billion, and some spending over $2.5 billion just on remote monitoring and home health.[55] Other directions include applying AI to water quality monitoring and modelling, combining data from varied sources, including satellite images, IoT sensors, and contributions from science initiatives,[56] allowing for improved decision-making in environmental management.[57] The number of IoT units is expected to grow from 14.6 billion in 2021 to just over 30 billion in 2027.[58]

The UAE's Telecommunications and Digital Government Regulatory Authority (TDRA) published as early as 2018 and 2019 an IoT Policy and IoT Framework to regulate and secure the IoT in the UAE.[59]

Over 30 global health systems have already spent

$2.5 billion

on **remote monitoring and home health**

The number of IoT units is expected to grow from

14.6 billion

in 2021 to just over

30 billion

in 2027.
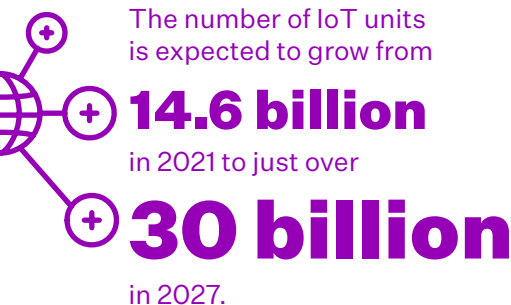
SIGNAL (4)

Driven by major projects, the MENA market for the IoT is expected to continue to grow faster than the global IoT market.

The global IoT market is expected to grow at a rate of

12%

to $1.2 trillion by 2025

The MENA IoT market is expected to grow at a rate of

18%

to $18 billion by 2025

While the global IoT market is expected to grow at a 12% compound annual growth rate (CAGR), reaching $1.2 trillion by 2025 from $793 billion in 2021, the MENA market looks set to grow at a rate of 18% to $18 billion by 2025 from $9 billion in 2021.[60]

Besides demand driven by the UAE's national strategy for AI 2031,[61] major projects include smart city development and growth in the NEOM and Al Ula projects in Saudi Arabia, the UAE's Expo 2020 site, where 15,000 cameras and 3,500 access control readers were installed in over 130 buildings, and the FIFA World Cup Qatar 2022 stadiums, which utilised over 40,000 IoT sensors to feed their digital twin with live data.[62]

MEGATREND 03

TECHNOLOGICAL VULNERABILITIES

Biotechnology, gene editing, new therapies in medicine and agriculture, ubiquitous digitalisation and automation, and the spread of IoT-enabled wearables are all ripe for exploitation. Vulnerabilities and risks will become more complex as they cross industries, technologies, and geographies, directly impacting every aspect of life and work.

ASSET TOKENISATION   COMMUNITY TRUST   CYBERSECURITY   DATA PRIVACY

DECENTRALISED FINANCE (DEFI)   IOT   SMART CITY DEVELOPMENT   SMART HOMES

MEGATREND IN ACTION IN 2024

Cybersecurity intensifies as smart home and wearable tech intensely exposed to security and privacy issues.

The rise of the committee for urban digital safety and trust.

The future of decentralised finance is debated.

SIGNAL (1)

Cybersecurity continues to be a concern.

In 2023, the global average cost of a data breach was $4.45 million, with the highest in the US at $9.5 million, followed by the Middle East at $8.1 million, and Canada at $5.1 million.[63] One in four attacks involved ransomware[64] with a 143% rise in ransomware victims globally in early 2023.[65] Data theft exfiltration in attacks rose from 40% in 2019 to 77% in 2022, and was expected to exceed this in 2023.[66] The annual cost of ransomware is projected to reach around $265 billion by 2031.[67]

143%

Rise in **victims of ransomware** globally in early 2023.

SIGNAL (2)

Challenges in security and privacy in smart home technologies will continue to grow.

Smart home technologies connect devices like lights, heating, and appliances to the internet. In the UK for example, 58% own smart TVs, 39% have smart speakers, 24% use smart fitness trackers, and 15% have smart thermostats.[68] Despite their benefits in automation and energy efficiency, smart homes pose security and privacy risks due to the sensitive data they collect and as IoT device adoption increases, understanding and mitigating these digital harms is important.[69]

There is a significant underground market on the dark web for IoT-based Distributed Denial of Service (DDoS) attack services.[70] In the first half of 2023, over 700 such service advertisements were found with prices varying based on the target's security, ranging from $20 daily to $10,000 monthly.[71] The average rate is $63.5 per day or $1350 per month, depending on factors like DDoS protection and CAPTCHA on the targeted site, which make it more challenging to carry out an attack.[72]

Smart homes pose **security and privacy risks** due to the sensitive data they collect

SIGNAL ③

We may increasingly see multisectoral digital infrastructure supervisory bodies or committees that focus on enhancing security measures for a safe and reliable digital environment in urban settings while also promoting trust within communities.[73]

One-third

of smart city projects fail and 80% of prototypes fail to scale.

As smart cities offer safer, more efficient, and resilient communities through technology and data-driven decision-making, they will bring forward potential vulnerabilities impacting public health, safety, economies, and national security.

Despite significant investments, some one-third of smart city projects fail, with 80% of prototypes failing to scale up,[74] and as projects are designed for long-term use, potential unintended consequences may last for years if not addressed early on.[75]

Not all smart city technologies are the same. Besides emergency alerts, smart traffic signals, and video surveillance, – which cybersecurity experts rate as higher risk because of their technical vulnerabilities, appeal to attackers, and potential for disruption[76] – critical infrastructure in, for example, energy, water and emergency response,[77] will be especially so because of increasing decentralisation.

The global smart city technology market is projected to grow from $121 billion in 2023 to $301 billion by 2032, with a CAGR of just under 11% CAGR.[78]

SIGNAL ④

Whether or not DeFi will be the future of finance continues to be discussed and is an area to watch.

The total value locked (TVL) in DeFi fell from

$163 billion

in April 2022 to

$36 billion

in October 2023

In 2023, DeFi reached its lowest total value locked (TVL) since its peak in 2020.[79] However, as the landscape evolves and the trend of decentralisation continues since 2018,[80] the need to consider regulatory collaboration through an umbrella framework addressing legal enforceability, conflict resolution, consumer protection, data privacy, and compliance with Financial Action Task Force (FATF) and EU crypto regulations may become important.[81]

The TVL dropped significantly from just over $163 billion in April 2022 to $36 billion in October 2023 with DeFi yields dropping from between 18% and 35% to Ethereum yields that are just over 3%.[82] The value of crypto assets in Ethereum-based DeFi applications reached $86 billion by the end of 2021, with lending being the largest segment, accounting for over half of the value in DeFi applications.[83]

DeFi's future growth faces challenges in scalability and blockchain-based settlement, with its decentralised nature also leading to potential higher transaction fees and longer confirmation times.[84] Its expansion depends on the development of asset tokenisation and liquidity.[85]

MEGATREND 04

ENERGY BOUNDARIES

Energy is imperative to everyday life and will continue to be so in the future. Technological advances and the growing demand for energy will drive exploration and the pursuit of new and alternative sources of energy. Novel materials and machine intelligence will enhance the generation of existing sources of energy and their transmission and distribution to any place on Earth or in space, pushing the boundaries of the energy ecosystem to levels previously unseen.

COP28   GEOTHERMAL ENERGY   REGIONAL GRID CONNECTIONS   PHOTOVOLTAICS (PV) MANUFACTURING

NEXT-GENERATION SOLAR CELLS   JUST ENERGY TRANSITION   RENEWABLE ENERGY   SOLAR ENERGY

MEGATREND IN ACTION IN 2024

A just energy transition advances with context-specific strategies.

Solar energy continues to grow with materials science.

Africa and other regions eyeing geothermal energy are crucial to boosting access to energy even beyond borders.
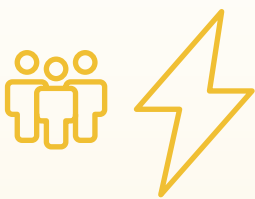
Top 10% of earners using

20x

more energy
than **the bottom 10%**

Although global energy
transition investment in
2022 hit

$1.3 trillion

**It is still less than
One-quarter** of the
International Renewable
Energy Agency's (IRENA)
2023–2030 yearly target

SIGNAL (1)

The pursuit of a just energy transition will continue with strategies aligned on specific aims that vary based on the context and industry mix.

In 2022, some 760 million people still lack access to electricity, the first increase in at least two decades because of increased energy costs and reduced investments, particularly in sub-Saharan Africa; this number was expected to go down to 740 million by the end of 2023.[86] Energy consumption disparities are significant, with the top 10% of earners using 20 times more energy than the bottom 10%.[87] Similar inequality extends globally: the poorest 20% in the UK consume over five times more energy per person than the bottom 84% in India.[88] In the EU as a whole, over 9% of households could not afford adequate heating in 2022, rising to, for example, 22.5% in Bulgaria and 17.5% in Lithuania.[89]

Historically, significant shifts in automation and industry have led to job losses and economic challenges, fuelling concerns about the potential hardships of future transitions.[90] As a result, a sustainable energy transition that addresses both income and energy inequality[91] is essential for widespread social support of the significant changes that this shift involves.[92]

Both the International Labour Organization (ILO)[93] and the World Energy Council[94] have developed a set of guiding principles and toolkits for a just transition. In addition, a high-level dialogue between COP28 and the International Energy Agency (IEA) agreed – what a concensus among 40 global leaders – to scale up clean energy investments in emerging and developing economies.[95] Although global energy transition investment in 2022 hit $1.3 trillion, it is still less than one-quarter of the International Renewable Energy Agency's (IRENA) 2023–2030 yearly target.[96]

SIGNAL (2)

Solar energy will continue to grow as costs continue to decrease and innovative materials boost efficiency and make solar photovoltaics (PV) ubiquitous.[97]

There are several sources of clean energy: solar, wind, green hydrogen, geothermal, hydropower, biomass, and tidal.[98] Solar energy is the most plentiful resource and is harvestable even in overcast conditions.[99] Its equates to 10,000 times the global energy usage rate.[100]

Solar PV, adaptable for both small and large-scale applications, remains the most affordable new electricity source worldwide, despite rising costs due to commodity prices.[101] Its share of the cumulative renewable energy capacity, at 14.7% in 2023, is expected to surpass natural gas by 2026 and coal by 2027, becoming the largest of the mix at 22.2%.[102]

From a materials perspective, next-generation solar cells will be thinner,[103] more flexible,[104] and – eventually – printable.[105] Perovskite, for example, is a material with the potential to triple solar panel conversion efficiency from 16% to 66% and potentially even up to 85% with maximum solar light concentration.[106] Using appropriate materials, windows may themselves convert invisible UV and infrared light to electricity.[107]

In 2022, the global solar PV manufacturing capacity soared by 70%, with 95% of new manufacturing facilities based in China.[108] Expecting growing demand, Middle Eastern nations must innovate locally in climate technologies , including solar, to be competitive.[109] In the UAE, and commissioned between 2013 and 2021, the largest two solar PV sites[110] include the Mohammed Bin Rashid Al Maktoum Solar Park in Dubai, and the Noor solar PV site in Sweihan Abu Dhabi, both of which generate just over 1 GW of power each.[111]

Reflecting the UAE's growing solar sector, and in the lead up to COP28, Abu Dhabi inaugurated the Al Dhafra solar PV site set to be the largest single-site in the world with a capacity of 2 GW.[112]

In the UAE, the three largest Solar PV sites include

Noor in Sweihan, Abu Dhabi
(1 GW)

Mohammed Bin Rashid Al Maktoum Solar Park in Dubai
(1 GW)

Al Dhafra site in Abu Dhabi
(2 GW)

SIGNAL ③

To address growing energy needs, Africa, and other regions, will pay more attention to geothermal energy, particularly in volcanic areas that, through regional grid connections, may facilitate the export of geothermal power to nearby islands.[113]

The top 10 countries, in descending order, for **Geothermal capacity**

⚡ **3.8 GW**

United States
Indonesia
Italy
Japan
Kenya
Mexico
New Zealand
The Philippines
Turkey
with a capacity of
0.6 GW

Geothermal energy is under-represented in decarbonisation efforts but its potential is high.[114] The sector aims to reach 48 GWe[B] for power by 2030[115] from nearly 16 GWe in 2021[116], with various regulatory frameworks, incentives, and other key enablers supporting geothermal market growth and increased collaboration between nations.[117] By 2050, with $35 billion investment and led by Kenya and Ethiopia, Africa's geothermal capacity will increase to 13 GW, surpassing Europe's 5.5 GW.[118]

Classified within 'other renewables' by the IEA, geothermal energy provides heating, cooling, and consistent power generation from diverse sources such as high-temperature hydrothermal resources, low- and medium-temperature aquifers, and hot rock resources, i.e. from the earth's crust.[119] Each type of geothermal source has unique characteristics in terms of location, temperature, and depth, requiring the development of specific technologies for each.[120] The top 10 countries, in descending order, include the United States, with a capacity of nearly 3.8 GW, Iceland, Indonesia, Italy, Japan, Kenya, Mexico, New Zealand, the Philippines, and Turkey, with a capacity of 0.6 GW.[121] Tax incentives, subsidies, grants, and other financial incentives can help make geothermal energy competitive with alternative sources of energy.[122]

Between 2015 and 2021, the geothermal sector grew around 5%, but accounting for only 0.5% of global renewable electricity capacity.[123] However, geothermal heating and cooling grew at around 9% between 2015 and 2020, to reach 107 GWt[C] in 2020, which is nearly 3% of the global renewable heating and cooling capacity.[124] The G2COOL project in Masdar City Abu Dhabi in the UAE, was launched in December 2023 and supplies 10% of cooling needs in Masdar City through geothermal energy.[125]

[B] Gigwatt electrical
[C] Gigwatt thermal

MEGATREND 05

SAVING ECOSYSTEMS

Driven by resource scarcity, climate change, and shifts in social values, environmental impact management will increasingly move towards the holistic management of ecosystems. Approaches to conservation will be more interdisciplinary and future-focused, taking into account both societal and environmental factors and with the goal of maintaining biodiversity while meeting basic human needs.

BIODIVERSITY   BIOTRADE   CLIMATE NARRATIVE   GREEN JOBS   SKILL SET TRANSITION

NET-ZERO   RESEARCH, DEVELOPMENT, AND DEMONSTRATION (RD&D)   SUSTAINABLE DEVELOPMENT GOALS

MEGATREND IN ACTION IN 2024

BioTrade is the new fairtrade.

Beyond R&D, investments in demonstrating new energy technologies in the path towards net-zero.

Climate narratives sharpen focus and demand new skills for a changing job market.

SIGNAL ①

BioTrade may emerge as the new fairtrade and will boost emerging economies through sustainable trade in biodiversity-derived products.[126]

Supported by the BioTrade initiative of the United Nations Conference on Trade and Development (UNCTAD),[127] BioTrade is part of the Sustainable Development Goals.[128] It refers to the sustainable collection, production, transformation, and sale of goods and services derived from biodiversity, available in a specific area, adhering to certain sustainability standards.[129]

'BioTrade', with capitalised 'B' and 'T', signifies sustainable trade in biological resources, unlike 'biotrade', which broadly covers trading in biological ingredients, regardless of sustainability.[130] BioTrade is active in around 100 countries.[131] In 2021, the global value of BioTrade was estimated at about $3.7 trillion, growing at an annual rate of 29% in the previous 10 years.[132] During the same period, BioTrade in medicine, pharmaceuticals, and personal care outpaced traditional animal and plant trade, with pharmaceuticals growing at 70%.[133] The top three exporters include the China, the European Union, and the United States.[134]

Biodiversity, vital for the livelihood of over 4.3 billion people's, especially the rural poor, faces severe threats, with 40% of the world's land degraded and a million species at risk of extinction.[135] To address this and to support the United Nations (UN) Sustainable Development Goals and the 2050 vision of living in harmony with nature, the Kunming-Montreal Global Biodiversity Framework was adopted in December 2022.[136] This non-binding, yet influential, agreement, aims to halt and reverse biodiversity loss by 2030.[137]
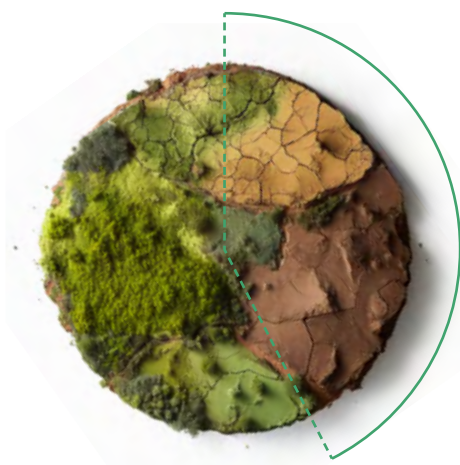
Biodiversity faces severe threats, with

40% of the world's land degraded

and a million species at risk of extinction.

In 2021, private companies invested nearly

$120 billion

in energy RD&D,

3X more

than government spending.

SIGNAL ②

Governments will prioritise investment into research and development, and also demonstration (RD&D), of energy technologies, as a key strategy for advancing towards net-zero goals.[138]

Recognising that many essential technologies for achieving net-zero emissions are not yet market-ready, this trend will focus on accelerating the maturity and deployment of these innovations, emphasising the crucial leap from research to real-world application.[139]

Global government energy RD&D spending reached $38 billion in 2021, 5% more than the previous year.[140] In 2021, private companies invested nearly $120 billion in energy RD&D, three times more than global government spending, with the automotive sector leading.[141] Despite the significant role of firms in energy innovation, detailed information on their activities, whether publicly or commercially available, remains limited.[142]

For policymakers, encouraging private sector involvement is essential for converting RD&D outcomes into market applications because private sector engagement – while growing – is often limited to later stages of the technology cycle, such as demonstration and commercialisation, rather than the early phases.[143]

By 2024

ESG

funds are expected to comprise half of the

$80 trillion

global professionally managed assets.

SIGNAL ③

The climate narrative will continue to spread, and met with greater scrutiny.

A trend towards a stronger environmental connection is anticipated influenced by advancements in technology and shifts in cultural attitudes.[144] Driven by meaningful community actions, some of the narratives may shift from climate anxiety to climate optimism.[145] However, narratives will most likely focus on ensuring that environmental claims are substantiated, either pushed by requirements such as the European green bond standard[146] or in response to a shift towards transparency and accountability in communications when it comes to environmental initiatives.[147]

In 2022, 52% of consumers made sustainability-driven purchases, with 34% paying notably more.[148] By 2024, environmental-, social-, and governance (ESG)-focused funds are expected to comprise half of the $80 trillion global professionally managed assets, but only 3% of consumer companies provide sustainability data as reliable as their financial data.[149]

SIGNAL ④

To reach net-zero aims, a new skill set will be necessary, altering both the demand and supply in the green job market.[150]

As in the just transition, acknowledging the unique economic mix within each country – industries and incomes[151] – is important as governments will focus on developing employment sectors that are context dependent.[152] The renewable energy sector will create 40 million jobs in the global energy sector by 2050, including jobs in wind and solar power, biomass, geothermal energy, and other renewable energy sources.[153] More generally, at least half of the world's workforce, amounting to around 1.5 billion individuals, will be impacted by the shift towards a more environmentally sustainable economy.[154]

For those already in the job market, 65% of employees prefer companies with aligned environmental policies and two-thirds want to learn green skills for future job relevance.[155] In the EU for example, employment in the environmental goods and services sector outpaced overall employment growth, increasing from 2.1% in 2010 to 2.5% in 2020, with 5.1 million full-time jobs.[156] This increase, mainly due to renewable energy, energy efficiency, and waste management jobs, aligns with the EU's goal to be carbon neutral by 2050.[157] Through decarbonisation and green industrial growth, the MENA region could generate 10 million new jobs and boost gross domestic product (GDP) to 7.2% and employment to 5.3% by 2050.[158]

The renewable energy sector will create

40 MILLION JOBS

in the global energy sector by 2050.

MEGATREND 06

BORDERLESS WORLD – FLUID ECONOMIES

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

BIG TECHNOLOGY COMPANIES

OVER-THE-TOP (OTT) SERVICES

CROSS-BORDER PAYMENTS

MARKET REGULATION

CENTRAL BANK DIGITAL CURRENCIES (CBDCS)

SMART CONTRACTS

TELECOMMUNICATIONS

UNIFIED LEDGERS

MEGATREND IN ACTION IN 2024

The financial market infrastructure continues to evolve through central and regional banks, and international financial institutions.

Unified ledgers streamlining global transactions gaining momentum in 2024. Central bank digital currencies keep coming up.

Telecommunications and media adapt to an evolving market landscape.

SIGNAL ① 1

Efforts towards a novel financial market infrastructure will continue[159] as central banks, regional development banks and international financial institutions like the World Bank, International Monetary Fund (IMF), and Bank for International Settlements (BIS) promote, announce, or take steps towards unified ledgers.

However, the idea of unified ledgers is not just limited to central banks – they can also be implemented in organisations. Leveraging smart contracts, secure data sharing, and tokenisation – irrespective of the use of blockchain or distributed ledger technology (DLT)[160] – paves the way for a new financial system expanding the scope of possible solutions to challenges in the financial sector.[161]

A unified ledger – automating and integrating transactions – would provide central banks and participants in the financial system greater efficiency, access to real-time data, and more transparency.[162] As a new financial infrastructure, it could maximise tokenisation's benefits by blending central bank money with tokenised deposits and assets on a programmable platform.[163] This would not only streamline transactions but would also use programming for innovative economic, currently not feasible, responses to challenges.[164] CBDCs are meant to make tokenisation even more seamless as a mean of settlement.[165]

This is not without risk though. To ensure interoperability and to reduce both inequality and cybersecurity risk, multiple specialised ledgers could coexist, interconnected through application programming interfaces (API) and tailored to specific jurisdictional needs,[166] also not trivial.

A unified ledger

would provide central banks and participants in the financial system **greater efficiency, access to real-time data,** and **more transparency.**

98%

of the global economy, encompassing 130 countries, is already exploring **digital currencies**

The push for CBDCs will continue in 2024,

driven by declining cash use and increasing competition from cryptocurrencies and technology companies, and as a response to sanctions impacting on global payment systems.[167] Some 98% of the global economy, encompassing 130 countries, is already exploring digital currencies.[168] Nigeria and several Caribbean nations are examples of the 11 countries that have already launched CBDCs.[169]

China's CBDC pilot covers 260 million people, while India and Brazil plan launches in 2024.[170] However, for those in the advanced stages or late stages of development,[171] the uptake has been mixed, with some countries like Nigeria seeing low adoption and others like Senegal and Ecuador halting development. In the case of Nigeria, following the launch of the digital currency eNaira in Nigeria in October 2021, the number of eNaira wallets reached 13 million by March 2023 compared with a population of 224 million[172] and, its value reached $48 million in comparison to a $220 billion informal – cash-based – economy.[173] To increase adoption, Nigeria would need to revisit policies related to exchange rates and financial inclusion.

Cross-border CBDC projects are increasing, with the European Union and countries like Australia and South Korea advancing pilots.[174] The European Central Banks (ECB) aims for a digital euro pilot by 2028, with over 20 other countries progressing towards pilots.[175] Saudi Arabia and UAE central banks collaborated on Project Aber, a digital currency and DLT proof of concept for improved cross-border settlements, suggesting further research into tiered CBDC issuance.[176] Following Project Aber's success, the UAE central bank is now implementing a comprehensive CBDC strategy throughout 2024, including the launch of 'mBridge' for cross-border transactions with India for international trade settlement after a successful pilot.[177]

In 2010,
the top 10 global telecommunication providers **outearned** big technology companies.

but by 2021,
big technology companies **earned 1.5 times more.**

Global data consumption is expected to

3X

by 2027, from 2022 around

$342 billion

in network investments is needed.

SIGNAL ③

Global telecommunications and media providers and regulators will continue to adapt to an evolving market landscape.

Telecommunication connectivity is expected to grow at a 2% CAGR from 2022 to 2026, and information and communications technology (ICT) services at a 5% CAGR during the same period.[178] ICT services , and not limited to, include technologies for information transmission, storage, creation, and sharing,[179] including the IoT, big data, cloud computing,[180] extended reality[D] robotics, and smart home services.[181]

In 2010, the top 10 global telecommunication providers outearned big technology companies,[E] but by 2021, big technology companies – who offer services alternative to traditional telecommunication and media services – earned 1.5 times more.[182] Streaming or over-the-top (OTT) services,[183] such as YouTube, iMessage, WhatsApp, Instagram, e-commerce and online video game platforms, Netflix, TikTok,[184] Shahid and Starzplay,[185] have been transforming economies in both developed and developing countries for the past decade[186] and are not subjected to the same regulatory treatment as traditional services.[187]

In response, global regulators are revisiting regulations ensuring growth and innovation in the long run[188] and supporting essential connectivity infrastructure investments.[189] As global data consumption is expected to triple by 2027, around $342 billion in network investments is needed.[190] Achieving such a balance is not trivial.[191]

Examples from around the world include the EU's Audiovisual Media Services Directive (AVMSD) amended in 2018,[192] and video-on-demand (VOD) providers in France, Greece, and Italy, who must, respectively, invest up to 25%, 1.5%, and 20% (by 2024) of their annual turnover in local/European productions.[193] Other examples include Canada's Bill C-11, which was passed in 2023[194] and the UK's draft media bill published in 2023.[195] Regulators in MENA countries have not disclosed similar plans despite higher capital expenses and increasing competition, and higher capital expenses,[196] from new technologies, large cloud service providers and low earth orbit satellite operators.[197]

[D] Encompassing augmented reality (AR), virtual reality (VR), and mixed reality (MR).

[E] Google, Apple, Meta, Amazon, and Microsoft.

MEGATREND 07

DIGITAL REALITIES

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

5G COVERAGE   6G NETWORKS   DECENTRALISED APPLICATIONS (DAPPS)   LOW LATENCY

SMART CONTRACTS   TECHNOLOGICAL INCLUSION   TOKENISED IP   WEB3

MEGATREND IN ACTION IN 2024

The sports industry moves further into digital realities.

5G deployment progresses as industry eyes 6G infrastructure for launch by 2030 while technological inclusion is seen as both a business opportunity and an opportunity for equitable access.

SIGNAL ①

Decentralised Applications (DApps) allow users to gain more control over ownership of digital services and experiences in Web3. This shift marks a new era of efficiency and empowerment in the sports industry.[198]

The sports industry expanded from $355 billion in 2021 to $501 billion in 2022 and is expected to grow to $708 billion by 2026 at a 9% CAGR.[199]

Athletes are adopting DApps for smart contracts, ensuring direct, prompt earnings and securing intellectual property, while the sports industry uses DApps for anti-doping transparency.[200] DApps can also enhance fan engagement through blockchain-based loyalty programmes, offering unique experiences[201] and increasing revenues while also rewarding fans for their participation and content creation acts as a first step towards tokenised intellectual property (IP).[202] As DApps operate on a peer-to-peer network, they would securely store user data across nodes, with smart contracts governing its functionalities, enabling automated, intermediary-free user interactions.[203]

The cryptocurrency Chiliz, through its Socios platform, has expanded its 'SportFi' ecosystem, incorporating over 25 sports-related ventures with the aim of developing Web 3.0 sports technologies on the Chiliz Chain, which includes over 150 fan tokens, applications, and games.[204] Despite criticism from fans and community leaders in respective sports team cities regarding the fan token concept, Chiliz champions its role as one that enhances fan engagement.[205]

The Chiliz Chain has facilitated over 3 million transactions with more than 2 million users, positioning it as the largest non-finance Web 3.0 platform globally.[206] Now a permissionless platform, it allows any party to start building applications on it.[207] This diverse ecosystem not only opens new revenue streams in sports but also marks a shift in how fans interact with their favourite teams, offering unique experiences like sports metaverses, games, and digital collectables.[208]

The sport industry is expected to grow from

$501 billion

in 2022

$708 billion

by 2026 at a 9% CAGR.

Decentralised Applications

(DApps) are shifting how fans interact with their favourite teams.

SIGNAL ②

As 5G networks are being deployed worldwide, the industry is shifting its focus to infrastructure needs to roll out 6G, which is expected to launch globally around 2030.

4G
coverage
has reached

90%

—

5G
coverage
has reached

32%

(2023)

Since 1979, cellular networks have evolved rapidly from 1G to 5G, improving bandwidth, latency, energy efficiency, reliability, security, and performance.[209] As global 4G coverage reaches 90% and 5G coverage reaches 32%, with significant expansion in the Asia-Pacific region and sub-Saharan Africa, 2G and 3G remain crucial in low- to middle-income countries.[210] Global 5G connections are expected to reach 3.8 billion by 2027, up from 1.5 billion in 2023.[211]

Currently still in research, 6G aims to significantly enhance connectivity, especially in terms of speed, reliability, and robustness, and extend network coverage to rural and remote areas, potentially integrating with the space and satellite sectors.[212] However, 6G will need to overcome more considerable development, investment, and technical challenges.[213]

Data speeds of up to 1 terabits per second (Tbps), 100 times faster than the current peak 5G speeds, are expected to be delivered by 6G enabling data-heavy applications like XR, high-definition streaming, and real-time collaboration.[214] The 6G technology is also anticipated to support up to 10 million IoT devices per square kilometre, a tenfold jump from 5G's 1 million and significantly surpassing 4G's 2,000 device capacity.[215] And 6G is a key enabler of digital realities.

6G is expected to deliver data speeds up to 2 terabits per second, **100 times faster than the current peak 5G speeds.**
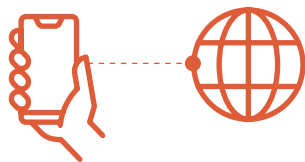
4 billion

people use smartphones to **access the internet**
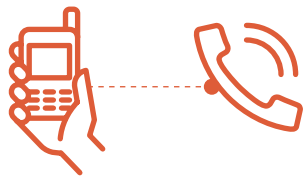
while

600 Million

rely on **basic mobile phones**

SIGNAL ③

Technological inclusion will emerge as a priority in order to support areas where networks cannot handle high-bandwidth and low-latency applications.[216]

Including areas that are outside areas of coverage or where coverage is unaffordable,[217] latency is the delay in sending and receiving data over the internet, while bandwidth is how much data can be transferred per second.[218]

In 2022, mobile internet adoption growth slowed, with only 200 million new users compared with 300 million in the two previous years.[219] Four billion people use smartphones to access the internet, while 600 million rely on basic mobile phones.[220] Internet access varies greatly worldwide, not just between developed and developing countries or rural and urban areas but even in some areas within developed countries.[221] Globally, in 2021, internet users in rural regions were half that of urban areas.[222]

In 2022, about one-third of the global population, some 2.7 billion people, lacked internet access, and just over half of the world did not have access high-speed broadband.[223] The distribution of these unconnected individuals differs significantly by region: 89% in Europe, over 80% in the Americas, and 70% in the Arab states have internet access, in contrast to Asia's 61% and Africa's 40%.[224]

MEGATREND 08

LIVING WITH AUTONOMOUS ROBOTS AND AUTOMATION[F]

While a robot is a machine designed to sense, process, act, and communicate, automation refers to technology that executes tasks with minimal human input; enabling the functioning of robots, as well as reasoning and decision-making systems. Driven by profound progress in mechanical engineering design, materials science, machine intelligence, and advanced communication networks, robots and automation will increasingly enter many, if not all, industries beyond the automotive, manufacturing, and supply chain logistics, and services sectors. This will provide opportunities for efficiency and innovation although there will also be ethical and societal challenges.

[F] Slightly amended from 2023

CYBERSECURITY   FUTURE OF WORK   ROBOTICS   GENERATIVE AI

GRADUAL AUTOMATION   LOW-CODE / NO-CODE AI   TASK AUTOMATION

MEGATREND IN ACTION IN 2024

Process automation gives way to low-code, no-code AI platforms that enhance productivity.

Existing machines and applications team up with GenAI to transform work and life.

How GenAI evolves and what comes next continues to get attention.

SIGNAL ①

While task automation globally is taking place at a slower pace than anticipated,[225] this is not the case when it comes to robotics in the Middle East.
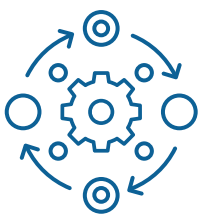
Globally, task automation stands at 34%, a marginal increase from 33% in 2020 but lower than the earlier forecasts of 47% by this time.[226] Businesses now forecast 42% task automation by 2027, 35% of which will involve decision-making and 65% of which will entail data processing.[227] In contrast, reasoning and communication will see an increase in automation of 9% by 2027.[228] As per the World Economic Forum's Future of Jobs Report (2023), 75% of companies are planning to use AI by 2027,[229] which is expected to lead to 50% job growth at 50% of surveyed organisations, and may also lead to job losses at 25% of surveyed organisations in various sectors.[230]

When it comes to robotics, it is not surprising to see a slower growth rate in industrial robot installations in 2023 as a consequence of economic conditions particularly in the United States,[231] and after the pandemic in the rest of the world.[232] Nevertheless, the long-term outlook is positive as global service robot installations set to reach $216 billion by 2030, growing at a 21.5% CAGR[233] especially in the Middle East where robotics is rapidly advancing and becoming integral to manufacturing, healthcare, and logistics and the service robotics market is set to reach $216 billion by 2030, growing at a 21.5% CAGR. Saudi Arabia, for example, plans to integrate 200,000 robots into NEOM city and automate 4,000 factories in five years or by 2028, while Bahrain aims to build 300 smart factories by 2026.[234] In the UAE, Dubai's Robotics and Automation Programme targets a 9% GDP contribution by 2032, deploying 200,000 robots in sectors like logistics, research and development in manufacturing, consumer services, mobility, extreme environments, and healthcare.[235] Overseen by the Dubai Council for Robotics and Automation, the plan is to position Dubai among the top 10 cities globally in robotics.[236]

Task automation stands at

34%

lower than the earlier forecasts of

47%

by this time

SIGNAL ②

Low and no-code AI platforms will continue to enable users to enhance their productivity and solve problems more efficiently.[237]

By the end of 2023, it was estimated that low-code platforms would have been used to develop 500 million digital applications just in the last decade; the same number of applications developed in the last 40 years.[238]

Implementing a low-code application platforms enables rapid application development, digitisation of services and processes, and the fostering of innovation,[239] examples including Microsoft Power Apps,[240] and Quickbase,[241] which allow organisational teams to create applications independently, reducing reliance on IT resources.[242] However, it also heightens risk with applications lacking IT oversight,[243] risking breaches that have reached, on average, costs of $4.45 million.[244] For example, in 2021, more than 1,000 applications configured using Microsoft Power Apps were breached, exposing 38 million records.[245]

The global no-code AI platform market size is expected to reach just over $20 billion by 2030 and is anticipated to grow at a CAGR of 27% from 2023 to 2030.[246] GenAI is transforming the no-code AI sector, potentially expanding the developer community by tenfold from its current 20 to 25 million developers[247] and opening up opportunities to non-technical users.[248] However, for complex tasks or those unfamiliar to the developer, time savings fell below 10%. Interestingly, novice developers sometimes spent up to 10%[249] longer using these tools whereas collaboration between tools and developers maintained quality without compromising speed.[250]

GenAI is transforming the no-code AI sector, potentially expanding the developer community by

tenfold

from its current
~25 million developers

The global **no-code AI platform** market size is expected to reach just over

$20 Billion

by 2030 and is anticipated to **grow at a CAGR of 27% from 2023 to 2030.**

SIGNAL ③

Generative AI will influence every area of work and life – online and offline – and its rapid evolution will continue to be challenging to track[251] and anticipate.[252]

The GenAI market is expected to grow from $40 billion in 2022 to $1.3 trillion in a decade.[253] This 42% CAGR is driven by digital advertisements, spin-off applications, services, and more.[254]

Google was 'the AI company' for nearly 10 years[255] until OpenAI introduced ChatGPT in November 2022.[256] This was followed by OpenAI's GPT-4 in March 2023.[257] By May 2023, Anthropic's GenAI Claude could process 75,000 words in a minute from 9,000 words just two months before.[258] Concurrently, Google introduced Search Generative Experience and PaLM 2 for its Bard chatbot[259] and in December 2023, Google unveiled Gemini AI, a new large language model that exceeds the performance and abilities of its predecessors.[260]

The UAE is leading the Gulf Cooperation Council (GCC), the Middle East and even rest of the world,, in adopting GenAI.[261] Government support and private sector strategies are fostering AI growth, emphasising job transformation, privacy, and safety.[262] As a result, investments in GenAI in the GCC are projected to generate $23.5 billion by 2030.[263]

By May 2023, Anthropic's GenAI Claude could process

75,000 words

in a minute from 9,000 words just two months before.

MEGATREND 09

FUTURE HUMANITY

Human potential is unlimited. With advanced machine intelligence, brain–computer interfaces (BCIs), technological developments 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.

- MENTAL HEALTH DATA DISPARITIES
- GENERATIVE AI
- HUMAN–AI CREATIVITY
- LONELINESS
- TALENT RETENTION
- UPSKILLING AND RESKILLING
- WELL-BEING
- WORKPLACE REIMAGINATION

MEGATREND IN ACTION IN 2024

Future of work shifts focus to talent retention, as well as both tangible and intangible workplace elements.

Beyond art, the rise of AI-supported creativity in text and audio, spurs a new creative wave.

Social isolation and loneliness continue to be reported across age and socio-economic groups with disparities in data access.

SIGNAL ①

By 2025

half of all employees

will need reskilling because of new technologies and

a third

of the essential skills will **consist of technology competencies.**

Along with a focus on the future of work, a transformative reimagination of the workplace may occur, focusing on both tangible and intangible aspects of work, with talent retention becoming crucial.[264]

Emphasis on co-creating new workplace norms and adapting human resources for non-traditional skill sets from digital literacy and communications, to cultures and sustainability, for example, will be key, alongside on-the-job upskilling.[265]

By 2025, half of all employees will need reskilling because of new technologies and a third of the essential skills will consist of technology competencies.[266] Extending to government and public sector entities who have traditionally used technology for the delivery of government services, the pandemic-induced remote work shift expanded technology's role as an opportunity to augment performance with technology and repurposing physical spaces to maximise delivery value of government services.[267]

The

$65 Billion

art market, employs

millions

globally.

In 2018, Christie's sells the 'Edmond de Belamy', **the most expensive printed AI art**[G] to date for

$432,000

SIGNAL ②

The rise and widespread adoption of AI-enabled creativity, producing new text, sounds, and images, will foster a new wave of creativity and demand new skills to effectively utilise these technologies.[268]

This evolution will lead to a shift in the traditional definitions of who an artist or designer is. The $65 billion art market, employing millions globally, continue to debate the long-term impact of AI-made art.[269]

While exact numbers are not always clear, DALL-E 2 has over 1.5 million users producing more than 2 million images daily, while Midjourney's Discord server has attracted over 3 million members.[270] GenAI is reshaping this space and making art and design accessible to the non-artists or non-designers,[271] reaching up to 100 million weekly ChatGPT users.[272]

Research depicted that art labelled as AI-generated is devalued, even if indistinguishable from human art,[273] and that comparing AI-generated art with human art enhances the latter in terms of perceived creativity.[274] To date, art created through human–AI collaboration is more valued than solely AI-produced art, but less so than exclusively human art.[275]

Whether this trend changes as more artists use AI through reskilling,[276] or artists get better at using AI, remains to be seen as there are concerns about potential standardisation and homogenisation risking originality, diversity, and dampening creativity.[277] Like research using GenAI, the risk of misuse and biased outputs, and concerns regarding authorship, could hinder diverse, unique, and subjective art production.[278]

[G] Christie's (2018) 'Is artificial intelligence set to become art's next medium?'. 12 December. www.christies.com/en/stories/a-collaboration-between-two-artists-one-human-one-a-machine-0cd01f4e232f4279a525a446d60d4cd1

SIGNAL ③

Social isolation and loneliness are widespread across all age groups and differences between high- and low-income countries will persist.[279]

An estimated 1 in 4 older adults (65+ years) are experiencing social isolation, and between 5% and 15% of adolescents are experiencing loneliness.[280] Loneliness arises from a gap between desired and actual social relationships, impacting well-being and it is linked to adverse health outcomes like poor cardiovascular health, sleep disturbances, cognitive impairments, and increased mortality risk.[281]

In a Meta-Gallup survey in 140 countries, older adults (65+ years) report the lowest loneliness levels (17%), while young adults (19–29 years) have the highest (27%), challenging assumptions about age and loneliness.[282] Globally, loneliness rates are similar between men and women, with 24% in each group reporting feelings of loneliness.[283] While, 49% of those surveyed worldwide do not feel lonely at all, some 2.2 billion people,[284] 5% of teenagers (aged 15–18 years) reported feeling disconnected.[285]

With data gaps between high-, middle-, and low-income countries,[286] it is challenging to further research and aid effective policies and solutions on social connectedness and loneliness around the world.[287] The need for standardised loneliness measurements covering broader geographical regions and age groups,[288] and with changing views on self-realisation, personal development, and community connectedness, underscore the need to tackle this challenge.

1 in 4

older adults (65+ years) are experiencing social isolation

and up to

1 in 6

of adolescents are experiencing loneliness.

MEGATREND 10

ADVANCED HEALTH AND NUTRITION

Progress in advanced machine intelligence, nano- and biotechnology, additive manufacturing, and the IoT will change both what we mean by health and nutrition and how they are experienced. Stemming from the unprecedented developments that will be required to respond to climate change, resource scarcity, and the desire for longevity, this megatrend will improve health in both the younger and the older years. It will reduce, if not eradicate, some communicable and non-communicable diseases and enhance the sustainable use of and access to water and food.

ATTENTION ECONOMY   FOOD PRICE INFLATION   LEGAL REFORM   MENTAL HEALTH

ORGANIC FARMING   SMART CITIES   SUSTAINABLE FOOD   WELL-BEING

MEGATREND IN ACTION IN 2024

Smart cities prioritise well-being and the impact of online platforms on mental health is more closely examined with legal implications.

Sustainable, and ethically produced food is important but so is affordability.

4.4 Billion

already live in cities today, with the **urban population expected to**

double

by 2050

Smart cities will increasingly focus on measuring and reporting on well-being. [289]

Smart cities, harnessing advanced ICT, aim to address socioeconomic and environmental challenges posed by rapid urbanisation.[290] Over 1,000 cities globally, notably in Europe, North America, Japan, and Korea, have adopted smart city initiatives, leading to economic expansion and societal transformation.[291] However, the impact of smart cities on human happiness has been marginally explored and it is unclear how smart city technology might affect various aspects of human happiness.[292] While 56% of the global population, some 4.4 billion people, already live in cities, this figure is expected to double by 2050,[293] which means that, by the end of this century, some 85% of the global population will live in cities.[294]

Addressing concerns requires collaborative efforts between government, residents, and stakeholders, ensuring that smart city development is inclusive and participatory.[295] GCC countries, which are highly urbanised, are embracing smart cities, but understanding residents' perceptions is crucial for successful implementation.[296] The Dubai's Happiness Agenda was launched by the Government of Dubai as early as 2015[297] resulting in Dubai's Happiness Meter, which captures customer happiness at various touchpoints across the city.[298] Since 2015, there have been 54.23 million votes, with the happiness average at 92% in 2015, rising to 94% in 2022 and used by 147 government entities across various service centres, counters, websites, and mobile apps.[299]

SIGNAL (2)

The impact of attention-demanding online platforms on concentration and mental health will be further scrutinised.[300]

In the **United States** increased smartphone ownership among teens,

from 24%
in 2014

to 95%
in 2022

with 46%
being 'almost constantly' online.

Companies benefiting from this economy might face growing liabilities as the link between digital consumption and well-being becomes increasingly evident.[301] In 2012, only 0.5% of worldwide digital data was analysed and only 50% was protected.[302]

Even though we don't have a similar exact figure today, big data and AI have led to new data-focused business models as technologies strategically collected and analysed personal data to use themselves or sell to advertisers and capitalise on user attention and engagement.[303]

The global attention economy, although hard to measure, is significant and could add up to $15 trillion to global GDP in the coming decades.[304] Uncovered in the United States vs. Google anti-trust trial in October 2023, Google spent $26 billion in 2021 through multiple browsers, phones, and platforms to remain the default search engine on devices, with $18 billion going to Apple.[305] This arrangement has sparked debate over who benefits and who might be exploited in the attention economy.[306] In contrast, Alphabet, the parent company of Google, reported in their latest earnings that Google Search's advertising revenue was approximately $44 billion in just quarter 3 of 2023 and $165 billion in the whole year.[307]

As our understanding of attention science evolves, the current attention economy model, focusing on unlimited online interactions, needs reform in order to support mental health and productivity.[308] In addition, while the alleged negative impacts on mental health of excessive social media use are not conclusively proven, legal reform is also warranted[309] even though the platforms' liability in this regard remains legally uncertain.[310]

In 2022, there was a significant increase in litigation against social media platforms in the United States, with 28 federal lawsuits filed, focusing on the use of allegedly addictive features.[311] These lawsuits claim that social media platforms have designed algorithms that cause addiction in minors, leading to serious mental health issues like depression and anxiety.[312] Also in the United States, as the use of social media has surged, with daily usage time jumping from 90 minutes in 2012 to 147 minutes in 2022.[313] The majority of teenagers engage with various platforms: 95% use YouTube, 67% TikTok, 62% Instagram, 59% Snapchat, and 32% Facebook.[314] This rise coincides with increased smartphone ownership among teens, from 24% in 2014 to 95% in 2022, with 46% being 'almost constantly' online.[315]

SIGNAL (3)

Throughout the year, a key aspect will be the price inflation of environmentally sustainable and ethically produced food products.[316]

As the demand for these alternative food products grows, strategic cost management will become essential.[317] This approach will be critical in mainstreaming their consumption and ensuring their sustainable adoption despite escalating prices.[318]

While the definition may not be clear, novel food types or proteins are seen as an alternative to meet the need for environmentally sustainable and ethically produced food including, among others, animal cell-based, fermentation-based, insect-based food plant-based.[319] Food is systems are responsible for a quarter of the world's greenhouse gas emissions,[320] and agriculture is responsible for 70% of its freshwater usage, and 78% of the eutrophication in oceans and freshwater sources, a process in which water bodies are polluted with nutrient-rich substances leading to algal blooms.[321]

In the coming years, new technologies and shifting consumer attitudes are set to significantly influence the food industry.[322] Despite higher labour costs and lower yields, organic farming is proving up to 35% more profitable than conventional farming because of its premium pricing.[323] However, although the global economy and high inflation added significant pressure onto food prices in 2023,[324] there were some signs of deceleration at the end of 2023 across food markets and related products (wheat, grains, rice, oils, sugar, meat, milk and fish).[325]

Even with a 15% price premium compared with non-sustainable products and although price remains a key factor in food and beverage choices, a growing segment of consumers is shifting towards eco-friendly and health-conscious options like 'All Natural' or '100% Organic',[326] particularly consumers with higher incomes.[327] In Japan for example, 45% of consumers with higher incomes, and only 20% of low-income consumers buy sustainable products; there are similar trends in Canada, South Korea, Poland, China, and the UK.[328] Businesses will need to close this gap through innovation that makes sustainable goods competitively priced[329] while also meeting their own climate goals.[330]

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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 to consolidate its global status as a leading city of the future. In partnership with its partners from government entities, international companies, start-ups 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, the Dubai Future Foundation 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 UAE Centre for the Fourth Industrial Revolution UAE, Dubai Future Accelerators, One Million Arab Coders, the Dubai Future District, Dubai Future Solutions, the Dubai Future Forum, and the Dubai Metaverse Assembly. Its many knowledge initiatives and future design centres contribute to building specialised local talent for future requirements and empowering them with the necessary skills to contribute to the sustainable development of Dubai.

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This report was prepared for informational, educational, and guidance purposes. It includes several future directions based on studies and research that should not necessarily be adopted or implemented. The findings, interpretations, and conclusions expressed in this report do not necessarily reflect the views of DFF.

The information presented in this report is based on studies, research, and data available up to the date of publication.

The report aims to provide information and stimulate critical thinking and informed decision-making in the areas of future foresight. DFF disclaims all liability related to the content and use of the report (or any reliance placed on it, in particular, for any interpretation, decisions, or actions based on the information in this report). DFF does not recommend or endorse any specific actions, strategies, or viewpoints discussed in this report.

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