

ANNUAL FORESIGHT

2024

FUTURE SPHERE



What is KPMG Futures?

We bring to life game-changing technologies and businesses to accelerate a better future for our clients.

KPMG Futures' focus is on the future – including future sectors, future technologies, services and business models with a view to creating value for our clients today.

We capture signals locally and globally related to social, demographic, technology, economic, environmental and political trends. From these signals we identify disruptive insights and innovation priorities to define a series of business model hypotheses for the firm and our clients. Our core competencies are research, experimentation, and incubation.



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Introduction

The next decade is going to be one of transformational change.

We are facing a new landscape of challenges across many different fronts, the climate crisis, rising wealth inequality, and increasing geopolitical instability. The ongoing rise in China's power, and conflicts in Russia and the Middle East have the capacity to disrupt global supply chains, financial markets, security dynamics and threaten our individual sense of safety – even here in Australia.

Simultaneously, Australia is facing productivity challenges, marked by significant annual productivity decline, with output per hour falling 2% since 1995.¹

As these problems compound and converge, creating brittle social and political structures, innovation and new technologies are creating opportunities to accelerate solutions to some of these challenges, while also creating other, new risks.

This decade is likely to see many of the ways that we work and live transformed by AI. This technology will help facilitate higher productivity levels, and coupled with advancing robotics, has the capacity to improve national resilience through more cost-effective and sustainable reshoring.

However, AI may also systematise bias and disrupt employment in traditionally high-earning industries, as well as accelerate the prevalence of misinformation and cybercrime.

Compounding problems, crumbling systems, and converging technologies are creating a fertile ground for innovation to create new solutions and business models. For example, the convergence of wearable technologies such as smartwatches, combined with AI diagnostic tools and gene-based medicine, could profoundly transform how and when people are treated for illness, possibly preventing certain instances of ill-health entirely.

And this is just one example that could build on the new foundations of AI, with further transformations to come, as other technologies, such as quantum computing, mature.

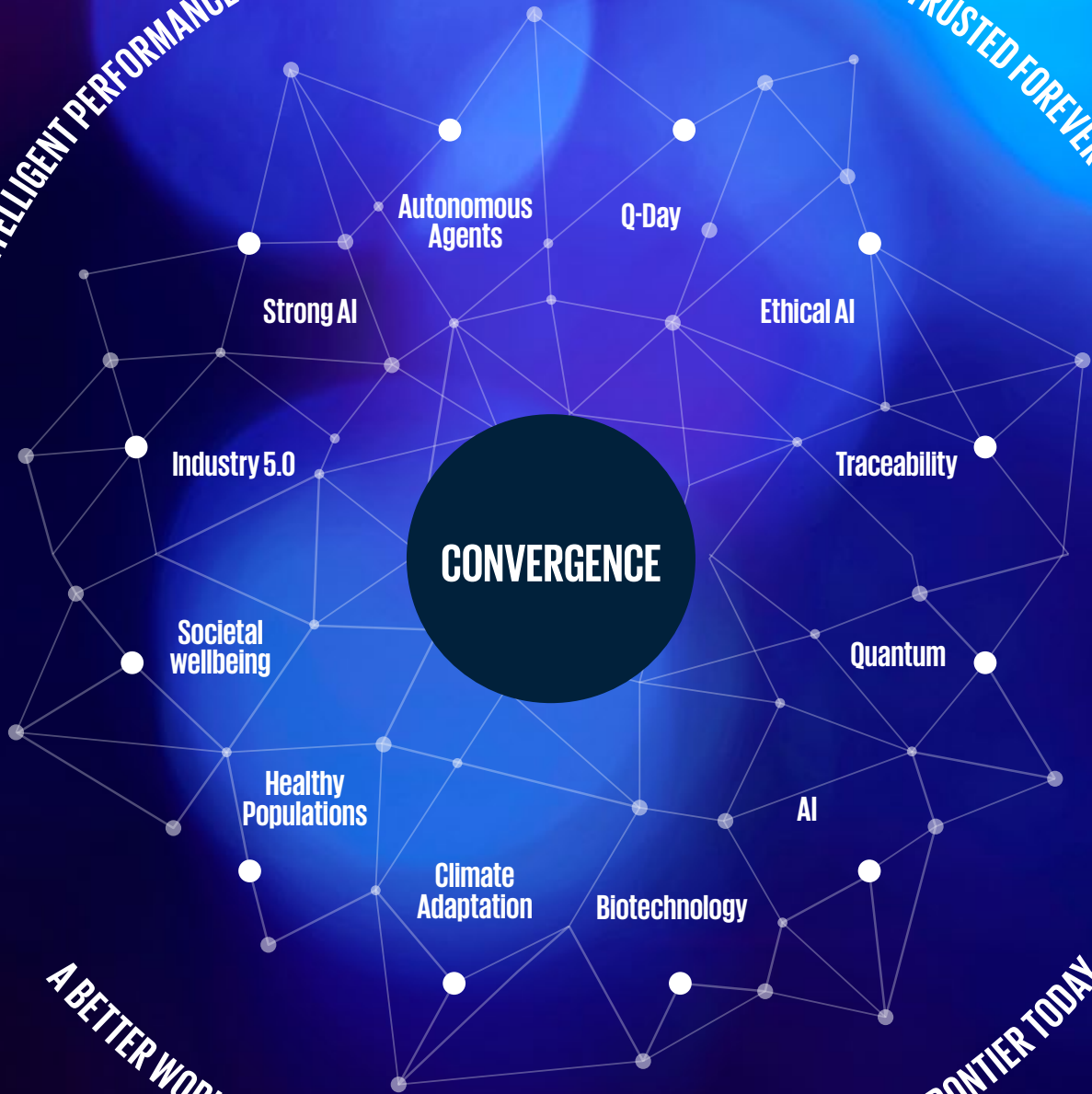
The future is not predicted but created. This report aims to articulate the kinds of opportunities that will emerge from both the challenges, but also the new technologies that are likely to help solve them.

Acting today is necessary to get ahead of these disruptive changes, and this report is a guide to some of these changes and how organisations can approach them to get ahead.

As problems compound and converge, new technologies are emerging that can accelerate solutions.

INTELLIGENT PERFORMANCE

TRUSTED FOREVER



A BETTER WORLD

FRONTIER TODAY

A better world

The World Economic Forum's 2023 Global Risk Report warned of a world that would not easily rebound from continued shocks.² However, over the past year there has been an acceleration in technological change and economic uncertainty as the climate crisis and geopolitical conflicts become increasingly pressing.

ESG has been a key trend for the past decade, primarily as a means of differentiating for consumers through values and to show investors that they are a force for positive change. As the decade continues, investing in ESG, and the technologies to power it are becoming essential as a means of maintaining business continuity, profitable performance, and a functioning society.

Beyond futureproofing businesses, sustainability initiatives can have a significant positive impact on the bottom line. Unilever's sustainability efforts have avoided costs of around EUR1.5 billion from its water efficiency measures since 2008.³

But the climate crisis is not the only one that threatens our current way of life. Already in Australia we are grappling with a cost-of-living crisis with more than half of Australians only making ends meet.⁴

This economic landscape is not predicted to improve in the longer term, with Australian Government research forecasting that the ageing population will lead to slower growth.⁵ Real GDP per person is projected to grow at an average rate of 1.5% per year over the next 40 years, compared with 1.9% on average over the previous 40 years.

Acting urgently to respond to these challenges will safeguard business longevity and unlock opportunities for new business models, revenue streams and better, more sustainable ways of operating.

ESG is transitioning from governance to an operational imperative.

Actions today

Map exposure to extreme climate events

Consider where your assets are located, and how organisational continuity might be affected by storms, floods, or extreme heat events. Work with startups and technology providers who can create data-led insights in this space.

Model workforce effects

Understand what kinds of tasks will change over the coming decade, and the effects this will have on your current workforce. Consider what kind of retraining will need to take place, and which educational partners to work with on delivery.

Undertake mitigation efforts

Organisations and governments will need to take action to respond to identified risks and challenges. This may mean adapting assets to manage climate risk, or even exiting certain business lines entirely.

Consider how risks can create commercial opportunity

As current business models become less profitable, consider what opportunities are emerging in the changing landscape to generate new revenue streams. As automation becomes increasingly common, assess where employees might be redeployed to add value. Consider what opportunities will emerge as climate-positive businesses and preventative healthcare become an increased focus.



Climate adaptation

While governments and the private sector attempt to achieve commitments made in the Paris Agreement to avoid the worst impacts of the emerging climate crisis, they will also need to manage and mitigate the changes that are emerging. By 2030, 1 in 25 Australian houses will be uninsurable due to climate risk,⁶ and 2% of total working hours worldwide will be lost every year as increased heat makes working more difficult. Natural disasters are also forecast to cost Australia \$73 billion a year by 2060, under a low emissions scenario. Changes in climate from 2000 to 2019 have reduced average broadacre farm profits by 22%⁷, and as many countries work to phase out coal, the mining sector will need to refocus its efforts on critical minerals to help support the transition.



Case study: ClimaSens

ClimaSens is a startup collaborating with KPMG to help clients plan, prepare, adapt and respond to climate risk. The platform helps governments and organisations take a data-informed view around extreme heat. By overlaying heat risk from the urban environment with population vulnerability, it allows councils to take a granular and targeted approach when managing these risks.

Today: managing and mitigating risk

New tools are emerging that allow government and businesses to model different forms of climate risk. These tools are already starting to be used by climate officers in councils to navigate extreme heat risk, ensuring that they can manage the impact of extreme heat events on vulnerable populations. Risk will need to be managed by mortgage and insurance providers, with actionable insights articulating the risk posed to each asset and what, if any, steps can be taken to mitigate these risks. For some locations, the resulting risk may be too high, and the government may have to develop relocation programs.⁸

2%

of total working hours worldwide will be lost every year.

Tomorrow: adaptation and new business opportunities

Businesses will continue to adapt to the commercial realities that the low carbon transition will present. Today, Australia is the world's third largest fossil fuel exporter, the world's largest exporter of LNG (gas) and the world's largest exporter of coal by energy content. Under the Australian Energy Market Operator's most recent draft plans, coal will be eliminated from the Australian grid by 2038.⁹ While exports still make up the lion's share of Australia's coal output, Australia's mines will need to shift their focus to critical minerals mining and processing, which will power the next generation of more climate-friendly technologies, from solar panels through to batteries. Increasing exports of these could create more than 115,000 new jobs and add \$71.2 billion to GDP by 2040. This could increase to 262,600 jobs and \$133.5 billion by 2040 if Australia builds downstream refining and processing capability and secures a greater share of trade and investment.¹⁰

Future: climate-positive industries

There is an optimistic scenario that will see organisations embrace the challenges posed by the climate crisis, which will see them creating strategies that are climate positive within the next decade. Australian agriculture accounts for 14.6% of annual GHG emissions, including methane and nitrous oxide from enteric fermentation of livestock/animals and cropping.¹¹ Transitioning to regenerative practices has the potential to significantly reduce this. Proponents of the practice are both looking to past techniques like no-till farming, and technology supported strategies like Loam Bio, an Australian biotech company that makes a microbial seed coating that it describes as 'supercharg[ing] a plant's natural ability to store carbon in soil'.¹²

Healthy populations

Western societies are facing an ongoing health crisis, with increasing numbers of people navigating chronic illness, ageing populations, alongside a shortage in the number of healthcare workers that is only going to worsen in the coming decade.¹³ In Australia, just under half (47%) of Australians had one or more chronic conditions in 2017–18, an increase from 42% of people in 2007–08.¹⁴ This is associated with several factors, including our ageing population, and risk factors such as poor diet and physical inactivity. With the number elderly people forecast to rise in the coming years¹⁵, these trends are likely to continue on their current trajectory. At the same time, technologies are emerging that are helping people improve their health and extend their lifespan, which is likely to increase patient expectations over the coming decade.





Case study: Genegenics

Genegenics is a startup that helps people to monitor their biometrics to ensure optimal health as they age. Testing includes brain function tests, through to blood and body analysis. Using an individual's biomarkers, the plan combines diet with vitamins, exercise and hormones to ensure optimum performance.

Today: AI diagnostics

AI tools are already being used to help speed up the diagnosis process, with the EU approving the use of ChestEye, an AI tool that scans chest x-rays and automatically sends patient reports on those that it sees without abnormalities.¹⁶ Any images that the tool flags as having a problem are sent to a radiologist for review. Similar studies on breast cancer suggest AI screening is as good as two radiologists working together, does not increase false positives and almost halves the workload.¹⁷

47%

of Australians had one or more chronic conditions in 2017–18.

Tomorrow: the emergence of personalised medicine and preventative care

Multimodal AI systems will be able to diagnose and manage a person's illness, leading to more personalised care. It is likely to combine medical imagery with other forms of patient data such as biosignals, vital signs, medical history, and laboratory test results to gain a more comprehensive understanding of a patient's health and the underlying causes of their symptoms. As these tools become increasingly commonplace, wearables and other health data will be able to provide richer insights that extend a person's healthspan. There are early signals around this from fitness wearable Whoop, which allows people to use generative AI to offer guidance on how the wearer can optimise their performance.¹⁸ Treating illness will also become more sophisticated as genomic medicine develops to a point where medicines are developed with an individual in mind.

Future: brain–computer interfaces

Emerging brain–computer interfaces are showing promise, particularly for people with paralysis. In 2023, scientists developed a digital bridge that restores communication between the brain and spinal cord. The first person to receive the implant was able to regain intuitive control over his leg movements, enabling him to stand, walk with crutches, climb stairs, and traverse complex terrains. Elon Musk's Neuralink recently gained headlines when he announced that the company had implanted a 'brain-reading' device into a person for the first time.¹⁹ In the next decade, these applications are likely to become more sophisticated and extend into other functions – even among healthy people – including decoding of thoughts, extension of human memory, telepathy communication, automation and control, intelligence sharing, brain energy harvesting, and optimised (targeted) treatment of damaged body parts.²⁰

Societal wellbeing

Economic inequality in Australia is at a 70-year high.²¹ The wealthiest 20% of households have six times the disposable income of the lowest 20%. Wealth inequality is even larger, with the wealthiest quintile having 230 times more net assets than the lowest. Excessive inequality can erode social cohesion, lead to political polarisation, and lower economic growth. Other factors are challenging social cohesion, with the 2023 Edelman Trust Barometer finding that more than three-quarters of Australians saying they would refuse to help someone who disagreed with their views. A siloing of information, where people choose news sources that validate their worldview, is only entrenching these beliefs even further. As new technologies create efficiencies, there is a risk that these inequalities and political polarisations will grow even further, deepening the social divide and entrenching political polarisation even further.



1.1 billion

jobs are liable to be radically transformed by technology in the next decade.



Today: deepening polarisation

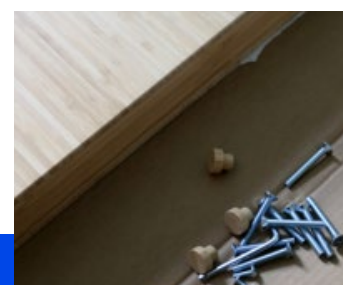
Social cohesion in Australia rose over the pandemic period but has now fallen to record lows. The Scanlon Foundation Research Institute found that declines in our sense of national pride and belonging, increasing financial strain and a weakening sense of social inclusion and justice were warning signs of further weakening in our social fabric.²² A key factor influencing this is the cost-of-living crisis. Between 2020 and 2023, the proportion of people who are satisfied or very satisfied with their finances declined from 73% in July 2020 to 61% in 2023. The rising cost of living has also drawn Australians' attention to economic inequalities and opportunities. As a result, our sense of social inclusion and justice has declined substantially and is the most significant factor dragging down our overall social cohesion.

Tomorrow: retraining imperative

While previous industrial revolutions have led to more jobs in the long term, the process to achieve this can be messy as old jobs disappear and new ones emerge. According to the World Economic Forum, 1.1 billion jobs are liable to be radically transformed by technology in the next decade. Government and the private sector will need to work together to develop reskilling strategies to ensure that the economic divide does not get wider. This may take the form of microcredentials through to a complete re-evaluation of how people are hired; through skills-based and aptitude-focused recruitment.

Future: a reformed work–life balance

If the next industrial revolution is managed well, the future may see many of the innovations being tested today making their way into the mainstream. This increased productivity is forecast to lead to shorter working weeks, including the four-day working week that is being trialled around the world. As more of today's work becomes automated, there will also be a need to create policies and strategies to prevent this from creating increased economic inequality and reduced social cohesion, through new government policies like Universal Basic Income.



Case study: Ikea call centre redeployment

Ikea has implemented an AI chatbot, Billie, which now handles half of the retailer's customer queries. It has retrained 8,500 call centre operators as remote interior design advisers, a service the retailer charges AU\$29–399 per consultation for. Globally, this sales channel generated EUR1.3 billion in sales for Ikea during 2022.

Intelligent performance

Australia is experiencing its most significant annual productivity slump, with output per hour falling 2% since 1995.²³ Historically, reduced productivity has led to lower economic growth and declines in living standards. Fostering growth and innovation across Australia's economy is crucial to ensuring wellbeing and prosperity.

The global pandemic revealed the fragility of international supply chains, unmasking issues with production strategies and transportation limitations, raising doubts about globalisation.²⁴ Goods today incorporate critical components that require sophisticated and specialised skills to make. With reduced manufacturing capacities as countries went into lockdown, the global economy witnessed the impact of a worldwide semiconductor chip shortage. Exposing these supply chain vulnerabilities prompted organisations to move production closer to their main markets. Geopolitical tensions and disrupted patterns of global trade will require manufacturers to reshape their supply chain strategies to reduce high-risk dependencies and build resilience.

Since the 1970s, Australia's manufacturing sector has been challenged with rising energy costs, high wages, and a skills shortage. With 86% of manufacturing CEOs planning to focus on boosting productivity, or having already done so, emerging technologies in AI, IoT, robotics, and digital twins offer

opportunities to enhance efficiency.²⁵ Data-driven insights and robotics will enable manufacturers to scale their operations, identifying how best to utilise their workforce and investments to deliver outcomes. Using technology to augment and enhance manufacturing operations will allow Australia to grow its manufacturing industry despite its challenges.

Work has transformed over the past few years and will continue to be disrupted as governments and businesses experiment with AI. The global pandemic and the rise of the gig economy has seen remote work, contingent workforces, and side hustles become the new normal. The emergence of new technologies will see fewer people working in manual labour or repetitive tasks, as robotics and algorithms automate these processes.

The efficacy of new technologies hinges on businesses understanding how to harness them to drive value. Considerations to current challenges with cyber, regulatory obligations and impacts to workforce must be addressed to determine the best approach for integrating with business operating models to deliver results.





Actions today

Map out current processes and match use case with best-in-class solutions

Explore use cases for robotics, IoT devices, digital twin optimisations and predictive analytics across manufacturing, warehousing and new materials development. Redesigning operations to take advantage of automations and exploring new ways that humans and technologies can collaborate will drive productivity and growth.

Consider opportunities across the extended supply chain

Experiment with building a smart supply chain with third parties to unlock the benefits from robotics, IoT, AI and digital twins. These technologies are well-suited to handling the complexity of sourcing, transportation, scheduling, maintenance and repair.

Build necessary partnerships and create an agile roadmap

The current AI market is fragmented: choosing the right partner requires an assessment of what is the best fit-for-purpose solution for each part of an organisation. This could mean a niche tailored solution for one part of a business or an off-the-shelf option for another. Experiment with proof of concepts to learn how to scale optimisations while managing adoption risks to deliver return on investment.

Industry 5.0

Smart manufacturing is becoming increasingly important as developed nations with high labour costs look to take advantage of converging innovations across robotics, AI, IoT, and cloud connectivity to optimise productivity, minimise waste and reshore operations.

Supply chain automation and augmentation has been a focus since the 1990s with big data and IoT.²⁶ However, rising input costs, geopolitical tensions and sustainability concerns are putting this back into the spotlight. Industry 5.0 expands the focus beyond economic value through automation and digitisation, to building a resilient and sustainable industry that prioritises the wellbeing of workers.²⁷



According to KPMG's global survey on supply trends, more than 60% of global organisations expect that geopolitical instability may have a detrimental impact on their supply chains in the next three years,²⁸ and 47% believe their supply chains are vulnerable to disruption.²⁹

Investing in automation and augmentation of supply chains presents a significant opportunity, as industrial manufacturers face a loss of 25 hours a month on average, due to unplanned downtime. Siemens estimated in 2021–22, Fortune Global 500 industrial organisations lost almost US\$1.5 trillion a year through unplanned downtime, resulting in lower productivity and lost revenue.³⁰

47%

of global organisations believe their supply chains are vulnerable to disruption.

Today: predictive maintenance

The automotive manufacturing sector currently loses US\$2 million for every hour of down time.³¹ This could be reduced significantly through predictive maintenance. Sensors enable machine performance data to be analysed to detect minor fluctuations in areas such as vibration, temperature variations, noise, pressure, and lubricant quality, which can indicate the beginnings of more significant problems down the line – allowing the facility to address these problems at a convenient time.³² This proactive approach reduces or eliminates unplanned downtime, allowing facilities to reap maximum productivity through equipment operation.

Tomorrow: cobots and the assisted supply chain

The manufacturing and supply chain sectors are increasingly augmenting their workforce with human-supported automation and cobots: collaborative robots intended for human-robot interactions. In 2022, US\$2.4 billion was spent on robots with 44,000 shipments to North American companies.³³ Businesses in the retail space are investing in automation to remain cost-competitive with businesses like Amazon, which, with 750,000 robots, has become the largest manufacturer of industrial robotics.

At Ford, cobots have been used to polish vehicles, accelerating the car production processes; but also to help drive inclusion efforts, potentially facilitating jobs in the future for older people, or those with disabilities. The manufacturer has been experimenting with a robot that helps a worker with reduced shoulder mobility complete tasks in the factory.³⁴

Future: the (almost) fully automated supply chain

In the next decade, almost all human touchpoints could be removed from the supply chain. For example, driverless technology is starting to be rolled out, with Aurora planning to deploy small fleets of electric trucks this year.³⁵

Depending on the pace of legislation, current estimates place autonomous trucking to be adopted at scale in 10 years across the US,³⁶ which may reduce up to 50% in costs for a small fleet,³⁷ eventually eliminating the need for drivers entirely.

The last mile is also likely to witness disruption as drones become increasingly more common. Walmart is extending its drone delivery service in Texas, and by 2030, the global drone package delivery market is forecast to be worth US\$8.4 billion.³⁸

Case study: Adiona

Sydney-based data science and AI startup Adiona is working with KPMG and a major telecommunications firm to reduce inefficiencies in last mile delivery routing and carbon emissions. Using its AI engine, Adiona identified cost savings of up to 61% and opportunities for electrification for up to 45% of journeys.



Autonomous agents

Autonomous agents – AI-powered automated programs – represent an evolution of intelligent systems that can manage their own activities, interpret information, make decisions, and execute actions without human intervention. Unlike current technologies such as Robotic Process Automations (RPA) which target repetitive tasks, or conversational AI and copilot assistants which create new content based on user prompts, AI agents will enable complex process automations. In a scenario where AI agents are used to schedule and complete delivery of goods, without the need for a user to provide detailed instructions, the agents will be able to identify the delivery channel (drone, click and collect or truck), schedule deliveries by determining the optimal delivery route and send instructions to warehouse robotics to initiate the picking process. Research has shown generative AI technologies can improve productivity by executing tasks 25% faster.³⁹ The AI-powered automation market is projected to reach US\$12 billion by 2026, according to IDC,⁴⁰ showcasing a growing demand for autonomous agents that are smart enough to work on their own.

Case study: Stanford University and Google

Researchers from Stanford University and Google have created a virtual world populated by 25 AI agents.⁴⁴ The interactions among the community of agents unveiled emergent AI behaviours that will advance the understanding of how agents can independently strategise and sequence tasks to accomplish goals, contributing to improved reliability in autonomous agents.



Today: AI assistants

Google's AI-powered videoconferencing tool, Meet, has announced plans to let Duet, its AI assistant attend on a person's behalf.⁴¹ On a meeting invite, you can click an 'attend for me' button, and Google can auto-generate some text about what you might want to discuss. Those notes will be viewable to attendees during the meeting so that they can discuss them. The call is then recorded and summarised by the AI agent. Increasingly we will see these AI tools take over more complex consumer service interactions, and as they become more reliable, more deeply ingrained daily assistants.

Tomorrow: the AI operative

Reliable and predictable autonomous agents will introduce new opportunities for a machine-to-machine economy, where AI agents can buy and sell services and finalise contracts on a business or person's behalf. Experts currently predict up to 125 billion IoT devices will be connected by 2030, enabling new use cases for automation.⁴² For example, BMW's Proactive Care⁴³ – its AI predictive car maintenance system – could be equipped with payments capabilities in the next couple of years. A future scenario may see vehicle sensors identify a failing car part, schedule maintenance, locate and purchase replacement parts – all without the owner involved in the process.

Future: idea-to-execution

Autonomous agents may become the future workforce for discrete end-to-end workflows that are highly manual today. Building on the success of tools like AutoGPT (which break a natural language request into subtasks and try to solve them using the internet) it's highly plausible that within the next decade, a product manager will be able to come up with a new product idea, initiate an AI agent that can orchestrate a team of specialised autonomous agents to conduct market research, create a campaign and prototype a new app. This now allows the highly manual tasks to be executed by an AI workforce, with humans involved to refine the new product throughout the research and concept phases.



Strong AI

For many operators in the AI space, achieving strong AI is the key goal for their companies, with computers that can think and reason at least as well as humans (although this has not yet been clearly defined).

As AI matures, it will reshape the working landscape as certain tasks can be redistributed to AI systems that can be trusted to deliver consistent, high-quality outcomes. Historically, labour dynamics were shaped by factors such as skill scarcity, ageing population, migration, unemployment, and wages. AI and automation more broadly will help offset labour and skill shortages to improve productivity by automating certain kinds of work while delivering accurate insights.

Concerns often arise with new technologies impacting the workforce, but history has shown the opposite effect. The introduction of personal computing and the internet reshaped the job market, with 5 million US workers in 'computer and mathematical' occupations today.⁴⁵ AI is poised to follow suit, disrupting existing jobs and industries while creating new opportunities. With Goldman Sachs estimating generative AI's impact at a 7% global GDP growth in the next decade,⁴⁶ there is likely to be a huge economic benefit to organisations that can harness this technological revolution.

Today: the generative AI boom

The conversation around AI accelerated in November 2022 when OpenAI launched ChatGPT into the market. Since then, there has been a raft of large language models (LLMs) launched, and deepening integration of natural language models into tools like Microsoft Office to enhance productivity.

While hype around this technology is peaking, few companies have figured out how to fully and reliably harness it yet. In the coming year, organisations will work to understand the different emergent use cases and start to build out experiments and test cases to see where it can add the greatest value.

Tomorrow: advancing R&D

The R&D function is already being transformed by the new wave of AI innovation and is set to gather pace in the coming years. Lengthy cycles of trial and error have traditionally characterised scientific breakthroughs; however, AI presents opportunities to accelerate scientific discovery.

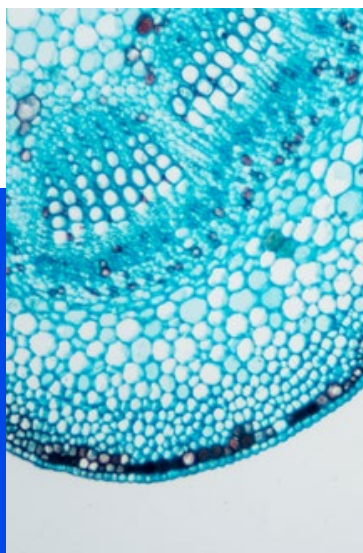
With its ability to analyse vast amounts of data, advanced AI systems will be more effective in predicting new stable compounds, creating lab-made materials that could revolutionise electronics, batteries, solar cells, and computer chips. Issues of scarcity for critical minerals such as lithium (crucial to battery performance) can be solved if new lithium alternatives can be created at scale in a lab.

Future: the artificial general intelligence (AGI) ambition

Mark Zuckerberg and Sam Altman, founders of Meta and OpenAI respectively, have teams that are working to build AGI: AI that is more intelligent than a human being, and is capable of reasoning and intuition. While there are predictions that developers will achieve AGI in the next decade, Altman has suggested that it will not be possible unless there is a breakthrough in energy provision, such as nuclear fusion, as AI models have significant energy requirements. Outside of the technical requirements, there will be significant challenges on the ethics and safety fronts as these technologies continue to develop and be defined. While there are predictions that developers will achieve AGI in the next decade, Altman has suggested that it will not be possible unless there is a breakthrough in energy provision, such as nuclear fusion, as AI models have significant energy requirements.⁴⁷ Outside of the technical requirements, there will be significant challenges on the ethics and safety fronts as these technologies continue to develop and be defined.

5 million

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Case study: GNoME

Google DeepMind's AI tool GNoME has predicted over two million new compounds, increasing the number of known stable materials tenfold from previous human efforts.⁴⁸ Benchmarks suggest GNoME's success rate at predicting stable structures reached 80%, up from 50% from previous algorithms. This will allow for new materials to be created as lab-made alternatives for battery and superconductor chip components.

Trusted forever

Trust in public institutions has been crumbling for some time. Just 50% of people surveyed in the 2024 Edelman Global Trust Barometer expressed confidence in governmental institutions and 48% were willing to express their trust in the media.⁴⁹

However, as the world becomes more complex, trust becomes an even more precious attribute. As more of our personal data is held by third parties, people need to feel that it is protected and used responsibly; and as more decision-making powers are handed over to AI, ensuring the outputs are fair and ethical becomes even more important.

There are additional technological risks on the horizon, with Q-Day, the day that current encryption methods are broken by quantum computers, which will require a complete overhaul of current cyber security and encryption methods.

Trust – the ability to accept and believe, despite incomplete information – forms the foundations for decision-making. Without trust, the fabric that ties together society, government and industry has the capacity to be disrupted by chaos and backlash that might jeopardise technological innovations, economic progress, and wellbeing.

KPMG, in collaboration with the University of Queensland, examined the public's trust and acceptance of AI in its Trust in Artificial Intelligence: A Global Study 2023 report. Findings revealed three out of five people worldwide are either ambivalent or unwilling to trust AI. Notably, a majority (76–82%) placed their trust in universities, research institutions, and defence organisations instead of

businesses and governments, to use and govern AI in the best interests of the public.⁵⁰

The democratisation of AI has the capacity to accelerate the erosion of trust, facilitating the creation and dissemination of deepfakes and misinformation, leading ultimately to the escalation of unrest. In the WEF's 2024 Global Risks Report, AI-generated misinformation and disinformation was the second-highest risk for this year, with 53% of the experts polled saying that it is likely to present a material crisis in 2024.⁵¹

Technology also has the capacity to help build trust. The convergence of AI and blockchain technologies offers innovative solutions to enhance supply chain traceability in support of sustainability and the circular economy. Investments in these areas will enable businesses to build trust through transparency.

Findings revealed

3 out of 5

people worldwide are either ambivalent or unwilling to trust AI.



Actions today

Assess risks and prepare

Evaluate the business exposure to regulatory, reputational and financial risks because of misuse of AI, cyberattacks, and the growing demand for sustainable practices.

Focus on transparency

Transparency and traceability are becoming both consumer expectations and regulatory ones. Ensure that systems are in place to meet these expectations. This may mean implementing blockchain platforms to ensure traceability through the supply chain or ensuring that algorithms are transparent and explainable to justify that they are fair and ethical.

Implement responsible AI practices and standards

Implementing responsible AI principles will require selecting the right partner to undertake this AI journey collaboratively. A successful partnership will help address implementation challenges in operationalising AI while ensuring the technology is harnessed in an ethical, responsible and safe manner.

Audit data to manage Q-Day risks

As store now, decrypt later attacks become more common, managing what kinds of data are held and for how long will be important for organisations to manage and mitigate the impending risk. Undertake regular cybersecurity audits to help manage this risk

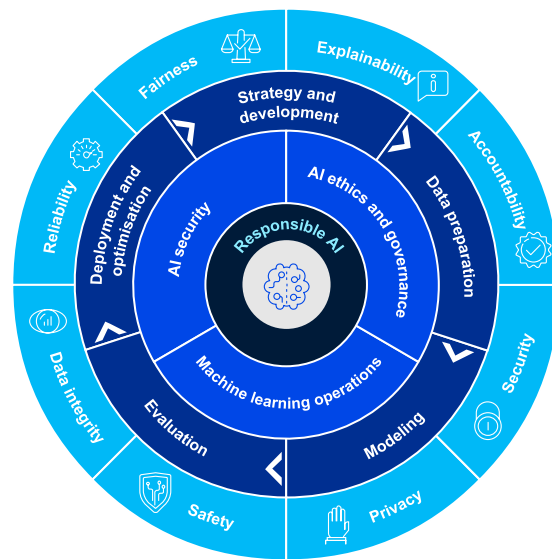
Accelerating mistrust and misinformation

While 2023 saw exponential growth in AI technologies, spurred on by the launch of ChatGPT in 2022, research has shown public distrust in the technology far outweighs industry excitement. The KPMG and University of Queensland Trust in AI global study found 60% of Australians do not trust AI at work.⁵²

The growth in AI also saw increased challenges in algorithmic bias, deepfakes and misinformation. A recent US study found algorithmic bias in fintech tools led to Latino and African American borrowers paying higher interest rates, collectively costing the minority groups an extra US\$765 million annually.⁵³

In the days leading up to Slovakia’s election, deepfake recordings of one of the leaders of the political parties talking about rigging the election went viral on social media.⁵⁴ Although manipulated and misleading content are not a new phenomenon, AI has streamlined the process, making it more accessible, efficient and cost-effective to generate sophisticated materials.

Organisations will need to adopt robust responsible AI practices to ensure safe deployment of AI technologies to counter risks of misuse and algorithmic bias.



KPMG’s Responsible AI framework

Case study: Responsible AI

KPMG’s Responsible AI frameworks, tools, controls, and processes are informed by eight core principles to ensure AI systems are designed and deployed in a trustworthy and ethical manner, while also helping companies accelerate value.

1. Fairness
2. Explainability
3. Accountability
4. Security
5. Privacy
6. Safety
7. Data integrity
8. Reliability



Today: deepfakes

In May 2023, fake images of the US Pentagon on fire had government officials and reporters scrambling to figure out if viral images of the explosion were in fact real.⁵⁵ Not only did the AI-generated images cause confusion, but it led to the Dow Jones dipping 80 points.⁵⁶ This brief market interruption demonstrates the far-reaching impacts of deepfakes and misinformation.

With national elections taking place across 40 countries in 2024,⁵⁷ Google, Adobe and Microsoft have all announced some form of content labelling approach to their AI products to easily signify AI-generated content to combat the spread of misinformation.⁵⁸

The Australian Government has said that it is considering guidelines around watermarking and labelling AI-generated content to prevent cheating or the dissemination of misinformation.⁵⁹

Tomorrow: algorithmic audits

To protect individual rights and prevent harm from unfair use or misuse of AI, algorithmic audits will become a necessity in the coming years. The EU's Digital Services Act (DSA) will require certain platforms to provide annual risk assessments that will be subject to external audits.⁶⁰

Scientific research has provided guidance on how algorithmic audits can be conducted to discover inaccuracies, discrimination, misuse, and other significant flaws in AI systems.⁶¹

AI system audits will see the emergence of algorithms capable of auditing other algorithms, allowing for real-time, automated, and unbiased assessments of AI models. Transparency tools will be needed to interrogate datasets used to train AI models, enabling businesses to check for biases and data privacy issues to ensure organisations meet ethical standards and regulatory requirements.

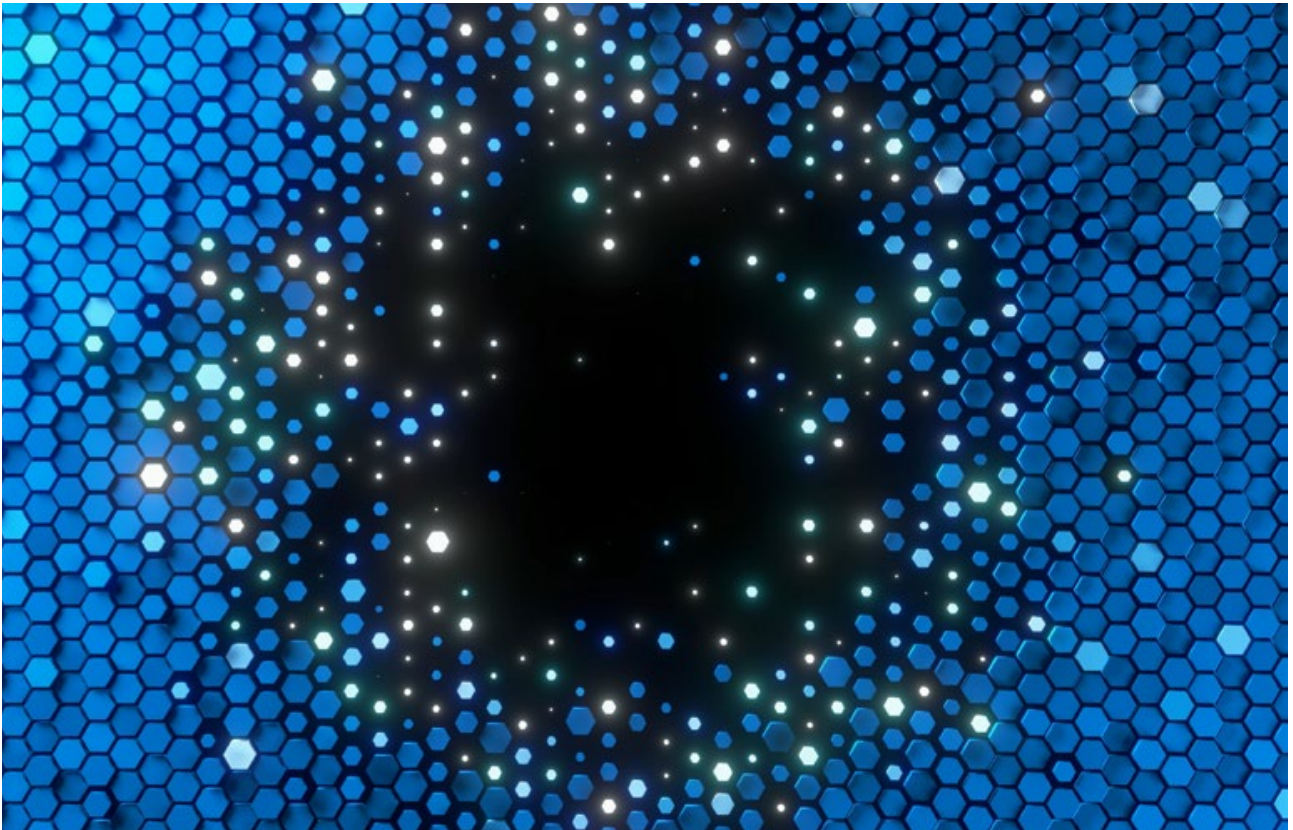
Future: adversarial attacks

AI companies are in a race to secure AI models from adversarial attacks. While ChatGPT has been adjusted to prevent harmful messages, researchers have proven AI models are vulnerable to prompts that can exploit their safeguards.⁶² Other adversarial attacks have targeted AI limitations, such as placing stickers on stop signs to manipulate the AI system's judgement, leading to autonomous vehicles misclassifying the object and unable to detect the stop sign at intersections.⁶³

In a future where AI-connected devices become integral to our daily lives – with experts predicting that by 2030 there will be 125 billion IoT devices globally⁶⁴ – it is crucial to invest in solutions that deliver responsive situational assessments to quickly detect, identify and respond to adversarial threats.

Safeguarding AI from such risks remains a challenge, however, emphasis on human-in-the-loop mechanisms for oversight and control will be pivotal to ensure responsible AI governance.

Q-Day



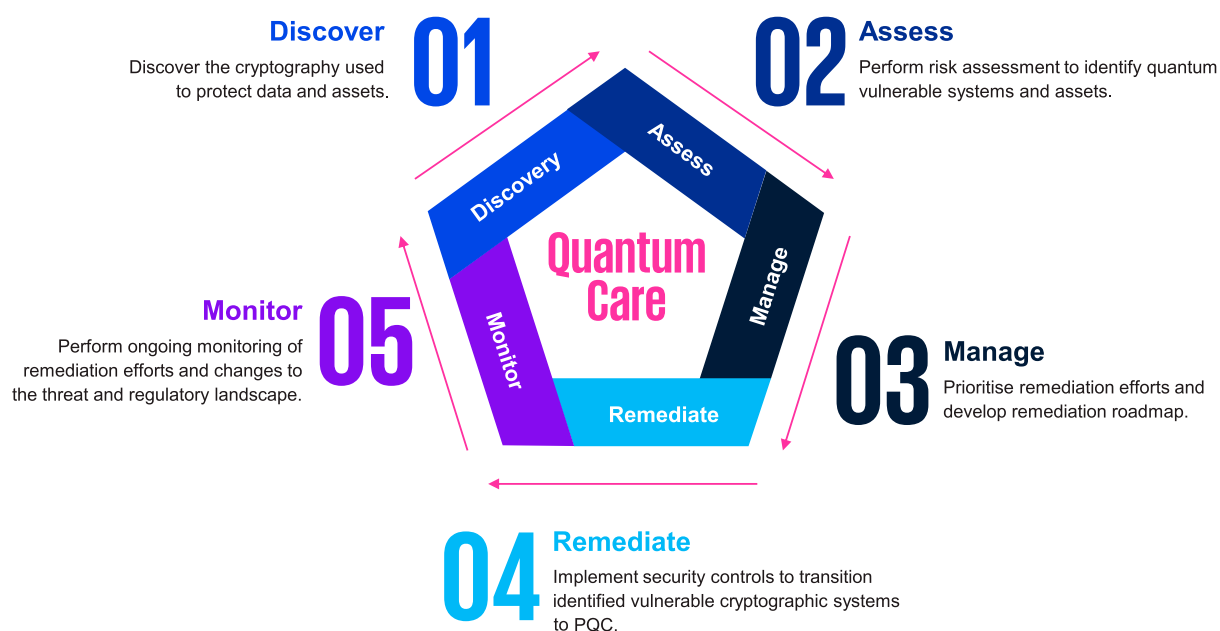
Q-Day is known as the day that current encryption methods are broken by quantum computers. Experts predict that a cryptographically relevant quantum computer (CRQC) will be available within the next 10 years.⁶⁵

What would take a classical computer trillions of years to crack, can be achieved in a matter of hours using a sufficiently powerful quantum computer.⁶⁶

Although Q-Day is approaching, its implications require action today. Store now, decrypt later attacks can enable adversaries to harvest encrypted information now with the intention of decrypting it in the future.

This poses significant consequences for technologies which rely on public-key algorithms for protecting the integrity and confidentiality of digital information. This includes web browsing, remote access, software, digital signatures, communications, crypto currencies, and identity validation.

Compromising these technologies can result in the loss of digital trust, interruptions to critical infrastructure, and interception of secured communications.



Case study: Quantum Care

KPMG has developed Quantum Care, a framework for helping organisations become quantum resilient. Quantum Care achieves this by supporting an organisation to gain an understanding of their cryptographic landscape, where their risks are, and how to appropriately remediate and monitor them.

Today: standards and regulation

Existing public-key cryptography has been fundamentally broken by CRQC and requires replacement with post quantum cryptography (PQC). Less secure implementations of symmetric encryption are at risk and require higher strength key sizes.

In response to the quantum threat, the National Institute of Standards and Technology (NIST) has initiated a PQC standardisation project and has announced four algorithms as candidates for finalisation.

This year NIST will run its next standardisation conference to further refine these algorithms.⁶⁷

In Australia, the Australian Signals Directive (ASD), which provides security guidance, announced that cryptographic controls will be informed by these standardisation efforts.⁶⁸

Tomorrow: the new age of cryptographic management

To date, organisations have generally not taken a centralised and holistic approach to cryptographic management, as existing cryptographic algorithms were considered unbreakable within a meaningful timeframe.

However, implementing new PQC algorithms alone is not enough to protect against the threat of decryption, as there is no guarantee that they will be secure in the future. This has generated the need for a new age of cryptographic management, known as crypto agility.

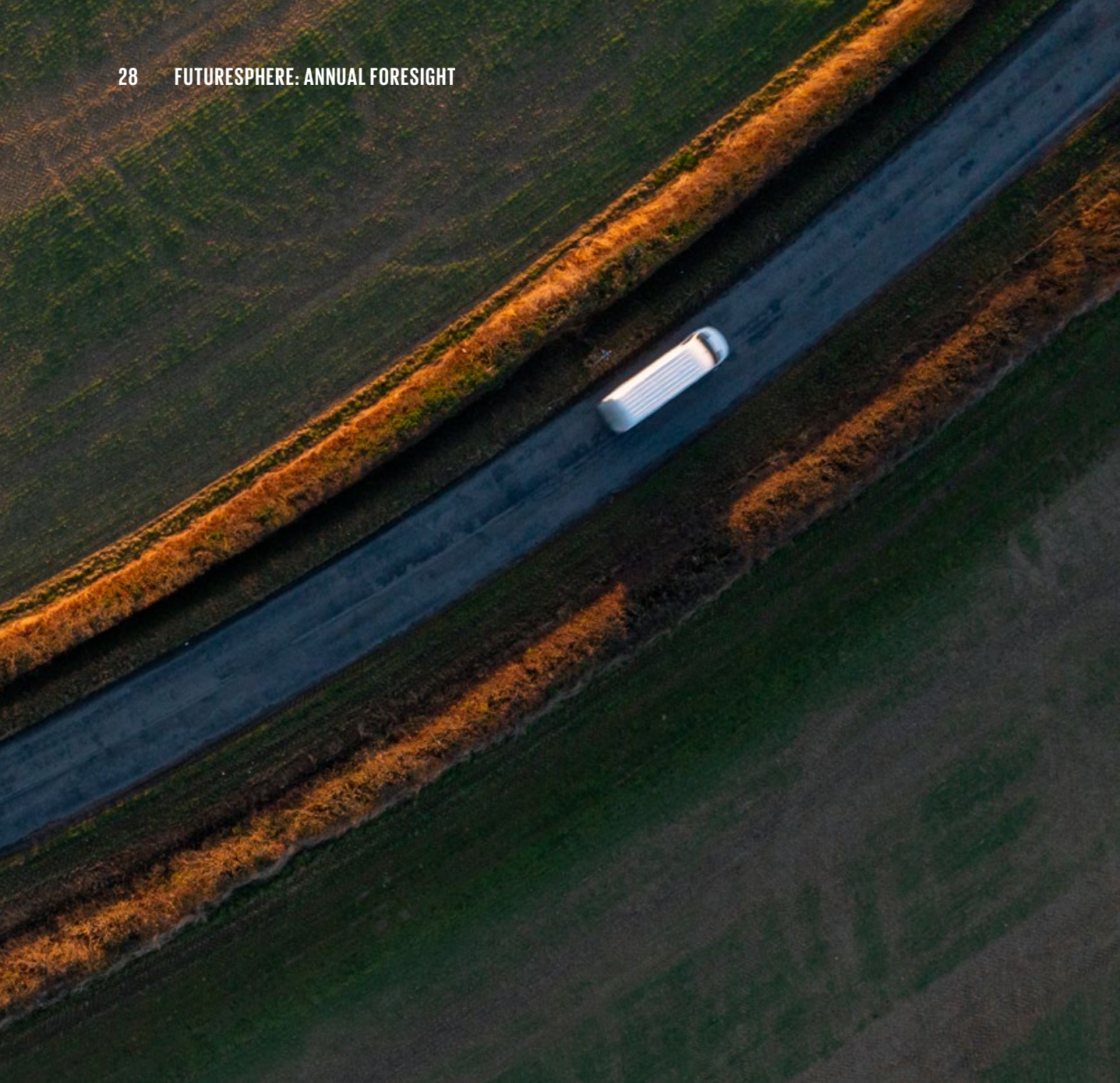
Crypto agility refers to the consolidation of cryptographic controls, and implementation of mechanisms that enable the rapid replacement of algorithms that are no longer secure.

Future consequence of Q-Day and development of future security hardware

PQC will have been widely adopted. However, PQC will continue to evolve and store now, decrypt later attacks will remain a threat.

Upon the arrival of Q-Day, the trust in digital technologies not using PQC will be broken. The impact of store now, decrypt later attacks will become apparent as previously encrypted information is now being exposed.

New security control mechanisms such as quantum key distribution (QKD) will see significant leaps in technology readiness. QKD will be adopted in situations that require the highest level of cybersecurity.



Traceability

KPMG’s supply chain survey found one-third of companies plan to increase their focus on sustainable sourcing as part of their future supply chain strategy as growing demand from regulators, shareholders and customers demand responsible sourcing practices.⁶⁹

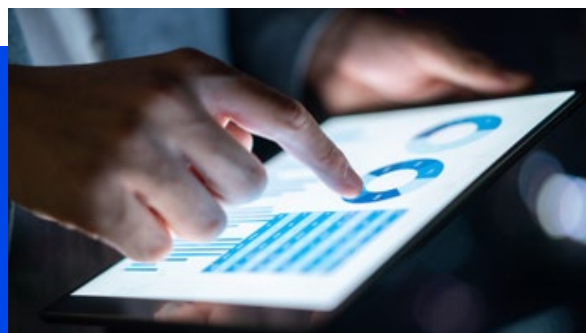
Supply chain traceability is an increasingly important requirement, especially for the commodity market, driven by issues such as the climate crisis, regulation, consumer concerns regarding sustainability, building trust around product provenance and safety. Australia is pursuing a national traceability strategy that will invest in systems

and frameworks that allow for movements of a product to be tracked as it progresses through stages of production, processing and distribution. The strategy, which focuses on critical minerals, food safety, provenance and biosecurity, will accelerate Australia’s goal of differentiating itself by the quality of its exports.

Case study: KPMG Origins Asset Traceability

KPMG Origins Asset Traceability solution uses blockchain technology to facilitate tracking of sustainable sugar production by Smartcane BMP accredited growers.

Currently, the tool solves for supply chain transparency, but it can be leveraged in digital product passports and circularity as sugar by-products become part of the new economy through new applications such as plastic replacements and bio-fuels, among others.



Today: supply chain transparency

The growing pressures for sustainable production regulation and carbon emissions reduction is driving the need for supply chain transparency technologies. The upcoming EU deforestation regulation (EUDR) will ban products sourced from deforestation areas, impacting commodities such as soy, beef and coffee, and will require supply chains to provide product traceability and transparency of forest degradation practices.⁷⁰ With agricultural production responsible for 80% of global deforestation and 60% of global greenhouse gas emissions,⁷¹ supply chain traceability will be a growing requirement for the commodity market.

Beyond legislation, increasing global customer concerns around greenwashing, ethics and provenance will require organisations to demonstrate origin, ethical claims and their validity.

Traceability solutions incorporate verifiable credentials, such as blockchain technology, to create immutable records of activity that can be trusted for transparency. Bringing accountability to the forefront, traceability solutions will handle data across a complex network of stakeholders and regulatory obligations to track product attributes and carbon emissions throughout the supply chain value chain.

Tomorrow: digital product passports

The digital product passport (DPP) – a tool that collects and shares a product's data throughout its lifecycle – will become just as common as nutrition information panels on packaged food. With the EU DPP legislation likely to take place by 2026, future products will need to display their sustainability, environmental and recyclability attributes.⁷² Adopting DPPs will allow nations to pursue decarbonisation, sustainability, and circular economy initiatives, with estimates suggesting that up to US\$4.5 trillion in value can be harnessed through circularity.⁷³

\$430m

worth of e-waste ends up in landfill, with only 17.5% recycled.

Future: cradle-to-cradle circularity

Cradle-to-cradle circularity represents a new production system where everything is designed to be reused. The philosophy states that all products should be easily disassembled into their components to be used in creating new products or systems. For example, each year in Australia, \$430 million worth of e-waste ends up in landfill, with only 17.5% recycled. By 2030, Australia's e-waste generation is expected to rise by nearly 30% to 657,000 tonnes, presenting an opportunity for growth.⁷⁴ With manufacturers under pressure to reduce their carbon footprint and become more sustainable, using recycled materials to produce new electronics is a strategic way to pursue growth while enhancing sustainability credentials. As circular economies become an increasing focus, products will need to be redesigned with the end of life in mind, with component parts labelled and set up for easy disassembly and reuse.

Frontier Today

There are a number of emerging technologies that will underpin the next wave of technological disruption, and innovative companies are already investing in them, even though the full extent of their applications are not clear yet.

At the heart of this exploration is the imperative for strategic foresight and proactive adoption.

The commercial is vast for businesses that actively engage in R&D, workforce development, and strategic partnerships to harness these emerging technologies.

As these technologies develop, they will mature from their nascent state to integral components of economic and social infrastructure.

Preparing for the impact of these technologies will be essential for organisations who want to harness first-mover advantage, while also ensuring that they are ahead of the trajectories of these technologies to avoid the manifold risks that these technologies will present as they mature.

In a decade's time, we envisage a world thoroughly permeated by advanced quantum systems, biotechnological marvels, and deep AI integration, underscoring the opportunities that await those businesses that are prepared. For instance, the gene editing market alone is forecast to reach US\$32 billion by 2035, growing at a CAGR of 30% between now and then.⁷⁵

However, this understates the transformational opportunity of CRISPR and other biotechnology innovations, as they have the potential to completely change the healthcare and agricultural sectors.

AI, Quantum and Biotechnology will underpin the next wave of technological innovation, and while not every organisation will invest in developing them, understanding these technologies and their potential impact will be key to long-term planning.

The gene editing market is forecast to reach

US\$32b

by 2025, growing at a CAGR of 30% between now and then.

Key actions

Explore potential implications for current operations

Undertake strategic foresight activities to understand what the potential primary and secondary impacts of new innovations will mean for your current operations.

Create talent pipeline

As these new technologies scale up, there is likely to be a dearth of talent in these areas. Create talent pipelines through university partnerships and through internal retraining programs.

Create a culture of exploration and experimentation

For new technologies, the ROI is often unclear and long-term. Innovate in a cost-effective way through small teams focused on future technologies that have space to test and fail with new ideas.

Build partnership muscle

Not all technologies will be able to be built in-house. Consider where external innovation might help to accelerate in-house activities. Evaluate the benefits of deeper engagement with the startup community through accelerator programs.



Quantum

Quantum technology leverages the principles of quantum mechanics to pioneer advancements in computing, communications and sensing, positioning itself as a critical innovation for today's businesses. As a multifaceted domain, it stands to disrupt traditional business models and carve out new commercial pathways, particularly in sectors projected to feel the impact first, such as chemicals, life sciences, automotive, and financial services – a market predicted to reach \$7.6 billion by 2027.

Quantum computers' parallel processing power allows for large datasets to be factored so many potential solutions can be evaluated simultaneously. This exponential uplift over classical computing capabilities allows for complex problem-solving that currently presents a challenge for today's computers.⁷⁶ By harnessing quantum technology, businesses can secure a foothold in a future where data security advanced sensing applications and computational capabilities define market leadership. The commercial opportunity beckons for those ready to invest in and build the requisite infrastructure and talent pipeline to thrive in the quantum era.

In Australia, the forecasts for a developing quantum industry indicate an additional

\$6.1b

to Australia's GDP by 2045, and the creation of 8,700 new jobs by 2030.

Today: building the first fault-tolerant quantum computer

IBM has continued to hit its technology development targets and released the 1,121 Qubit Condor quantum processor. IBM has updated its roadmap to show⁷⁷ its development path to 2029, and is investing in education to build the ecosystem and meet the demand for talent.

Similarly, other potential quantum computing hardware providers (Intel, Quantinuum, Microsoft, DWave, Google, Xanadu and others) are driving their own path to fault-tolerant quantum computing at scale, investing billions of dollars to achieve this goal.

Meanwhile, large multinationals (Ford, JPMorgan Chase, Boeing, Lockheed Martin, Barclays and many others) are building quantum capability to assess and develop their practical understanding of use cases, so they have the capability to quickly shift and capture the disruptive opportunity of quantum technologies.

Tomorrow: experimentation with quantum computing use cases

Early adopters seeking quantum advantage will capture early wins using a quantum approach to existing problems, through quantum-inspired optimisation and quantum annealing. These organisations will develop internal knowledge of quantum technologies, the applications, and their pathway to use in production environments. This knowledge will streamline their transition to gate-based quantum computing systems for applications at industrial scale. Chemical, pharmaceutical, and material science companies will quickly realise benefit in chemical and drug discovery processes. Financial services with applications in targeting, prediction, trading optimisation and risk profiling will likewise benefit, as will logistics and energy companies, with broad applications across resource management.

Future: a quantum future

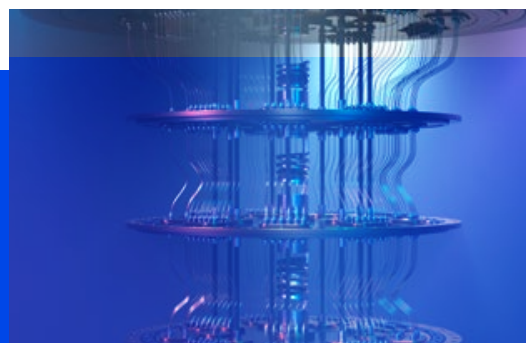
A decade from now, quantum technology is expected to reshape the technological landscape, as access and commercial supply chains of quantum technologies are established. Quantum secure communications networks will be established for system-critical transactions in finance and defence. Quantum risk assessment will be part of procurement processes across industry and government, and quantum computation will be a common scientific tool enabling unprecedented scientific breakthroughs.

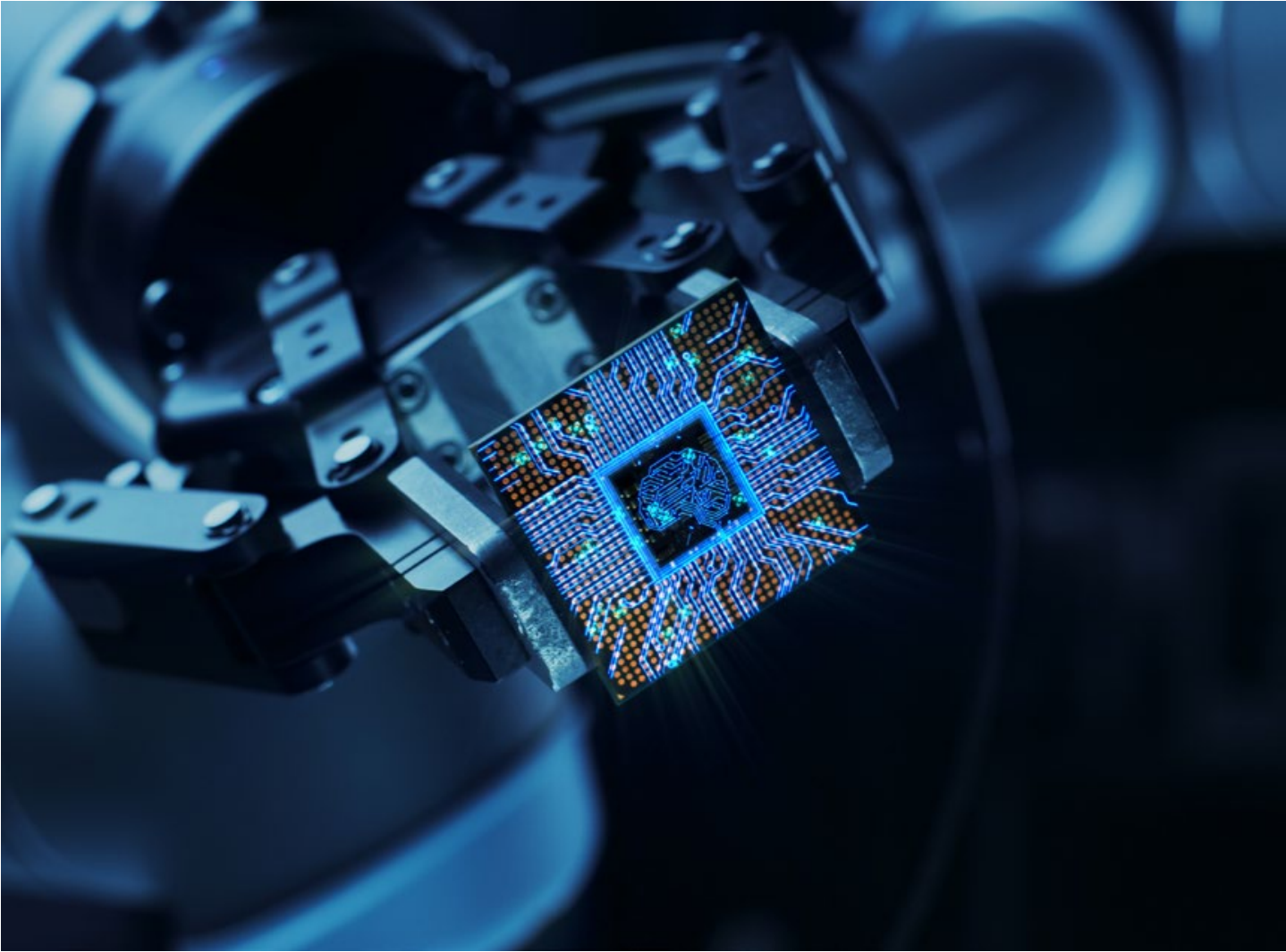
Industry will implement hybrid computing systems that mix AI, classical and quantum technologies for energy efficient and cost-effective computation. Organisations with quantum computation capability will operationally perform better across ESG and financial metrics, as they implement quantum computation for dynamic resource allocation.

In Australia, the forecasts for a developing quantum industry indicate an additional \$6.1 billion to Australia's GDP by 2045, and the creation of 8,700 new jobs by 2030.⁷⁸

Case study: KPMG Quantum

The KPMG Quantum team is venturing into quantum computing, not just to advance cybersecurity and system optimisation but with a broader exploratory mission. The area is highly technical and dynamic, and our small team is proactively experimenting with quantum use cases. This includes running code on real quantum systems and sharing some of that code as open source, helping support the broader sector's growth. Our forward-thinking approach positions KPMG at the forefront of quantum exploration, driving innovation, solving problems, and offering strategic insights for investment in the quantum landscape.





AI

The applications of AI have been the key focus in the past year, as the underpinning technologies took significant leaps forward as large language models (LLMs) gained mainstream use. As the next decade progresses, these underpinning technologies will continue to evolve and innovate.

The evolving AI landscape may birth new models surpassing existing LLMs, or demand distinct architectures for varied applications like robotics or drug discovery.

The coming years will see innovators in the space focus on solving some of the immediate challenges being posed through the first generation of LLMs, such as copyright infringement and energy use. The next generation of developments will see entirely different forms of computing emerge as synthetic biology lends itself to the creation of biological computing.

By 2027, experts predict the global demand for AI will be responsible for

6.6 billion

cubic metres of water used.

Case study: Cortical Labs

Researchers in Melbourne have for the first time shown that 800,000 brain cells living in a dish can perform goal-directed tasks – in this case, the simple tennis-like computer game, Pong. Cortical Labs are the creators of the DishBrain, combining living brain cells with computing devices to create machines with biological intelligence.

Today: fair use of training data

AI models require access to high quality data to train LLMs. Using machine learning principles, algorithms learn to identify relationships and generate relationships between pieces of data, using probabilities to generate media. Large AI systems from OpenAI, Microsoft, Google, Anthropic and others have been using copyrighted works as part of their training datasets. This has spurred several lawsuits from high-profile companies, including The New York Times, over the unauthorised use of its published works. In anticipation of the changing legal landscape, new machine learning approaches will need to be adopted, or alternatively, AI business models will need to account for training data licences.

Tomorrow: more sustainable AI

The emergence of powerful AI technologies enables high levels of automation and operational efficiency. However, this comes at a cost. By 2027, experts predict the global demand for AI will be responsible for 6.6 billion cubic metres of water used – the equivalent of half of the UK's annual water consumption.⁷⁹ Similarly, by 2027 it is estimated 1.5 million servers will be running at full capacity for AI technologies, consuming at least 85.4 terawatt hours (TWh) of electricity annually – more than what many small countries use in a year.⁸⁰

In the search for a more sustainable AI, innovations will be required to curtail the energy and water footprint associated with AI. A prospective strategy entails embracing modularity, where servers are deconstructed into standardised building blocks, defining interfaces between those blocks so they can work together and allowing for components in the ecosystem to be reused.

Shifting to smaller, finely tuned AI models tailored to specific knowledge domains may help reduce energy consumption, offering an alternative to today's LLMs.

Future: organoid intelligence

As developers in the AI sector look to replicate human intelligence using AI, increasingly the architecture that sits behind it may look more human as well. Organoid intelligence (OI) describes an emerging multidisciplinary field working to develop biological computing using 3D cultures of human brain cells (brain organoids) and brain-machine interface technologies. This emerging field of research could lead to the creation of biological computing, which may become faster, more efficient, and more powerful than silicon-based computing and AI, requiring only a fraction of the energy. The development of the field requires scaling up current brain organoids into complex, durable 3D structures enriched with cells and genes associated with learning, and connecting these to next-generation input and output devices, and AI/ML systems.



Biotechnology

The emerging biotechnology sector stands at the forefront of the bio revolution, a period that will be defined by advances in bioinformatics, synthetic biology, gene editing and bioprinting. This multidisciplinary field is revolutionising our ability to understand and manipulate biological systems, offering opportunities across broad industries beyond healthcare, such as agriculture, food, and heavy industry.

It is paving the way for personalised medicine, sustainable agricultural practices, accelerated pharmaceutical development, and entirely new ways of computing and ensuring that societies are fed. Precision therapies, where treatment is tailored to the patient's individual needs based on individual

characteristics and mechanism of disease, will accelerate off the back of technological convergence. CRISPR gene editing, sequencing and AI means that this sector is forecast to grow at a 28% CAGR between 2023 and 2030 from US\$820 billion to approximately US\$4 trillion by 2030.⁸¹

Today: gene editing

The end of 2023 ushered in the beginning of the CRISPR gene editing era, as sickle cell disease (SCD) was successfully treated using the technology, and approved for use in the UK and US. CRISPR first emerged just over a decade ago, but it has taken this time to safely develop these complex treatments. CRISPR/Cas9 can be directed to cut DNA in targeted areas, enabling the ability to accurately edit (remove, add, replace) DNA where it was cut. The modified blood stem cells are transplanted back into the patient where they attach and multiply within the bone marrow and increase the production of foetal haemoglobin (HbF), a type of haemoglobin that facilitates oxygen delivery.

Tomorrow: new routes to discovery

In the coming years, there is likely to be a huge surge of investment in using AI to uncover new classes of drugs and more resilient crops. In recent months, scientists discovered a new class of antibiotics that can kill drug-resistant *Staphylococcus aureus* (MRSA).⁸² Unlike traditional black box AI, the researchers say they were able to figure out what kinds of information the deep-learning model was using to make its antibiotic potency predictions. This knowledge could help researchers to design additional drugs that might work even better than the ones identified by the model.

Future: redefining our food systems

As climate change and population growth puts pressure on our traditional food systems, cell-based meat will fill the gaps in supply from traditional sources such as beef or pork. In the US, lab-grown meat is forecast to account for a quarter of meat on shelves by 2035.⁸³ While lab-grown meat has been approved for sale in Singapore and the US, applications are still pending in Australia, with the government forecast to decide later this year.⁸⁴ Currently, lab-grown meats are more energy-intensive to create than their traditional forms, but as they become more mainstream, processes will become more efficient.⁸⁵

Case study: Sanford Stem Cell Institute

Researchers at the Sanford Stem Cell Institute in California are using space as an ageing accelerator. Their experiments are working to confirm that the microgravity environment accurately mimics human ageing and then use it to further dissect the ageing process to help scientists understand stem cell ageing and cancer – without having to rely on lengthy and expensive clinical trials on earth.⁸⁶

How KPMG can help

The world is changing rapidly. Understanding the emerging risks across a multitude of fronts – and turning them into opportunity – will be what defines success over the coming decade. We will help you cut through the complexity, identify present and emerging risks, and most importantly, take action.

We can help you engage with scenario planning to understand where emerging risks might apply to your organisation and create long-term strategies to help solve them.

Combining our deep sector knowledge across geopolitics, business, climate and technology, we can help clients undertake large-scale transformation projects, digital transformation and help you to understand where you can experiment with emerging technologies.

With KPMG you can bring greater confidence to your future planning activities. We will work with you to assist you to navigate the immediate risks, while also working to mitigate and manage the long-term ones.

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