

Outlook 2024

Why prospects for a more sustainable economy remain undimmed



Impax Asset Management is a specialist asset manager focused on investing in the transition to a more sustainable global economy.

We believe that capital markets will be shaped profoundly by global sustainability challenges, particularly climate change, environmental pollution, natural resource constraints, and demographic and human capital issues such as diversity, inclusion and gender equity.

These trends will drive growth for well-positioned companies and create risks for those unable or unwilling to adapt.

We invest in companies and assets that are well positioned to benefit from the shift to a more sustainable global economy.

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Executive summary

Macroeconomic and geopolitical storm clouds linger as we enter 2024, but fundamental forces and economic logic dictate that the transition to a more sustainable economy cannot be derailed.

In this paper, we share our perspectives on key themes that we believe will shape opportunities in global markets in 2024 and beyond.

- 1 The transition to a more sustainable economy won't be derailed
- 2 Political tensions create selective opportunities
- 3 Mitigating drivers of biodiversity loss will create new markets
- 4 Society's challenges can be efficiently addressed through innovation
- 5 Artificial intelligence (AI) can accelerate the transition to a sustainable economy



1

The transition to a more sustainable economy won't be derailed

The transition to a more sustainable economy won't be derailed

Impax's investment thesis is grounded in a conviction that the global economy is irreversibly shifting towards a more sustainable model in which growth is delivered with a focus on environmental and social outcomes. Despite some negative market sentiment, and a recent focus on the cost of living and energy security, we believe that the fundamental drivers of this transition remain firmly intact.

Short-term challenges could continue, not least arising from the geopolitical backdrop and risks associated with important elections in 2024. Nonetheless, we are encouraged by signs that the tightening phase of the monetary cycle may be coming to an end. Although markets are likely to remain volatile, we are cautiously optimistic about the outlook for 2024. We expect that the New Year should present opportunities for investors to benefit from structural long-term drivers of demand growth.

Recent headwinds for the transition

The past couple of years have been a challenging environment for many investors, and for many of the companies we invest in, with major headwinds from market sentiment and macroeconomic conditions to navigate.

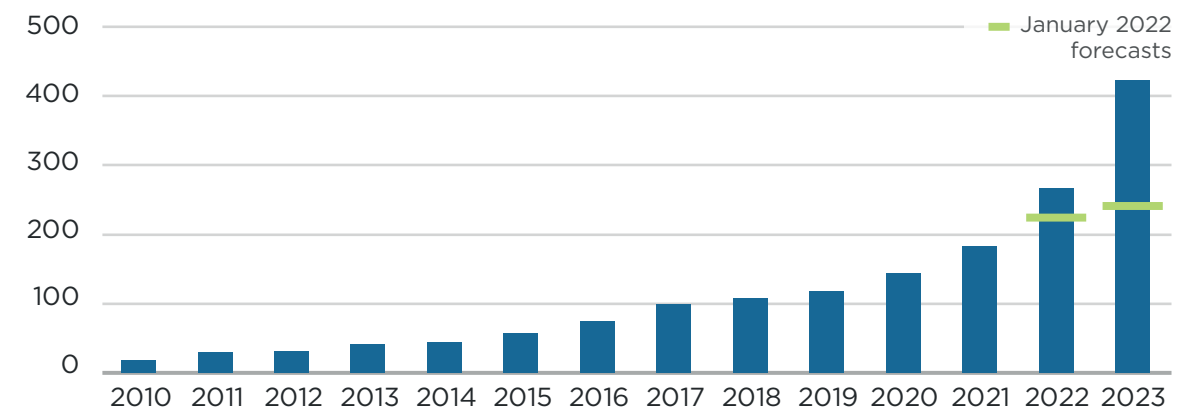
The share prices of companies exposed to structural growth opportunities, including sustainability-related solutions, arguably became detached from fundamentals a couple of years ago. High inflation and rising interest rates have changed the relative short-term appeal of certain assets, and financial markets have reallocated capital towards assets with shorter payback periods.

More challenging macroeconomic conditions have had an impact at the corporate level. Rising costs and the monetary response to them have presented headwinds for many sectors central to the transition, including renewable energy. Inflation has increased the cost of making and installing capital-intensive offshore wind farms, for example. Higher interest rates have also reduced consumer demand for residential solar systems by raising financing costs.

Nonetheless, the resilience of the energy transition – and by extension the broader transition to a more sustainable economy – has been demonstrated by progress in the real economy. Net renewable electricity capacity additions continue to rise year-on-year, powered by their competitiveness on cost and policy momentum.¹ BloombergNEF estimates that new global solar PV installations in 2023 will total 413GW – four-fifths more than in 2022 and far exceeding recent expectations (see chart below).²

Solar roll-out eclipses expectations

Annual global solar PV installations (GW)



Source: BNEF, November 2023. 2023 is forecast data, as at 30 November 2023.

1 IEA, 2023: Renewables
2 BNEF, 30 November 2023



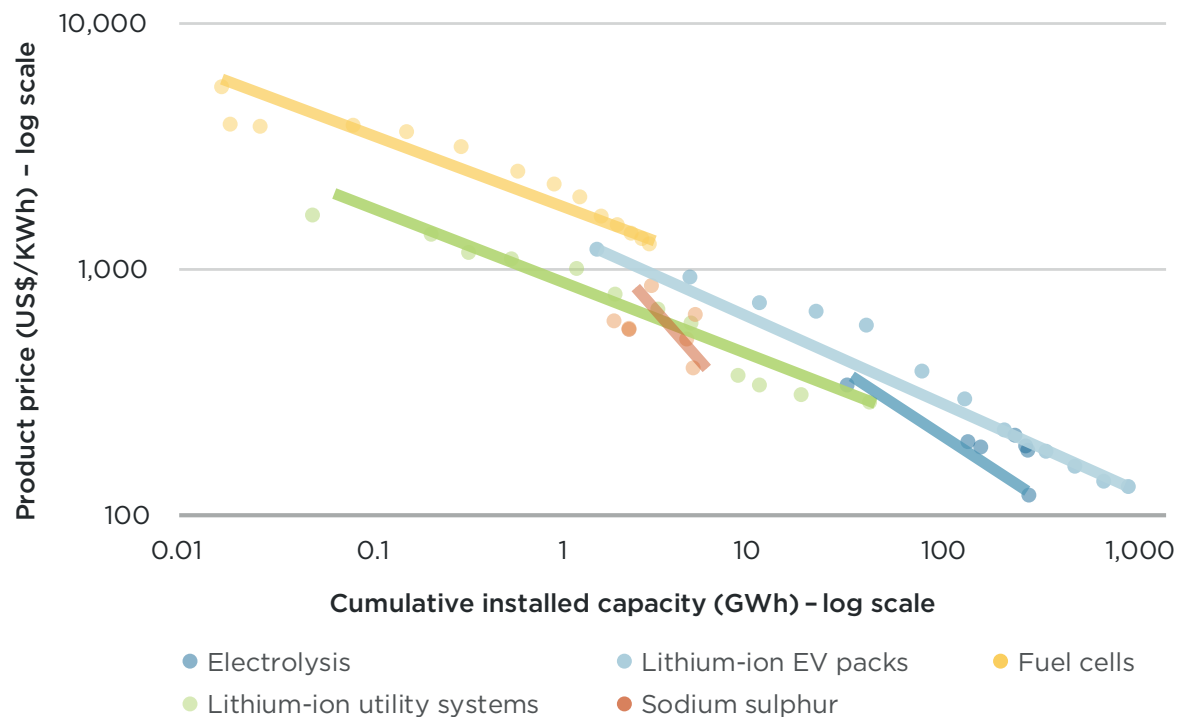
Secular drivers of the transition

We perceive four overarching drivers of the transition to a more sustainable economy: changing technology, consumer preferences, societal changes, and policy and regulation. Despite recent headwinds, we believe these disruptive forces continue to drive opportunities for companies whose products and services can solve environmental and social challenges.

1: Rising uptake of emerging technologies — and the efficiency and improvements that accompany rising adoption — continues to disrupt sectors like transport. The chart below shows how quickly energy storage costs have fallen. The battery packs that power electric vehicles (EVs) now cost about one-tenth of what they did 15 years ago.³ With continuing cost reductions enabled by technological innovation and wider adoption, EVs could hit price parity with internal combustion engine models in Europe next year.⁴ Globally, almost one-fifth of new cars sold in 2023 are expected to be EVs.⁵

Electricity storage costs are falling

The roll-out of technologies has driven exponential declines in cost



Source: Schmidt, O., & Stafell, I. 2023: Monetizing Energy Storage - A toolkit to assess future cost and value. Analysis as of December 2022.

3 Office of Energy Efficiency and Renewable Energy, 4 October 2021: DOE Estimates That Electric Vehicle Battery Pack Costs in 2021 are 87% Lower than in 2008
4 Rocky Mountain Institute, September 2023
5 IEA, 2023: Electric vehicles



2: Consumer preferences and a demand for change are important disruptors in the transition. The long-term trend towards greater consideration of the environmental and human impact of goods and services shapes both policy-making and corporate action. Research shows that half of consumers want to buy zero-waste products, for instance: this reflects the scale of opportunity for companies that can replace disposable single-use goods with circular (recycled, recyclable or reusable) alternatives.⁶

3: Demographic shifts and rising consumption in many parts of the world are placing more pressure on the built environment and basic services. The needs and demands of a growing, ageing and urbanising global population are driving a new wave of infrastructure investments, from social infrastructure like senior living communities to resource infrastructure like water treatment and waste management.

4: Policymakers increasingly recognise the need to manage climate change as one of the key tail risks to long-term economic growth. The EU's Green Deal, for example, aims to align industrial policy with the bloc's climate policy. The extreme weather of 2023 has meanwhile shone a spotlight on the importance of managing physical climate risks: even with fewer hurricanes making landfall in urban areas, the US had experienced a record annual number of billion-dollar weather or climate-related disasters by September.⁷ Absent adaptation measures, it is estimated that global GDP could be reduced by 4.4% by 2050 if global temperature rises are not limited to below 2°C.⁸

In the long run, we believe that companies well-positioned for the transition to a more sustainable economy can benefit from rising demand for their products and services, and so deliver strong earnings growth relative to companies that are not. For example, the trend towards greater electrification – supported by all of these four drivers – will create opportunities for companies like cable manufacturers that support the expansion of global grids, which are forecast to grow by 90% in length by 2050 based on current policies.⁹

6 Capgemini Research Institute, 2021: Circular Economy for a Sustainable Future
7 National Centers for Environmental Information, November 2023: Billion-Dollar Weather and Climate Disasters
8 S&P Global Ratings, November 2023: Sustainability Insights Research: Lost GDP: Potential Impacts Of Physical Climate Risks
9 IEA, 2022: World Energy Outlook 2022. Forecasts made under the Stated Policies Scenario (STEPS) which is based on a review of the current climate policy landscape.

Positive signals into 2024

As we consider the prospects of our investee companies, we believe two short-term factors offer particular grounds for optimism.

The cycle of interest rate rises looks largely complete in major markets. Though interest rates may remain at elevated levels compared to the 2010s, indications that central banks are unlikely to tighten monetary policy much further have been welcomed by markets in late 2023. A stable or falling interest rate environment would be expected to provide a more favourable backdrop for stocks that are well-placed to benefit from structural long-term growth opportunities.

We are encouraged by signs of recovery in more cyclical sectors that have recently faced soft demand. The recent improved performance of sectors exposed to construction is one example of this. Meanwhile, certain sectors that we see as central to the transition are set to recover from post-pandemic inventory destocking that temporarily disrupted demand. Natural ingredients and life sciences tools are among those that saw a ramp-up in demand during pandemic-era supply chain bottlenecks, only to see that reverse as customers have drawn down on their stocks.

Irrespective of any policy disruptions that could arise as a result of upcoming elections in 2024, the transition towards a more sustainable economy has strong momentum. It is our conviction that the urgency of addressing global challenges, and the emergence of promising solutions to many of them, means the investment question has long passed being “whether” to invest through this lens, to being a question of “how”.



2

Political tensions create selective opportunities

Political tensions create selective opportunities

Tense relations between the US and China have ushered in a new *modus operandi* for the global economy. While the world's two largest economies have committed to work together in some areas – climate action, for example – competing geopolitical interests cloud cooperation in others.

Security concerns have driven the US to tighten export controls on cutting-edge semiconductors to China and led to an upcoming ban on US investment in certain Chinese technology companies.¹⁰ Notwithstanding an improvement in the tone of US-China relations after a November 2023 summit described by Chinese state media as “positive, comprehensive and constructive”, the prospect of convergence looks remote.¹¹

The combination of trade barriers, tariffs and large incentives are prompting the slow relocation of supply chains and manufacturing away from China in strategic industries. Fault lines in the Pacific pose obvious challenges for some companies and raise the cost of goods. However, the trend towards decoupling could reduce supply chain risks across the global economy and is already creating investment opportunities.

Decoupling can improve resilience and spur industry growth

Across several important sectors, the moment of ‘peak globalisation’ has long passed. The replication of supply chains involves costs that are ultimately borne by consumers, in the form of higher prices, or taxpayers, via subsidies. However, some degree of economic decoupling from China, which dominates aspects of many key global industries, could help improve the overall resilience of the global economy.

The economic and operational impact of the COVID-19 pandemic highlighted existing vulnerabilities associated with long-distance manufacturing networks that rely on

geographically concentrated suppliers. Local restrictions slowed and, in some cases, stopped the flow of raw materials and finished goods around the world, snarling up manufacturing processes.

Government support for target industries can help develop local sectors and supply chains, and ultimately improve resilience to supply chain shocks. Take the battery industry, for example. China dominates the global lithium-ion battery supply chain, hosting 75% of all battery cell manufacturing capacity and 90% of anode and electrolyte production.¹² US tax incentives for locally-made EV components are encouraging lithium-ion battery recycling – a relatively nascent technology – to expand: capacity is forecast to increase six-fold by 2030.¹³

Fiscal stimulus for in-focus sectors is meanwhile supporting the local growth of those industries and, by extension, boosting demand for supporting industries and in the wider economy.

Take the important area of chipmaking, for example. According to the US government, companies have announced US\$166bn in investments in semiconductor and electronics manufacturing following the 2022 Chips and Science Act, which includes US\$53bn in direct support for the chipmaking industry.¹⁴ More than a dozen major chip fabrication plants (or ‘fabs’) are being built in the US, with McKinsey estimating total investments of up to US\$260bn.¹⁵ The multiplier effect of these investments means opportunities for companies whose products and services enable the construction, fitting and servicing of these facilities. We believe that equipment rental is one such sector that is well-positioned to support the industry’s growth.

The Chinese government meanwhile is pursuing self-sufficiency and global leadership in a range of sectors deemed strategically important. National high-tech ambitions include technologies that hold the key to environmental solutions like renewable

10 Sevastopulo, D. & Hille, K., 7 October 2023: US hits China with sweeping tech export controls. *Financial Times*
11 Sevastopulo, D. & McMorro, R., 16 November 2023: Joe Biden and Xi Jinping agree to resume high-level military communication. *Financial Times*
12 BNEF, 12 November 2023: China's Battery Supply Chain Tops BNEF Ranking for Third Consecutive Time, with Canada a Close Second
13 International Council on Clean Transportation, September 2023: Will the US EV battery recycling industry be ready for millions of end-of-life batteries?
14 Shepardson, D., 9 August 2023: US reports big interest in \$52 billion semiconductor chips funding. *Reuters*
15 McKinsey & Co, January 2023: Semiconductor fabs: Construction challenges in the United States Keeping political risks in perspective



energy equipment, industrial automation equipment and EVs. Five of the largest 11 recipients of Chinese state subsidies in 2021, which totalled roughly US\$31bn, were EV manufacturers or battery makers.¹⁶ Targeted state support has fostered the world's largest EV market, creating opportunities for innovative (and investible) companies across the supply chain — in both hardware and software.

Decoupling is a slow process

While US and other governments have initiated efforts to diversify supply chains, there is recognition that this is not possible overnight. Pragmatism often prevails in the near-term.

The EV battery sector again illustrates this well. Rather than ban Chinese imports, the US government is instead using fiscal incentives to encourage an increase in domestic, or at least non-China, production. Only EVs without battery components manufactured in China will be eligible for a tax credit worth US\$7,500 per vehicle.¹⁷ Batteries made in the US, by US companies, using technology licensed from Chinese companies may be set to qualify, however.

Given the need for policymakers to balance long-term diversification goals with economic reality, not all sectors are equally exposed to relocations. Governments have a hierarchy of sectors deemed strategic and are prioritising those (such as semiconductors) that sit at the top. Where products are lower down the hierarchy of strategic importance, there are few reasons why market access would suddenly be curtailed.

For this reason, we believe some concerns that Western companies could lose access to the world's largest market of middle-class consumers are over-estimated.¹⁸ Take healthcare, for example, where China's large, ageing population represents a major market. Restrictions on access to drugs developed by overseas pharmaceutical groups, and often sold or manufactured with local partners, would negatively affect the health of the population.

Nonetheless, we remain mindful of the potential risks arising from the gradual decoupling of the Chinese and US economies. We actively track which industries and parts of the global supply chain look most at risk from geopolitical tensions, as well as where opportunities might arise. The battery, solar and EV markets are all among those currently in focus.

Dislocations in global markets inevitably create risks and opportunities that active investors can pursue. 2024, a year of prominent elections — including in Taiwan and the US — is likely to present its fair share of both.

16 Nikkei Asia, 22 July 2022: Made in China 2025 plan thrives with subsidies for tech and EV makers
17 Chu, A., 1 December 2023: US moves to choke China's role in electric vehicle supply chain. *Financial Times*
18 Brookings Institute, 2020: China's influence on the global middle class
19 US Department of Energy, September 2023: DOE Unveils New Interactive Map Showcasing Clean Energy Investment Announcements Nationwide
20 Lawrence Berkeley National Laboratory, June 2023: U.S. State Renewables Portfolio & Clean Electricity Standards: 2023 Status Update
21 IMF, August 2023: IMF Fossil Fuel Subsidies Data: 2023 Update



US elections: Why the IRA is unlikely to be repealed – whatever the outcome

The US Inflation Reduction Act (IRA), which is likely to direct more than US\$1tn in incentives to support clean energy, has become a major issue ahead of the 2024 US elections. Former President Trump, the presumptive Republican candidate, has articulated his desire to unravel the IRA and reverse measures to support the energy transition.

Any US president's ability to revise legislation depends on Congressional support. Even with a Republican 'trifecta' (control of the White House, the Senate and the House of Representatives), it is our view that a total repeal of the IRA will not happen.

Our confidence rests on history. Despite Trump campaigning on the repeal of the Affordable Care Act ('Obamacare'), efforts to repeal the Act failed to pass in a Republican-held Congress in 2017. In many ways, the IRA would be more difficult to repeal than the Affordable Care Act. Since passage of the IRA in 2022, more than US\$160bn has been committed by the private sector to new clean energy manufacturing facilities in states that often or sometimes have Republican congressional majorities. The federal election swing states of Georgia and Michigan are currently the top two destinations for new IRA-related manufacturing investment, with thousands of new jobs on the way.¹⁹ A repeal would not be in the self-interest of those states or their elected representatives.

State-level political dynamics will matter too. Today, 17 US states have legally binding 100% clean energy targets.²⁰ These cannot be undone at the federal level.

There is, however, a real prospect for a Trump-led administration to impair the implementation of certain provisions in the IRA, alongside executive orders to support fossil fuel production and downgrade climate action. The threat of these actions, although damaging to sentiment, does not change our view about the lasting impact of policy support to date. Fundamentally, the economics of renewable electricity, EVs and other advanced environmental technologies have improved to the point that they can outcompete incumbents – even without government subsidies. Indeed, according to the IMF, global subsidies to fossil fuels amounted to more than 7% of global GDP in 2022, far outweighing subsidies to clean energy.²¹



3

Mitigating drivers of biodiversity loss will create new markets

Mitigating drivers of biodiversity loss will create new markets

Biodiversity has rapidly risen up corporate and investor agendas, with growing recognition of the global economy's far-reaching dependencies on ecosystem services. The World Economic Forum has estimated that biodiversity underpins more than half of global GDP.²²

The goal of mobilising US\$200bn a year in finance for biodiversity by 2030 was agreed at the COP15 biodiversity summit in late 2022. Despite this ambition, there is limited information about how companies can address nature-related risks and opportunities. Enhanced disclosures ultimately enable investors like us — and our clients — to make better informed investment decisions.

The scarcity of reporting is a function of the complexity of measuring both impacts and dependencies on biodiversity and natural capital. Unlike climate change, for which GHG emissions and avoided emissions are measurable indicators of a company's impact, biodiversity has no simple global metrics and is highly location specific. There is also limited understanding of where and how companies depend on nature in their operations.

We believe bridging the information gap is a crucial step towards addressing this issue and advocate firmly for enhanced disclosure requirements. Following the publication of the final recommendations of the Taskforce on Nature-related Financial Disclosures (TNFD) this September, we anticipate that 2024 could be an illuminating year in this journey and have already seen a strong up-tick recently in companies' interest and reporting on the topic.

Improving nature-related practices and reporting

There are three potential drivers of momentum towards widespread adoption of nature-related reporting.

- 1:** Some companies are already beginning to voluntarily report in line with the TNFD framework, with others publicly committing to doing so.²³ Norms and investor expectations should evolve as they have for climate-related reporting.
- 2:** It looks likely that corporate reporting standards will begin the journey of moving TNFD into the mainstream. The International Sustainability Standards Board looks set to incorporate the TNFD framework as it has the Taskforce on Climate-related Financial Disclosures (TCFD).
- 3:** We expect the COP16 biodiversity summit — due to be held in late 2024 — to focus on mechanisms for realising the ambitions of COP15, including mobilising private finance to protect and repair the natural environment.

To date, investors have understandably focused on addressing commodity-driven tropical deforestation, a highly visible and significant cause of global forest loss. Impax is a signatory to the Finance Sector Deforestation Action (FSDA) initiative, under which investors commit to working together to end agricultural commodity-driven deforestation.

TNFD is rightly and primarily focusing on the risks facing companies, given their myriad dependencies on nature. However, biodiversity-related opportunities are also an important part of the framework.

²² World Economic Forum, 2020: The Future of Nature and Business.

²³ TNFD, September 2023: Final TNFD Recommendations on nature related issues published and corporates and financial institutions begin adopting



Capturing opportunities as well as risks

The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) identifies five overarching direct drivers of biodiversity loss. In addition to the changing use of land and sea (which includes deforestation), the direct exploitation of organisms (such as overfishing), climate change, pollution and invasive species are all harming biodiversity. To differing extents, there are products and services that can address, or at least alleviate, the pressures on ecosystems from each of these drivers. In turn, given the critical importance of mitigating biodiversity loss, we believe that these can create long-term opportunities for investors.

Three of these five areas present familiar territory for us, having invested in environmental solutions for over two decades. First, and most obvious, is climate: most solutions that enable the transition to a low-carbon economy will by extension help protect ecosystems that are vulnerable to the effects of climate change. Second, pollution: the state of biodiversity is intimately connected with air, soil and water quality. Here, for instance, companies involved in the testing and treatment of water can help control pollution and reduce or prevent harm to water-borne life. Third, changing land use: global demand for timber and commodities is driving the conversion of natural forests into tree plantations, crops and grazing land. Packaging companies whose products advance circularity can reduce the use of virgin materials, and so pressure on the land.

Solutions to the other two drivers of biodiversity loss are emerging. Sustainable aquaculture can help avoid overfishing, for example. Providers of water ballast treatment can meanwhile help the shipping industry prevent the spread of invasive marine species — an issue that causes at least US\$23bn in economic losses each year.²⁴

As with investing in climate solutions, there are times when addressing a driver of biodiversity loss may still contribute to the issue. Importantly, it does not restore the biodiversity we have already lost, which is another task ahead of us.

Better data and disclosure are critical steps to shine a light on the issues and enable an accurate assessment — and valuation — of the risks and opportunities associated with biodiversity loss and its mitigation. Only then will capital flow where it is needed.

TNFD is rightly and primarily focusing on the risks facing companies. However, biodiversity-related opportunities are also an important part of the framework.

²⁴ Cuthbert, R. N., et al., 2021: Global economic costs of aquatic invasive alien species. *Science of the Total Environment*

4

Society's challenges can be efficiently addressed through innovation

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While inflation is returning to more 'normal' levels, elevated prices — particularly those of energy and food — continue to suppress living standards around the world. Many households face higher loan repayments as a result of interest rate rises. Lower income families are particularly affected by the squeeze.

Governments face higher costs of borrowing too. The yield on 10-year US government bonds has risen to above 4%, up from 1.5% in late 2021.²⁵ This matters when national debts are relatively high: on average, OECD countries' debts equate to roughly 90% of GDP.²⁶ When fiscal deficits are already being run, many governments have limited scope to boost spending without raising taxes.

Meanwhile, the number of over-60s worldwide is expected to rise 40% to 1.4bn by 2030.²⁷ This demographic transition is rapidly reducing working age populations and putting more pressure on public services like healthcare that are used more by older citizens.

Innovative private sector solutions will be important to addressing challenges like ageing populations in a way that reduces the burden on public purses. We believe companies whose products and services enable better societal outcomes at a lower cost can benefit from profound long-term structural drivers of demand and grow regardless of the stage in the economic cycle. Three areas illustrate these kinds of opportunity.

1: The growing emphasis on wellbeing and quality of life. Solutions that enable people to take better care of themselves — from fitness centres to over-the-counter medicines — can improve health outcomes and help prevent burdening healthcare systems. It is estimated that self-care products and associated services avoid US\$119bn in global healthcare costs each year and deliver 41bn days in gained productivity.²⁸

2: Better access to finance. Especially in emerging markets, access to solutions ranging from simple accounts to loans can remove structural barriers to opportunity. Companies that offer life insurance can meanwhile protect workers from unforeseen circumstances and those offering retirement solutions can help them save for their futures. The combined trends of ageing populations and the growing middle class in emerging markets provide tailwinds for innovative solutions in this sector.

3: Advancing more inclusive careers. Digital technologies are enabling high quality, personalised learning and recruitment services that connect people with the skills and professional roles they aspire to. Meanwhile affordable childcare solutions help overcome barriers to returning to work: according to a recent study, 40% of US parents reported not having access to the childcare they need.²⁹

Over recent years, we have developed a proprietary framework, the Impax Social Taxonomy, to classify and identify companies that we believe are benefitting from the long-term secular trends shaping society. We see many growth opportunities arising from these trends currently being underestimated by the market as the global economy transitions to a more inclusive model.

²⁵ Bloomberg data, as at 28 November 2023

²⁶ OECD, 2023: Government at a glance

²⁷ World Health Organization, 2023: Ageing and health

²⁸ Global Self-Care Federation, 2022: The Global Social and Economic Value of Self-Care

²⁹ Bright Horizons, 2023: 9th Annual Modern Family Index



5

AI can accelerate the transition to a sustainable economy

AI can accelerate the transition to a sustainable economy

Artificial intelligence (AI) offers the prospect of radical disruption to the global economy and to society. The efficiencies that technological advances are unlocking could transform whole sectors and ways of work — possibly even ways of life. Regulation will be needed to manage risks, but the opportunities for AI to address environmental and social challenges should be harnessed.

2023 was a breakthrough year for emerging AI models. In March, Microsoft-backed OpenAI released its latest content-generation model, GPT-4, that demonstrates human-level intelligence in responding to complex queries in natural-sounding language. Google launched its own rival chatbot, Bard, which will soon be upgraded using the company's latest Gemini AI system. ChatGPT now boasts more than 100mn weekly users.³⁰

As generative AI models like these demonstrate their capacity to process complex requests with growing accuracy and nuance, the long-term applications can seem limitless. Even in the near-term, the potential impact of AI is huge given models' ability to quickly learn and improve on their own. Google DeepMind has demonstrated an AI-powered robot system that can self-improve without any need for human supervision. The risks of a powerful, self-learning technology have also come into focus.

AI as an environmental solution

We are particularly interested in AI's potential to enable new and improved solutions to pressing challenges facing global society, environmental and social. Considering environmental solutions first, there are three areas where we perceive particular opportunities for progress.

1: AI has been leveraged to accelerate and improve the development of environmental technologies. For example, wind turbine maker Vestas is using an AI-driven system to improve wind farm design and maximise clean electricity generation. The model uses reinforced machine learning (using trial and error) to manage the 'shadow effect' or wake that turbines cast, affecting those around them.³¹ Looking ahead, the ability to predict the structures of new materials — as demonstrated by Google DeepMind — could unlock innovation in areas including batteries and semiconductors.³²

2: AI is being used to optimise the efficiency of energy-intensive sectors like buildings and transport, reducing GHG emissions. Networks of connected sensors already help adjust buildings' heating, ventilation, and air conditioning (HVAC) systems and lighting. AI modelling can predict how energy may be used, reducing waste.

3: AI models have surpassed the ability of supercomputers to accurately predict the weather.³³ The chart on page 20 shows how the Google GraphCast model has demonstrated less error than a leading existing model in forecasting severe weather events like hurricanes and atmospheric rivers (corridors of concentrated moisture than can lead to intense precipitation).³⁴ Better weather forecasts can help agricultural output and, in extreme cases, save lives. Extrapolating from this, AI could be used to help predict the physical impacts of climate change more robustly, and so guide better decisions on climate adaptation-related investments.³⁵

30 Murgia, M., 6 November 2023: OpenAI set to launch store as ChatGPT reaches 100mn users. *Financial Times*

31 Microsoft, 2022: How one of the world's largest wind companies is using AI to capture more energy

32 Henshall, W., 29 November 2023: Google DeepMind AI Breakthrough Could Help Battery and Chip Development. *Time*

33 Voosen, P., 14 November 2023: AI churns out lightning-fast forecasts as good as the weather agencies. *Science*

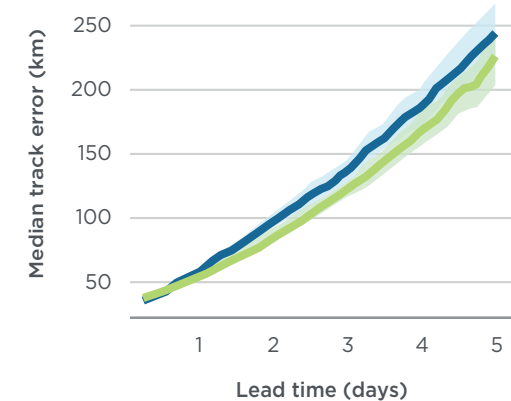
34 Lam, R. et al., 14 November 2023: Learning skillful medium-range global weather forecasting. *Science*

35 Schneider, T., et al., September 2023: Harnessing AI and computing to advance climate modelling and prediction. *Nature Climate Change*

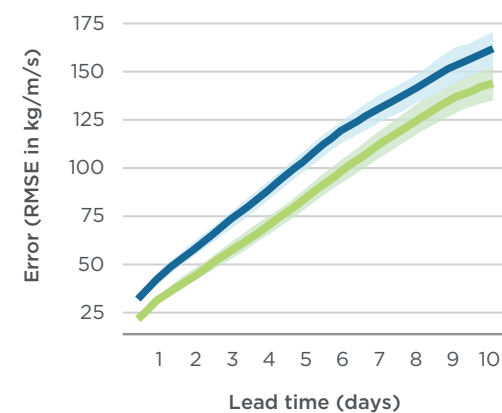
AI weather models are now better

Relative accuracy in forecasting severe weather patterns

Cyclone tracking



Atmospheric rivers



— HRES supercomputer model
— GraphCast AI model

Source: Lam, R., et al., November 2023: Learning skillful medium-range global weather forecasting. *Science*

AI as a solution to society's challenges

Two sectors stand out for AI's potential to deliver positive impacts for society: healthcare and education, where innovative companies are leveraging technological advances to improve patient and student outcomes. The likes of Duolingo, a leader in the mobile language learning market, use AI to deliver more a personalised learning experience and drive the continued refinement of its platform.

Within healthcare, AI is already being applied to improve the accuracy of cancer diagnosis and predict different forms of cancer using genetic data and samples.^{36, 37} For example, an algorithm that studied tissue imaging and genetic changes achieved a 97% accuracy rate in diagnosing lung cancer, versus 83% for previous leading

computational methods.³⁸ Drugmakers are leveraging AI to speed up the drug development process as more accurate simulation and more precise patient identification should enable success or failure of drug trials much more quickly.³⁹ AI-led innovations like DeepMind's discovery (and open publication) of the structure of more than 200mn proteins could unleash huge advances in medical and biological innovation.

More broadly, AI is already demonstrating its capacity to improve productivity in the workplace. Microsoft's Copilot tool, which is being integrated into the company's suite of software, can automate tasks like email writing and slideshow creation. A survey of early adopters found they were 29% faster in tasks including research and writing.⁴⁰

³⁶ Zhang, B., Shi, H., and Wang, H., 2023: Machine Learning and AI in Cancer Prognosis, Prediction, and Treatment Selection: A Critical Approach. *Journal of Multidisciplinary Healthcare*

³⁷ The Institute of Cancer Research, 2023: Harnessing the power of AI to improve outcomes for people with breast cancer

³⁸ National Cancer Institute, 2018: Using Artificial Intelligence to Classify Lung Cancer Types, Predict Mutations

³⁹ Grover, N and Coulter, M., 22 September 2023: Big Pharma bets on AI to speed up clinical trials. *Reuters*

⁴⁰ Microsoft, November 2023: What Can Copilot's Earliest Users Teach Us About Generative AI at Work?

Challenges posed by AI

The emergence of a powerful self-learning technology undoubtedly poses risks to society. The risks arising from disinformation and deepfakes are real, and AI products can already incorporate many sources of bias and discrimination, and distort information, with real-world consequences. Concerns that AI could lead to mass redundancies also have some credibility: unlike previous technological revolutions, AI may displace workers beyond manual, labour-intensive tasks.

Agreement on global governance of AI is therefore needed to provide guardrails and allay concerns that "machines could take over". Initiatives like the AI Safety Summit, convened by the UK government in November 2023, are important steps to manage risks facing society.

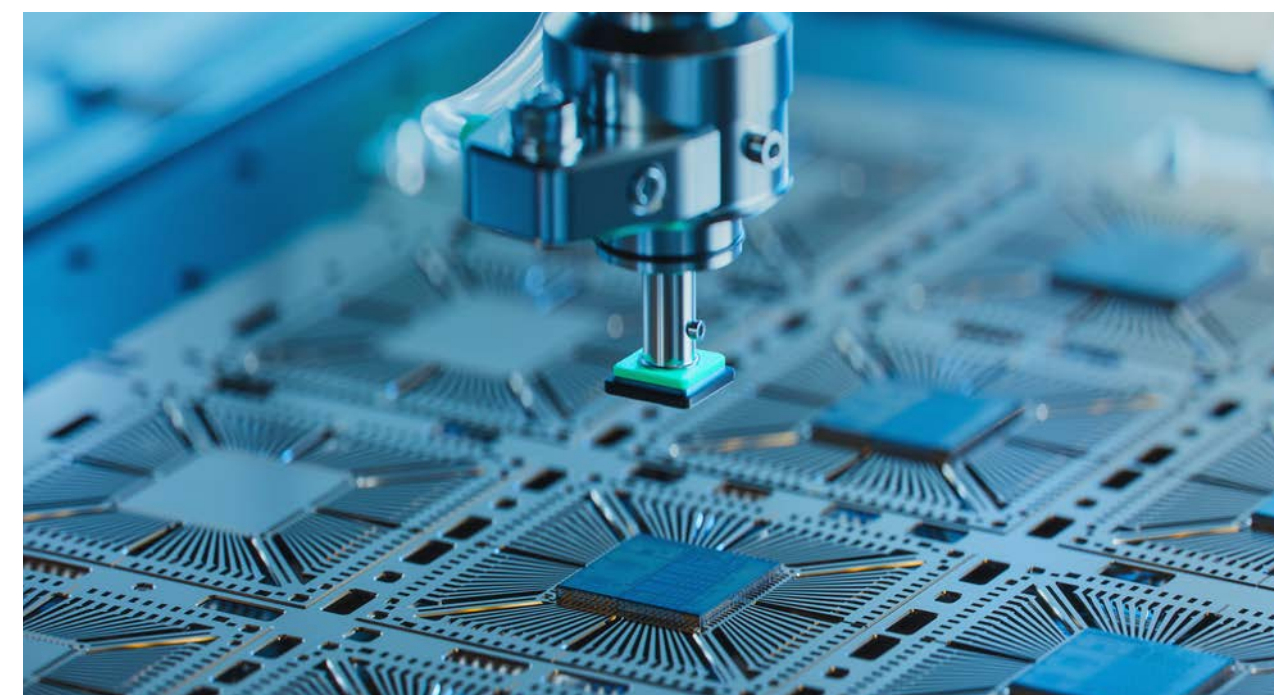
The environmental implications of the AI revolution — arising from the energy intensity of complex computation — are more manageable. Powering and cooling the servers and other hardware used in data centres consumed between 0.9% and 1.3% of global electricity in 2021. Energy use will rise with the capabilities and complexity of AI models, but energy efficiency solutions — from better-designed chips to systems management — should keep a lid on energy needs, and so emissions. Indeed, AI models are themselves being employed by the likes of Schneider Electric to optimise energy management in data centres.

Enablers of the AI revolution

Rising AI use creates opportunities for companies whose products and services play key enabling roles. While many investors focus on the companies designing AI models, their backers and the leading advanced chip designer Nvidia, we are focused on opportunities in four areas exposed to the technology's ascent.

First are the designers of electronic design automation software, like Cadence, that provide instructions for chip designs. Second are companies like ASML that supply sophisticated chip-making equipment used to etch atomic-level details on wafer-thin chips. Third are the hyper-scale data centre operators who provide the raw computing power needed by AI models. Fourth, and often overlooked, are makers and designers of 'lagging-edge' chips used extensively — and increasingly — in collecting the real-world data that enables AI-driven analysis.

It is our conviction that the adoption of AI across the global economy will continue to soar in 2024, powering growth opportunities for technologies that underpin it.





Conclusion

Progress towards a more sustainable global economy might seem to have been delayed in 2023. Tighter macroeconomic conditions have not helped sentiment towards assets associated with the 'green' economy. Geopolitics and national policy changes also threaten to undermine progress. These short-term challenges notwithstanding, the fundamental long-term drivers of transition to a more sustainable economy remain firmly intact.

Key environmental issues remain in focus, including biodiversity loss ahead of the COP16 global biodiversity summit later in 2024. Meanwhile we continue to perceive a growing need for innovative cost-effective solutions to support a healthier, more productive and more inclusive global society. We will continue to investigate how applications of AI could address some of these environmental and social challenges.

In addition to these long-term prospects, as we look ahead to 2024, we are encouraged by indicators that the monetary cycle may be turning. We believe that this will both support companies in some of the sectors we focus on, and also create selective investment opportunities for those focused on the transition.



Contributors

Contributors (continued)



Hubert Aarts

Deputy CIO, Listed Equities

Hubert serves as Deputy Chief Investment Officer, Listed Equities. Hubert is a key figure overseeing Impax Asset Management's investment strategies in the listed equities space and is jointly responsible for the development of our investment process, research, and team. He also researches stocks globally, specialising in industrials and consumer discretionary companies. Hubert co-manages the Leaders and Water strategies.



Lisa Beauvilain

Global Head of Sustainability & Stewardship

Lisa co-heads the Impax Sustainability Centre. As the Global Head of Sustainability & Stewardship she is responsible for sustainability and stewardship in Impax's investments and for the sustainability insights in the firm's Beyond Financial Returns activities, such as product development and reporting. She co-chairs Impax's Sustainability Lens committee and is a member of Impax's Senior Leadership Team.



Julie Gorte, Ph.D

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Julie oversees ESG-related research on prospective and current investments as well as the firm's shareholder engagement and public policy advocacy. Julie is also a member of the Impax Gender Analytics team.



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Luciano has been part of the Impax Asset Management team since 2017 and specialises in Digital Infrastructure and New Energy. He researches stocks globally with a focus on the Information Technology and Industrials sectors. Luciano co-manages the US Environmental Leaders strategy.



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Charlie is a Senior Economic Advisor at Impax and Visiting Professor of Sustainable Finance at the Foster School of Business at the University of Washington. Charlie's role at Impax deepens the firm's expertise in understanding the opportunities arising from a global energy transition.



Charles French

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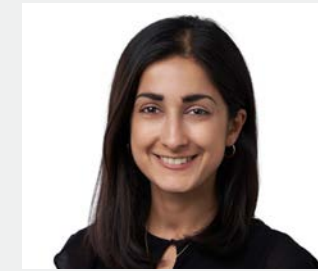
Charles joined Impax in 2022 as Deputy Chief Investment Officer of Listed Investments. Charles provides support and leadership in the development and growth of the Listed Equities business globally. Charles co-manages the Global Social Leaders strategy, launched in December 2023.



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Kirsteen is a member of Impax Asset Management's portfolio management team, specialising in Financials. She has worked at Impax since 2009. Kirsteen co-manages the Global Opportunities strategy.



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Shahbano works closely with investment teams to provide insights on the risks and opportunities created by policy changes and trends relevant to Impax's portfolio. She supports listed investment team's idea generation process, company risk analysis and portfolio management decisions. Shahbano also supports the development of public policies and standards by working with regulators and industry bodies to shape policies that catalyse a more sustainable transition.



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In the long run, we believe that companies well-positioned for the transition to a more sustainable economy can benefit from rising demand for their products and services, and so deliver strong earnings growth relative to companies that are not.





Outlook 2024

Why prospects for a more sustainable economy remain undimmed

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