

INNOVATION: WHY IT'S CRUCIAL FOR SUSTAINABILITY

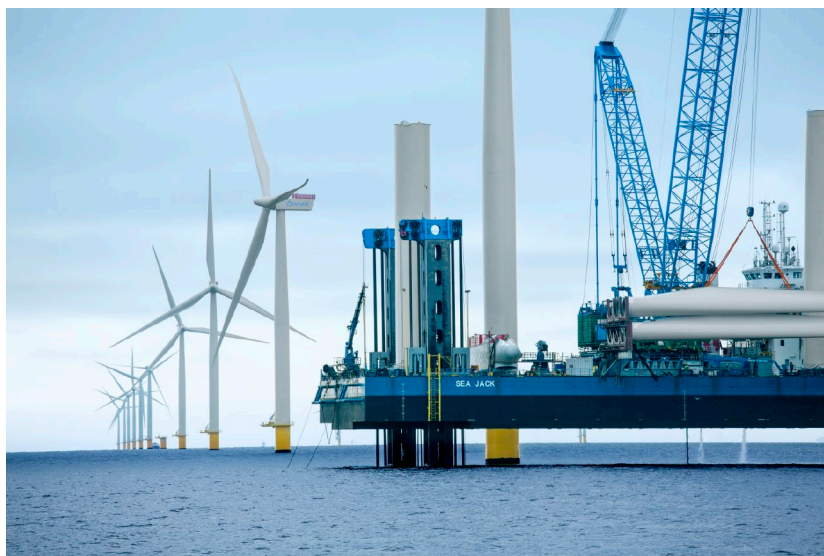
Lee Qian, Investment Manager

Scientists and economists have long feared that rapid population and economic growth could lead to our downfall. But Lee Qian, Investment Manager in Baillie Gifford's Positive Change Strategy, tells us why we shouldn't fear it. Instead, we should harness innovation and economic growth to create a more prosperous, sustainable and inclusive world.

THE IMPORTANCE OF ECONOMIC GROWTH

I hope the readers won't mind if I share my personal story.

I was born in China, in the city of Nanjing, in 1991. Back then, my parents earned around RMB 1,000 per month. We lived in a flat without central heating and where my parents' bedroom was also our living room. One of the chores that my dad and I used to do was collecting all our old newspapers, cardboards and bottles and taking them to the recycling centre. We would get some money for those and my dad often used it to buy me an ice cream or some candies. To be clear, we were already among the lucky ones. We lived in the city and my parents had stable jobs. The simple fact was that China was a poor country. At that time, two-thirds of the Chinese population lived in poverty and per capita GDP was only \$1,500.

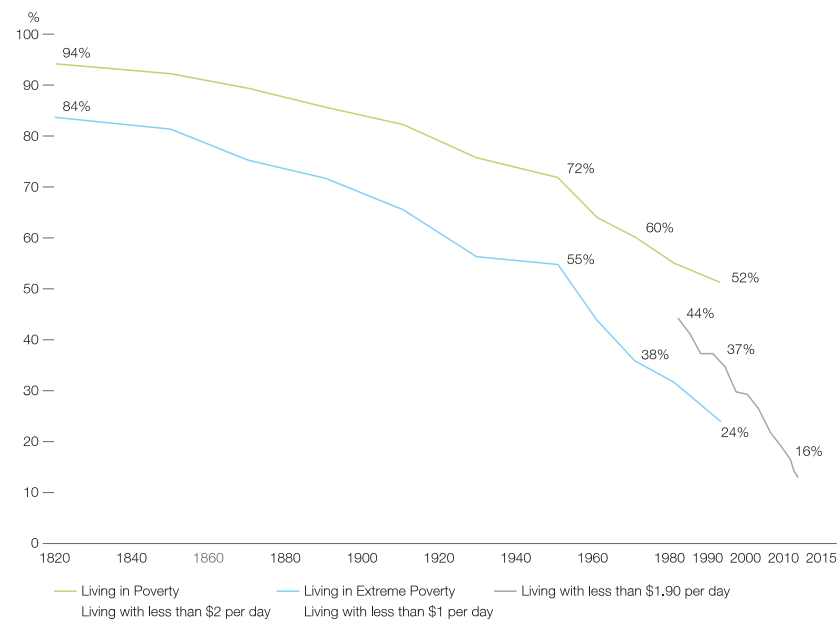


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We all know what happened since then. State planning gave way to a market-driven economy and China experienced phenomenal economic growth. This led to broad-based improvements in living standards. People got better jobs and had more choices for food and clothing. Access to healthcare improved and more families were able to send their children to schools. Fast-forward to today, China's poverty rate has fallen to single digits. China is home to some of the most innovative companies in the world, such as Alibaba and Tencent. Today, even people in poorer communities will have better living conditions than my parents did 30 years ago. Such is the power of economic growth.

What happened in China is not unique. Over the long term, economic growth has resulted in huge improvements in the quality of life for people around the world. Since the start of the Industrial Revolution, global poverty rate has fallen from 90 per cent to 10 per cent. Life expectancy at birth has more than doubled, from 29 years to 72 years, largely due to better nutrition, improved hygiene and new technologies and scientific discoveries. Finally, with greater prosperity, more people have received an education. Between 1800 and 2016, the global literacy rate improved from 12 per cent to 86 per cent.

Share of the World Population Living in Absolute Poverty 1820–2015



All data is adjusted for inflation over time and price differences between countries (PPP adjustment).
Source: OurWorldinData.org

The benefits of economic growth extend beyond the material realm. Economic growth plays a crucial role for enabling social progress. When the economy is stagnating, one person's gain is another's loss, but when the economy is flourishing, many people can look forward to a brighter future at the same time. This creates an environment where people are more willing to support greater social mobility, help people who are less fortunate or marginalised, and be tolerant to those from different backgrounds. As Benjamin Friedman put it, 'Economic growth – meaning a rising standard of living for the clear majority of citizens – more often than not fosters greater opportunity, tolerance of diversity, social mobility, commitment to fairness, and dedication to democracy.' If we want to create a prosperous, sustainable and inclusive future, then economic growth is not the problem, but part of the solution.

LIMITS TO GROWTH?

The legend goes that the inventor of chess in India took his game to the emperor. The emperor was impressed and asked the inventor to name his prize. After thinking for some time, the inventor 'humbly' asked for some rice to feed his family, one grain on the first square, two grains on the second, four on the third, until all 64 squares are filled. The emperor happily agreed, thinking this would be a small prize. However, as his adviser started to fill the chess board, he realised that he was tricked. By the 32nd square, he would have needed 4 billion grains of rice, roughly 120 tonnes. By the 64th square, he would have needed rice that weighed more than Mount Everest. We don't know what happened to the inventor...

This story illustrates the power of exponential growth. When compounded over time, seemingly small quantities can become astronomically large. Using this observation, many prominent thinkers have argued that humanity's growth – in population and economic terms – is not sustainable.



A leading figure of this movement was the 18th-century English economist and cleric Thomas Robert Malthus. Whereas his father, Daniel Malthus, believed that humankind could create a Utopia, the younger Malthus was much more downbeat. He believed that the exponential growth of the human population would far exceed the increase in food production, resulting in famine, epidemics and conflicts. He wrote in his famous book *An Essay on the Principle of Population*, 'The power of population is so superior to the power of the earth to produce subsistence for man, that premature death must in some shape or other visit the human race.' Almost two centuries later, Paul Ehrlich, a biology professor at Stanford University, would put it in more alarming terms, 'The battle to feed all of humanity is over. In the 1970s and 1980s hundreds of millions of people will starve to death in spite of any crash programs embarked upon now.'

Despite those dire predictions, the human population has continued to increase. What's more, more and more people have escaped poverty and undernourishment has declined on relative terms. When Malthus wrote his book, 12 million British inhabitants ate on average 2,400 kcal per day. Today, 67 million British inhabitants are supplied with 3,400 kcal of food per day. Globally, the food available for eating averages out at 2,790 kcal per person per day, more than sufficient for the average person. So, why have those predictions not come to pass?

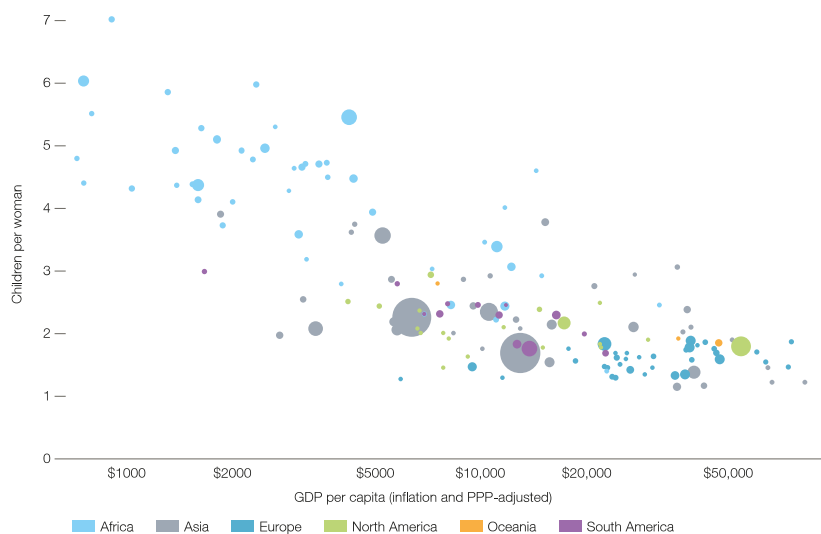
Malthus's followers like to use the analogy of a Petri dish. In an experiment that's repeated by millions of school children across the world, a few micro-organisms are added to a Petri dish containing a growth medium. Come back in a few days, the organisms would have multiplied and colonised a large part of the Petri dish, but give it enough time, they would have eaten all the nutrients and died. Humans, Malthus's followers would argue, are just like those micro-organisms. Without control, we would consume all the available resources and catastrophe would follow.

In this context, what's happening to the human civilisation is quite remarkable, possibly unprecedented. The growth of human population is slowing down. The rate of growth peaked in 1963 at 2.2 per cent per annum. It has since halved and is expected to decline to nearly zero by the end of the century. What's more, the driving force of this deceleration is not some kind of enforced population control, as advocated by Malthusian thinkers, but rather, due to the voluntary decisions of individuals. It seems that economic growth has a big role in this. Cross-sectional and longitudinal studies have found strong correlation between economic growth and declining population growth. This makes intuitive sense. Economic growth fosters greater opportunity and improved access to education. This leads to the empowerment of women and their ability to pursue a career outside of just raising kids and household work. This helps to reduce birth rate and population growth. Once again, economic growth is important to a sustainable future.



Children per woman by GDP per capita 2017

Children per woman is measured as the total fertility rate. This is the number of children that would be born to the average woman if she were to live to the end of her child-bearing years and give birth to children at the currently prevailing age-specific fertility rates. GDP per capita is measured in international dollars. Each bubble represents a country. The size of the bubble represents population size and the colour of the bubble indicates the continent to which the country belongs.



Source: OurWorldInData.org

Possibly the two greatest weaknesses in Malthus and his followers' argument are mistaking the Earth as a closed system and underestimating the role of innovation and new technologies. Returning to the Petri dish analogy, when the experiment starts, a lid is placed on top of the Petri dish and no new nutrients can be added. Once the micro-organisms have consumed all the food, their demise is inevitable. But unlike the Petri dish, the Earth is an open system. The sun continuously bathes our planet with a steady stream of solar energy. This energy helps to sustain life and the human civilisation. In fact, this stream of energy is so abundant it's 5,000 times greater than our current global energy consumption. Our task is to harness this abundant energy source so to minimise the need to extract energy from the Earth. This is a big challenge but also an exciting opportunity. In the long term, we should also consider the prospect of humans becoming a multi-planetary species, as suggested by Elon Musk. This might sound like science fiction, but so our current world would probably seem to people alive in Malthus' time.

On innovation, Malthus and his followers assume that technology would, at best, improve at a linear pace. In reality, technology is likely advancing at a faster pace. Brian Arthur proposed that technology advances through ‘combinatorial evolution’ where new inventions are created from existing technologies and knowledge. In other words, technology proliferates and the boundary of possibility constantly expands. Since the start of the Industrial Revolution, new technologies including electrical power generation and the Haber-Bosch process have improved access to food and energy; medical breakthroughs from the discovery of penicillin to modern genomics are helping us to overcome diseases; new forms of transportation are enabling more of us to travel and see the world; and digital technology is facilitating access to information and vital services, such as banking and healthcare. As the economist Paul Romer declared, “Every generation has perceived the limits to growth that finite resources and undesirable side effects would pose if no new recipes or ideas were discovered. And every generation has underestimated the potential for finding new recipes and ideas. We consistently fail to grasp how many ideas remain to be discovered.”

INNOVATIONS FOR A MORE SUSTAINABLE FUTURE

We believe that innovation is key to a sustainable future. The most valuable activity the investment community can do is supporting this wonderfully creative and entrepreneurial process. When it comes to a sustainable future, we need to solve the obvious environmental challenges our planet is facing, but we also need to ensure that addressing those doesn’t undo the tremendous progress human civilisation has achieved to date. At a minimum, people in all parts of the world should have decent standards of living – safe housing, clean water and sanitation, affordable nutrition, and accessible education and healthcare. But even in richer countries, more needs to be done. For example, the heroic and much-needed campaign by footballer Marcus Rashford highlights the upsetting frequency of child hunger in the UK. We believe that innovation will play an important role in addressing those challenges. Here, we highlight a few areas that we are particularly excited about.

1. ENERGY TRANSITION

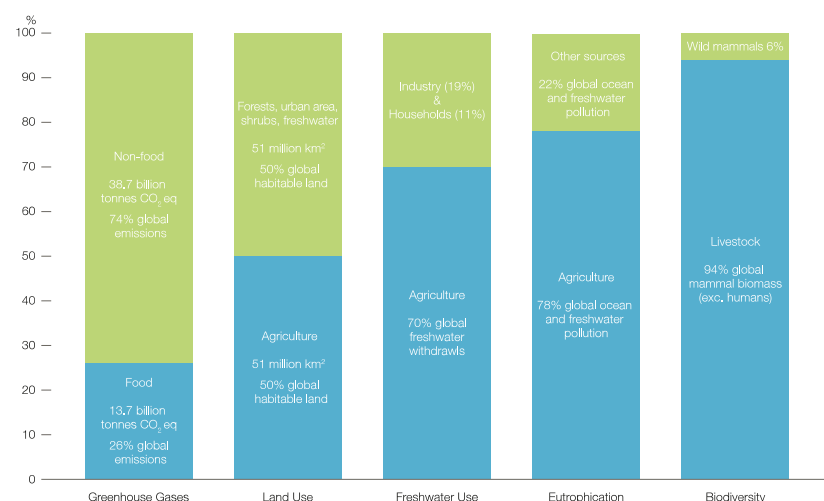
Our earliest ancestors derived all their energy from the food they ate. Since then, the discovery of fire, the domestication of animals, and the use of windmills, waterwheels, fossil fuel and modern renewable technologies, such as solar and wind, have steadily increased our energy supply. Today, energy used in everyday life is 20 times greater than energy consumed as food. The extra energy heats our homes, lights our streets, enables us to travel long distances and makes possible all sorts of products, from life-saving drugs to smartphones. However, the downside of this is that 80 per cent of our energy supply comes from fossil fuel. In addition to the obvious environmental damage, fossil fuel is a limited resource. It takes millions of years to create fossil fuel but at our current rate of consumption we will deplete it in a fraction of that time. We need to find a more sustainable alternative quickly.

The most promising strategy for the energy transition is to electrify all our energy consumption and supply all electricity from clean renewable sources, such as solar, wind and hydro. Tesla has shown the way in electrifying personal mobility, but we desperately need similar innovations in other areas, such as heating and industries. Ørsted is pioneering the offshore wind industry. It's the world's largest developer of offshore wind. After helping to lower the cost of offshore wind in Europe, it's taking the technology global, expanding to the US, Taiwan and Japan. In 2019, compared to fossil fuel generation, Ørsted's heat and power generation helped to avoid 11.3 million tonnes of CO₂ emissions. To overcome renewable energy's intermittency challenge, we also need better storage and grid technologies. All those areas should present exciting investment opportunities over the long term.

2. SUSTAINABLE FOOD AND AGRICULTURE

We mentioned earlier that the rate of population growth is slowing, but in absolute terms, a large number of people will be added to the total living on our planet. The UN medium projection variant forecasts there will be nearly 10 billion people on Earth by 2050. In addition, more people will demand a developed diet. As a result, it's expected that global food production will need to increase by between 25 per cent and 70 per cent to meet the rising demand. At the same time, agriculture incurs enormous environmental impact. Food production accounts for a quarter of global greenhouse gas emissions and 70 per cent of freshwater use. Half of the world's habitable land is used for agriculture. Fertiliser runoff can also lead to dead zones in the marine ecosystem. Finally, intensive animal farming presents significant public health risks due to the overuse of antibiotics and the transmission of diseases that spread from animals to humans.

What are the environmental impacts of food and agriculture?



*Eutrophication is a process caused by pollution from sources such as fertilisers, which reduce oxygen in water, killing fish and other animals.

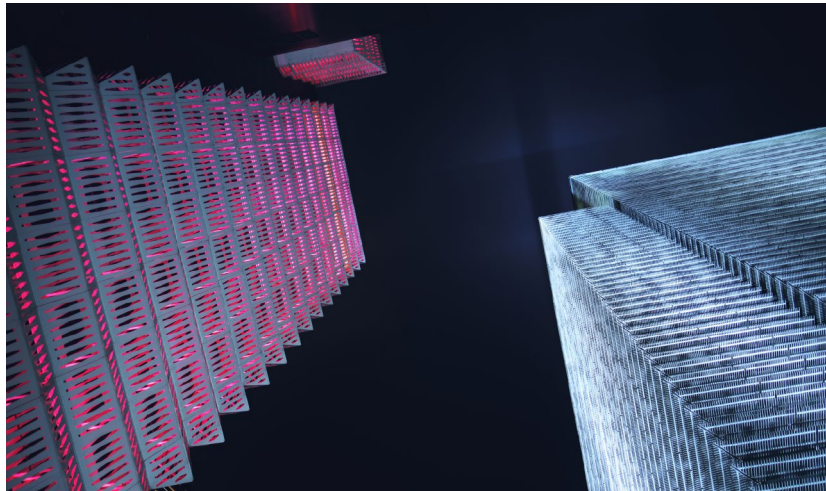
Source: OurWorldInData.Org

Fortunately, many innovations can help make agriculture more sustainable while meeting the growing food demand. Baillie Gifford's sponsorship of the James Hutton Institute is helping us to learn more about new technologies and sustainable farming practices. A good example is precision agriculture. By combining technologies including sensors, satellite communication and software, companies such as John Deere are helping farmers to increase yield while using less fertilisers and pesticides. Plant-based protein is another interesting opportunity. Animal husbandry is incredibly inefficient. The US livestock industry converts 1,187 Pcal (the ratio of protein energy to total dietary energy) of feed into just 83 Pcal of human edible proteins annually. Beyond Meat is aiming to make plant-based food mainstream by appealing to traditional meat eaters with products that mimic the taste and texture of animal meat. Its products are sold by Walmart, Tesco, Dunkin' Donuts, Starbucks and others. Longer term, indoor vertical farming could be a promising technology. By growing crops in a controlled environment closer to cities, it should reduce the need for water and pesticides and cut down on food waste due to transportation.

3. INCLUSIVE DEVELOPMENT

Since the Industrial Revolution, we have made tremendous progress at lifting people out of poverty and improving living standards. However, across developed and developing countries, there are still large number of people who have benefited very little from economic growth. Globally, there are more than 700 million people living in extreme poverty, defined as having an income of less than \$1.90 a day, and a further 2.7 billion people have an income of between \$1.90 and \$5.50 a day. A prosperous and sustainable world needs to be inclusive, a place where the vast majority of the people feel the benefit of economic growth.

Development is multi-dimensional and we must acknowledge that businesses are only part of the solution. Government policies in areas such as education, health and job creation are vitally important. Nevertheless, businesses and innovations do have a role. In particular, we are excited by the opportunity of leveraging on digital and mobile technologies to deliver essential services in a more accessible manner. Safaricom serves as an excellent example. Its mobile money service M-Pesa is used by over 24 million customers on a monthly basis, helping them to save money, pay for goods and services and send money to family and friends. A 2016 study by researchers from MIT and Georgetown University estimated M-Pesa helped to lift 194,000 householders out of poverty. Now, Safaricom is looking to provide other mobile services, including education contents for students and services and support for smallholder farmers.



CONCLUSION

Like everyone, we hope the future will be prosperous and sustainable. We believe that innovation plays a huge role in ensuring future economic growth is compatible with the obvious environmental boundaries. As investors, our primary role is to support those innovations. This might not be as easy as it sounds. Innovation is risky and has a high failure rate. Innovation also requires patience and long-term thinking. The market's obsession with quarterly earnings is utterly unhelpful for companies who are pursuing disruptive innovation. Investors must think about the next 5, 10, 20 years and be willing to back companies over those time periods. Indeed, one of the most valuable activities that investors can do is to encourage companies to invest for the long term. Ultimately, we believe that entrepreneurship and innovation, when directed at solving societal challenges, can be a powerful force for positive change. There are many industries where businesses can have such a positive impact. For patient investors, this offers a great opportunity to be part of some of the most exciting businesses of the future.

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Lee joined Baillie Gifford in 2012 and is an investment manager and decision maker in the Positive Change Team. He is a CFA Charterholder and graduated BA (Hons) in Economics and Management from the University of Oxford in 2012. Lee grew up in China during a period of incredible economic and social progress, when hundreds of millions of people were lifted out of poverty and the standard of living improved for the majority of the population. Witnessing that has influenced Lee deeply and he has been interested in development since.

