

Rathbones Review

Summer 2021

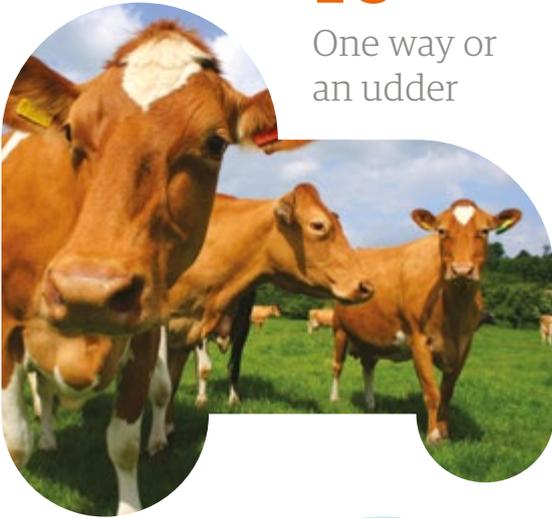
How soon can
we abandon
fossil fuels?

Is a carbon-neutral future
closer than we think?

Rathbones
Look forward

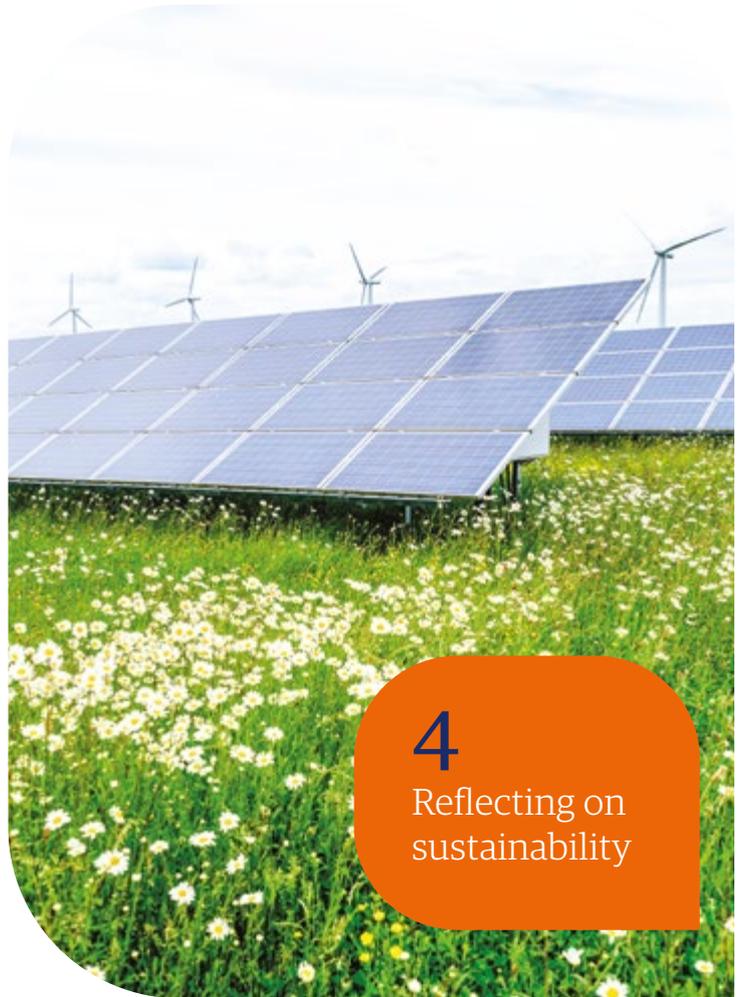
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One way or an udder



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Where sport meets science



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Reflecting on sustainability

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Welcome

to the Summer edition
of *Rathbones Review*



Convened by the United Nations and the governments of the UK and France, the global Climate Ambition Summit 2020 took place last December. UN Secretary-General António Guterres launched the event by warning that current efforts to address the threat of environmental catastrophe could yet prove inadequate, despite the targets enshrined in various far-reaching accords and agendas.

Britain seems better positioned than most nations in potentially defying this sombre outlook. The era of coal is almost at an end in the UK, and our use of renewable energy has grown fivefold in just a decade. So can we achieve a net-zero economy by 2050, per our official commitment, or might we even get there sooner? As we explain in our lead story, the road ahead is likely to be difficult – but by no means impossible.

Of course, this journey will involve significant innovation and disruption. These two phenomena have become central to so many aspects of our lives, particularly in the face of COVID-19. Ours is an age of arguably unprecedented novel thinking and technological transformation, as we explore in articles examining the cutting edge in sectors as diverse as dairy farming, sport, waste management, social media, 3D printing and music.

We also consider how new ideas come about, looking at the fascinating role that sleep can play in fuelling creativity. In addition, we revisit the upheaval caused by decimalisation to see if the experience offers any lessons for the challenges of today and those still to come.

Elsewhere, again with the future very much in mind, we offer useful insights into passing wealth on to the next generation. Finally, we reflect on the positive change that has occurred in another sphere, the world of the Rathbones Folio Prize.

As ever, I hope that you enjoy all the articles. We appreciate your feedback, so please do not hesitate to get in touch with any comments – or, indeed, suggestions for topics we might tackle in forthcoming editions.

Martha Back
Editor and Investment Director

If you have any comments on this publication or suggestions for topics that you would like to see discussed in the future, please let me know.

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Connect with Rathbones



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Rathbone Brothers Plc

The value of investments and income arising from them may fall as well as rise and you might get back less than you originally invested.



Giant solar farms such as this one in Lincolnshire could increasingly become a feature of the British landscape as the journey towards net zero continues.

Image: Paul Glendell/Alamy

How soon can we abandon fossil fuels?

If Britain is to meet its target of generating net-zero greenhouse gas emissions by 2050, we are going to have to wean ourselves off fossil fuels – coal, oil and gas. We are well ahead of many developed nations, but how hard is the challenge that confronts us?

Jane Sydenham, Investment Director, [Rathbones](#)

Few may have noticed amid the turmoil of COVID-19, but last April and June something rather unusual happened in Britain. For the first time since the opening of the Holborn Viaduct power station in 1882 we managed to survive two months without burning coal for electricity.

The days of coal are nearly at an end in Britain. The Drax power station, near Selby, North Yorkshire, stopped coal production in March. Four of its six boilers have now been converted to biomass, burning compressed wood pellets to create electricity.

The final two coal-fuelled power stations on the UK national grid network – at West Burton and Ratcliffe-on-Soar, Nottinghamshire – will close in 2024.

Eliminating coal-burning power stations has helped Britain cut emissions faster than any other developed country during the past 20 years. Between 1990 and 2018 carbon dioxide (CO₂) emissions fell by 43% in the UK, compared with a decline of 2% for the rest of the G7 countries. And this is a period during which the economy has grown by 75%.

Winds of change

What has driven this transformation is the fivefold growth of renewable energy in just a decade. It now accounts for around 40% of our power needs.

Half of our renewable energy comes from onshore and offshore wind power. Onshore wind power is the fastest-growing source of power generation globally and is already as cheap as fossil fuels. Offshore wind power costs are falling rapidly.

In October 2020 the Prime Minister told his party conference that within 10 years offshore wind farms would generate enough electricity to power every UK home. Research suggests fulfilling this pledge would cost £50 billion and involve the installation of a new offshore wind turbine every day for the next decade.

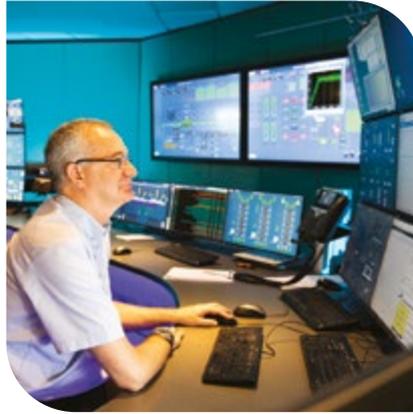
It is a tall order, but the government is certainly committed. In March it unveiled £95 million worth of investment in the Humber region and Teesside for port infrastructure to enable the building of the next generation of offshore wind farms.

It is claimed that once complete the two ports will have the capacity to support the development of up to nine gigawatts (GW) of energy from offshore wind projects each year – enough electricity to power around eight million homes.

Solar so far

Wind is only part of the story. We are also seeing rapid expansion of solar energy production. In 2020 solar plants in development were expected to generate 13.43GW of energy on completion. Those installed during the past decade already provide around 6% of our electricity. The cost of solar has fallen dramatically, and estimates suggest it will drop by another 27% by 2030.

We are now seeing the construction of a number of super-size solar farms –



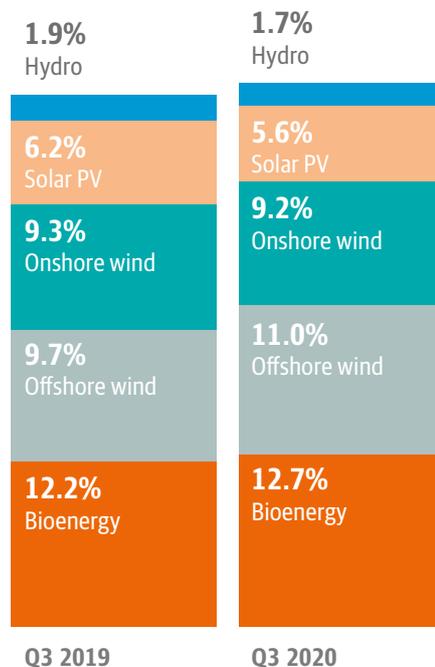
Above: The control room at the Drax power station.



Right: Half of our renewable energy now comes from onshore and offshore wind power.

“The days of coal are nearly at an end in the UK. Our final two coal-fuelled power stations will close in 2024.”

Renewables' share of electricity generation



Source: Energy Trends December 2020, gov.uk

near-1,000-acre plots of land dedicated to harvesting the Sun's energy.

None of these renewable energies is without problems. Biomass plants raise concerns about destruction of forestry. Solar farms and onshore wind farms change the face of the countryside and distress residents. Offshore wind farms are perhaps the least controversial, though migrating birds can be caught in the propellers – which themselves are hard to recycle and dispose of.

All things considered, most people would welcome the rise of renewable energy. Our success in ending dependence on coal and reducing CO₂ emissions is certainly to be celebrated.

Yet we will also have to wean ourselves off gas and oil if the UK is to meet its 30-year target of bringing greenhouse gas emissions to net zero. This next phase will be much harder.

Roads less travelled

The biggest source of emissions in the UK is transport. It accounts for 28% of emissions in a typical year. One in 15 vehicles sold in the UK last year was battery-powered, and nearly 30% – usually hybrids – had some



Above: A car being charged using a ubitricity lamp post EV charging point in London.

electric drive capacity. But no new petrol or diesel cars will be sold in the UK from 2030, and sales of new hybrids will be phased out by 2035.

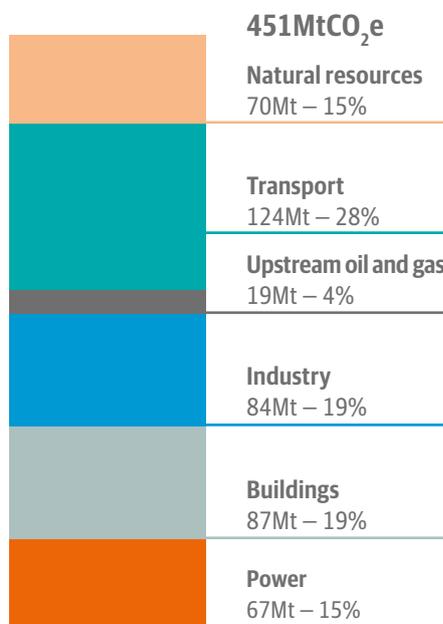
With at least one in five motorists not having a drive on which to charge their car, we will need much more on-street charging. The idea of fitting chargers into lamp posts has gained ground in recent years. Expect to see a huge surge in the numbers of public charging points across the country, too. There are currently around 40,000 in nearly 15,000 locations, and hundreds are being added each month.

New technology is speeding up charging times. ‘Range anxiety’ should also diminish, as virtually all major car manufacturers are now working on electric cars – an investment that is worth many billions of pounds and which should lead to significant range extensions.

Meanwhile, we need public transport and freight to become zero-emission – and we need more people to spend less time in their cars. We are already seeing more electric buses. Newer rolling stock is improving CO₂ emissions on Britain’s rail network. In 2018 emissions from passenger trains

“We are going to become much more dependent on electricity. The electricity needs to be from renewable sources, and supply needs to be dependable.”

UK territorial emissions



Source: Department for Business, Energy & Industrial Strategy, National Atmospheric Emissions Inventory, 2018; MtCO₂e = metric tonnes of carbon dioxide equivalent

dropped by 195,000 tonnes – the equivalent of taking around 90,000 cars off the road.

Around 70% of passenger trains are already electric-powered, and the government has challenged the rail industry to remove all diesel-only trains by 2040. This will mean electrifying more of the network. However, with rail travel projected to grow by 60% in the next 30 years, emissions are expected to rise rather than fall. More needs to be done. There is hope that hydrogen may provide the answer – more on this shortly.

The final transport challenge is air travel. The Department for Transport expects international and domestic aviation demand to increase by 73% between 2018 and 2050, but more efficient planes and uptake of low-carbon sustainable aviation fuels mean emissions are at least likely to remain broadly flat.

Home heating

One of the the biggest challenges in achieving net-zero emissions, as identified by the government’s Committee on Climate Change (CCC), is eliminating the use of natural gas to heat our homes – all 29 million of them. Buildings are the second-largest source of emissions in the UK, thanks largely to the burning of gas to heat radiators. Nearly 90% of Britain’s homes are heated by gas – compared to 47% in Germany, where there is much greater dependence on electric and shared ‘district heating’.

For years we have been encouraged to install supposedly energy-efficient gas combi-boilers, but now we are told we need to replace them with heat pumps and electric underfloor heating. While we are at it, we need to make our homes more energy-efficient to reduce the need for power and prepare them for a changing climate.

Gambling on batteries

What is clear from this brief overview is that we are going to become much more dependent on electricity. This electricity needs to be from renewable sources, and supply needs to be dependable.

This is one of the biggest problems of solar and wind power. Neither sunshine nor wind can be guaranteed. This makes it harder to match peak energy production with peak energy use. And it means we need back-up for those dark, still days.

This will need to be provided by batteries. Until recently the size of a battery needed to store a meaningful amount of energy has been too large to be practical. Today we have the prospect of high-energy-density lithium-ion batteries – developed for use in mobile phones and electric cars – being deployed in vast arrays to store enough energy for use in the power grid. Tesla's Elon Musk is among the trailblazers in this field.

In 2016 South Australia experienced a near total blackout after a powerful storm. Politicians blamed the push for renewable energy for the extent of the shutdown. Through Twitter, Musk laid a bet with Australian billionaire Mike Cannon-Brookes that he could guarantee steady renewable energy within a hundred days if Cannon-Brookes could arrange the finance.

Musk promised that the Australians could have the \$50 million system for free if he should fail to install it in time. The result was what was then the world's largest battery farm. The Hornsdale Power Reserve stores a hundred megawatts (MW) of energy from nearby wind and solar farms – enough to power 30,000 homes for eight hours. That is sufficient to enable the grid to absorb power surpluses and ride power dips, reducing outages. Musk won his bet: the system was installed with 40 days to spare.

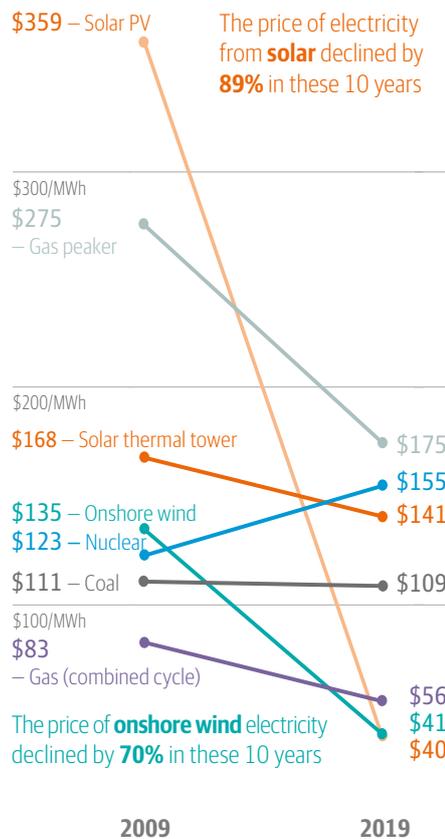
“When combined with oxygen, hydrogen creates electricity efficiently. No heat is produced, and the only by-product is water.”

Coming to a field near you

Hornsdale has become a model for other countries. Last November the UK government gave the green light to a 320MW lithium-ion battery site at DP World London Gateway, a new port and logistics centre on the Thames Estuary in Essex. Costing £200 million, the project has the potential to double in size – at which point it would have about a third of the capacity of a large coal-fired power station. It will dwarf the UK's biggest active battery project so far, the 50MW Thurcroft battery storage site in South Yorkshire.

Batteries can provide one answer to the problem of intermittent renewable energy. But they are not the only one.

The price of electricity from new power plants



Source: Our World in Data, Lazard

Hydrogen

Hydrogen is one of the great hopes for many in the energy industry. It has a number of potential uses as an energy source. It can be blended (5%-15%) into the existing natural gas pipeline network without damaging gas boilers, helping to reduce emissions from existing gas power.

When combined with oxygen it creates electricity efficiently. No heat is produced, and the only by-product is water. Hydrogen holds more energy in less space than electric batteries – though not as much as petrol or diesel. It is seen as a viable fuel for trains, lorries and buses.

Some car manufacturers are also exploring its potential. Toyota's hydrogen-powered Mirai saloon has a range of 342 miles and can be refuelled in under five minutes at a similar cost to petrol. But there is one drawback: there are only 13 hydrogen refuelling stations in the UK at the moment.

There are two major issues with hydrogen. One is storage – the gas needs to be compressed, liquefied or chemically combined prior to storing, and at present there is no standardised approach for

doing this. The other is that the most common form of production involves natural gas and creates a CO₂ by-product.

Scientists are exploring ways to address this through carbon capture and storage. They are working with a group of leading power companies on a project in Humberside – the Zero Carbon Humber. The Humber is the most carbon-intensive industrial cluster in the country, with its steel and chemical industrial manufacturing plants emitting 12.4 million tonnes of CO₂ a year.

The government hopes to produce hydrogen at scale in Humberside and convert neighbouring industrial plants to its use while at the same time capturing the carbon. This could bring down the price of hydrogen, stimulate demand and set the stage for greener forms of hydrogen to be produced more competitively in future.

Nuclear

The other energy source we have yet to mention is nuclear. Britain's old nuclear *fission* power stations – seven of them – generate around a fifth of the country's electricity supplies. Six are due to be retired by 2030, with the seventh, at Sizewell, set to be decommissioned in 2035. Plans to build new large reactors have hit funding challenges.

The UK Atomic Energy Authority is currently inviting communities to bid to host a prototype nuclear *fusion* plant, to be completed by 2040. The government has committed £525 million to the project, with the hope that similar plants would follow. It sees nuclear as a clean energy source. Whether it will work is another matter.

There is a big difference between fission and fusion. One works by splitting large atoms and creates highly radioactive particles. The other works by fusing lighter atoms into a larger one – as occurs in stars, such as the Sun – and is argued to be



Is the dream of nuclear fusion reactors connected to the national grid at last set to become a reality?

“The promise of nuclear fusion has remained a dream, always seemingly just 20 years away, since the 1950s.”

much safer. The promise of nuclear fusion has remained a dream, always seemingly just 20 years away, since the 1950s.

Gridlock?

The list of challenges grows. We also need to spend billions on the national grid. Britain started to create its national grid system in 1937, when a series of smaller regional grids were connected to try to improve the security of supply and reduce the overall cost of electricity.

As energy demand has increased over time, new capacity has not kept pace. This means the amount of headroom – the difference between peak supply and peak demand – has dramatically reduced. As a result, power companies need to fire up older and more inefficient power stations to meet peaks in demand.

The process of getting electricity from where it is generated to where it is needed is fairly simple. The grid was designed to transmit huge amounts of electricity great distances. But this is very inefficient, and large amounts of power are lost due to lengthy supply lines. As

renewables are integrated into the grid, the sources of power are increasing from hundreds of traditional power stations to millions of geographically dispersed, small power plants – think of all those solar panels on roofs.

A complex puzzle

What is clear from all this is that weaning ourselves off fossil fuels is not going to be easy. It is not a case of simply switching to renewable energy. We need to reduce our *demand* for energy. We need to *store* energy. We need *different sources* of energy. And we need a more efficient grid.

Reaching net zero by 2050 will be hard, but it is not impossible. A small but growing number of economists are talking optimistically about the transition. Two things are encouraging.

First, governments and populations around the world are becoming aligned in seeing this as a priority for the planet. Policymakers everywhere are addressing the problem and allocating resources to change.

Second, technology is making renewable energy cheaper and cheaper – as our chart shows. There will come a time when we will not need policymakers to drive us in this direction. Simple finances will make the shift happen. As we reach that tipping point, change could come very quickly indeed.



Land of milk and money

You might think this has been a bleak time to be a British dairy farmer, with Brexit, COVID-19 and the growth of veganism adding pressure to an already demanding job. But Britain's farmers are a tough breed, and many of them are responding to the challenge with energy and creativity.

Rowland Flower, Investment Director, **Rathbones**

Coronavirus struck Scottish dairy farmer Robert Sloan's family early on. Robert's sister, who lives next door to his farm in Ayrshire and works for the NHS, caught the virus. He had to send his three staff home amid fears they would be infected, but that left just him and his father, Bryce, looking after their 60-cow herd.

Fortunately, Robert's earlier investment in automatic milking machines and calf feeders paid off. The farmhands could stay at home for a short time without compromising the wellbeing of the herd, the business or their respective families.

Labour problems are far from the only challenge the pandemic has created for Britain's dairy farmers. In the past year the country's 24,000 cafés have been forced to close, driving down demand. Getting milk to supermarkets has not been easy at times either.

The total number of UK dairy cows fell from 2.6 million in 1996 to 1.9 million in 2018 – a 27% reduction. It fell another 2.8% last year – the equivalent of 50,000 fewer cattle.

The industry faces deep-rooted problems. Looking ahead, many worry that there will be less demand for milk. A third of British 16-to-24-year-olds use non-dairy milk, according to one recent survey.

The trend is global in the developed world. For example, milk consumption per person has shrunk 40% since 1975 in the US, where net sales fell by \$1.1 billion – or 8% – between 2017 and 2019 alone.

Part of the appeal of non-dairy alternatives is connected to climate change. Around 37% of greenhouse gas emissions stem from cattle production. Dairy farming accounts for 4% of emissions – more than the airline sector.

There are also criticisms of the dairy industry from an animal welfare perspective. “Cows that never get out to grass are now producing more than half the milk that people buy in supermarkets,” says Patrick Holden, founder of the Sustainable Food Trust. “I think a lot of people are going vegetarian and vegan because they don’t like farming done on these vast scales.”

Pressure may be coming from an unusual source, too. Scientists at American business TurtleTree Labs are creating raw milk by using cells from mammals grown in their laboratory, encouraging the cells to produce milk in giant bioreactors. Will we even need dairy farmers soon?

Going green

It is easy to underestimate just how big the British dairy industry is. The UK is the world’s 11th-largest milk producer. Dairy is a £4.5 billion market that employs 50,000 people directly or in supporting businesses.

It is true that the number of dairy cows is falling, but those numbers can be misleading. Smarter breeding and automation have increased productivity substantially in recent years. Robot machines, like those installed by the Sloans, allow the cows to decide when to eat, drink or be milked. This makes them more relaxed and leads to more milk.

The dairy industry is so fragmented that it is also hard to see just how many farms are embracing technology.

At Copys Green Farm, Wighton, near the north Norfolk coast, Stephen Temple has managed to cut production costs dramatically and reduce his carbon footprint at the same time. He grows forage maize to provide fodder for his

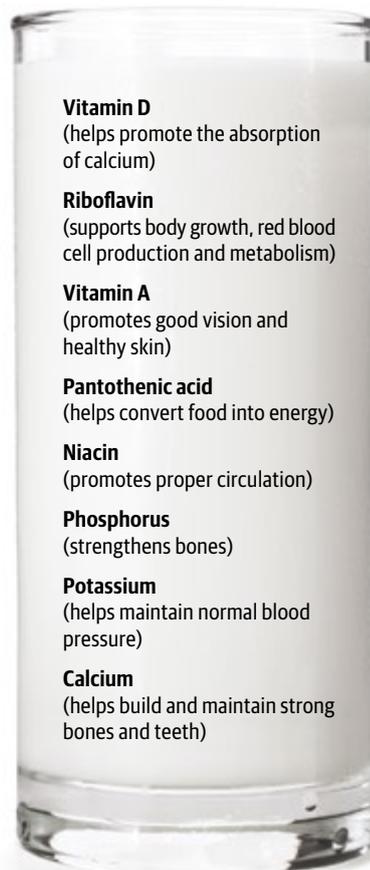
dairy herd and feedstock for an anaerobic digester plant installed on the farm.

The digester takes the maize and manure from his 130 cows and whey from his cheesemaking enterprise. It generates heat for grain drying, cheesemaking

“More than two thirds of the farmland in the UK is grassland. Most of this is unsuitable for crop production.”

Got milk?

Milk is rich in valuable nutrients. Only soya milk compares in terms of nutritional value. Other milk alternatives need added artificial nutrients to reach similar levels of vitamins and calcium.



and warming his farm, office and three cottages. It also produces electricity for the farm and national grid. The waste or ‘digestate’ from the plant acts as a perfect fertiliser for his crops and soil.

Temple also uses electric vehicles where possible. He has an electric farm jeep for fetching in the cows for milking, a second-hand Tesla, a Nissan Leaf – used by the farm’s full-time engineer – and, for delivering cheese, a Renault ZOE.

Dr Olivia Godber, a sustainable agriculture specialist, who last year moved from the UK to take up a post at Cornell University in New York state, says: “The UK dairy industry has made great progress towards improving its sustainability and reduced its carbon footprint by 24% between 1990 and 2015. But further action needs to be taken. The National Farmers’ Union has set the goal of reaching net zero by 2040.”

Godber says that modern farming is highly scientific. Methane production is an inherent part of rumination, but the quantity produced per litre of milk can be reduced through improving diet. This can mean optimising the balance of grass and maize silage, increasing the proportion of fat and oil, using high-sugar-content grasses – such as ryegrass – or even giving the cows probiotics. The way manure and slurry are stored and used on a farm can also help.

The supermarket challenge

One of the biggest challenges for dairy farmers is the squeeze on milk prices. Since 1994 – when the Milk Marketing Board, which guaranteed minimum prices, was effectively scrapped – farmers have been left on their own to negotiate with supermarkets, which use cheap milk to attract customers.

It has taken time, but farmers are increasingly joining cooperatives to strengthen their position. An example is Arla, a European dairy cooperative owned by 12,000 farmers, around 2,500 of whom are in the UK. By working together,

members take greater control over how their milk is processed and sold and have a greater share of the profits.

Farmers are also being creative in finding new markets for their produce. In 2015 Joe Towers, a farmer in Lancashire, learnt that the best frothing milk for baristas had 3.6% protein. His 330 Holstein Friesians were averaging only 3.1%. He invested in 70 in-calf Jerseys from Denmark. He now supplies 35,000 litres of milk a week to London coffeehouses and a further 22,000 litres direct off the farm through his own branded milk business, Lune Valley Dairy.

Many farmers have turned to producing their own dairy products – yoghurts, ice-creams and cheeses – to enhance the money they can make.

Of course, Brexit adds another challenge. For now farmers are receiving funding similar to that which they received under the Common Agricultural Policy, but the new Environment Bill seeks to shift away from making payments to farmers based on the amount of land they manage – a model criticised for pushing up land prices. Instead farmers will be paid to produce ‘public goods’ – things that can benefit everyone but which bring no financial reward, like clean air and water. They will be rewarded for improving soil quality.

Tim Mead, founder and CEO of Yeo Valley, the UK’s largest organic dairy brand, has been running tests on the soil of his farm near Bristol for 15 years. He says: “Soil stores three times more carbon than all the trees and plants in the world. The potential of soil to store carbon is immense.”

Tests on Mead’s 2,000 acres show an annual growth of soil carbon in excess of one-and-a-half times the carbon footprint of his herd of cows. More research needs to be done, but the numbers are encouraging in supporting organic farming and in highlighting the role that farmers can play in the battle against climate change.



Above: Arla is a cooperative that helps dairy farmers across Europe. Left: Using forage maize as cattle fodder can reduce costs and carbon footprints.

“Many farmers have turned to producing their own dairy products – yoghurts, ice creams and cheeses – to enhance the money they can make.”

A new era?

“Grassland stores carbon, whereas ploughing releases it into the atmosphere,” notes beef farmer Rosamund Young. She is one of the surprise publishing successes of the past few years. In her book, *The Secret Life of Cows*, she describes the different personalities of the cows on her land at Kite’s Nest Farm in the Cotswolds.

She notes how each cow’s milk tastes different. She argues that grassland converted to cropland often results in the digging up of hedgerows and trees, which otherwise help offset the methane emissions of livestock. She recognises that modern agriculture is not perfect

– she condemns the intolerable pressure to cut costs, which leads farmers to trawl international markets for the cheapest feedstuffs. She is also uncomfortable that so much good arable land is used to grow crops to feed animals – globally, it is estimated that a third of cropland is used for feeding grazing animals, including dairy cattle.

But she says: “More than two thirds of the farmland in the UK is grassland. Most of this is unsuitable for crop production. Keeping cattle and sheep on grassland is the only way to get food from it. We cannot eat grass, but they are purpose-built to do just that.”

There may be challenges for this industry, and COVID-19 has not helped, but milk is still a huge part of the British diet. Thousands of British farmers are working hard to produce a quality product, farmed sustainably and profitably.

Speaking on Back British Farming Day last year, Minette Batters, President of the National Farmers’ Union, summed up the challenge and the ambition of the industry. She said: “We want to be world leaders in climate-friendly farming. We want to be making sure we are producing carbon-neutral food by 2040... We are facing a new era. It is so important that we get this right. We cannot afford to fail. The future of our food and the future of our iconic landscape depend on it.”



Lord Fiske, chairman of the Decimal Currency Board, tries a new decimalised automatic ticketing machine at Euston station.

Decimalisation – lessons in change

They called it D-day. On 15 February 1971 Britain woke up to a momentous transformation – overnight our currency had turned decimal. Suddenly there were a hundred new pennies to the pound rather than 240 pence. How did we cope with such a big change? And, half a century later, is there anything we can learn from the process?

Jonathan Hill, Investment Director, Rathbones

Kate Ironside has an unusual relationship with the coins in her pocket. Whenever she picks up an old 50p piece she sees her mother – literally.

This is because her father, Christopher, designed all the reverses of Britain's first decimal coins. His wife, Jean, posed for the illustration of Britannia while he sketched. "She sat clutching a large ruler as a trident and a rolled-up paper as her frond," recalls Kate.

After drawing the coins at his desk in the corner of the family's living room, Christopher made plate-sized plaster casts on the kitchen table. He then carved out the designs in reverse before pouring more plaster into the delicate moulds to create 3D versions.

It was painstaking work – and his toddler daughter did not help. "Working from

home had its dangers in the 1960s, the same as today," says Kate. "I escaped from my cot at 6am, climbed on Dad's desk and trashed a key set of plaster designs just hours before they were due to be delivered to the Royal Mint. I wanted to play at designing, too. It took him two days to repair the damage."

Going decimal

If the work of designing the new coins was demanding, so was the job of introducing them. Ahead of D-day, in 1968, the 5p and 10p coins – deliberately made the same size as the existing one-shilling and two-shilling coins – were put into circulation. The following year the new 50p coin replaced the 10-shilling banknote. Out went older coins like the 'threepenny bit' and the 'half-crown'.

Kate points out that 'pennies' were deliberately kept: there was no switch to

"There will always be resistance to change. You need to know what will create most resistance and avoid that if you can. It shows that you've listened."

“Dad's designs were the longest-lasting set of coin designs in Britain.”

‘cents’. “Decimalisation made intellectual sense, but it was important to make people as comfortable emotionally as possible,” she says. “Our money plays into identity, so Dad created a thistle for Scotland, the Prince of Wales feather for Wales and the lion for England. Britannia was for all of us.”

Chartered psychologist Alison Duncanson teaches at City Lit university and runs her own executive coaching consultancy, specialising in change management. She is just about old enough to remember decimalisation affecting her pocket money. She says decimalisation is a classic example of how to introduce change.

“By making the 5p and 10p similar to the shilling and the two-shilling coins, they kept things familiar,” she explains. “They also kept the sixpence for a long time. You don’t throw away something precious to people.”

“There will always be resistance to change, and you have to be quite analytical sometimes in working out what that is. You need to know what will create most resistance and avoid that if you can. It shows that you’ve listened, which is really important. I see many businesses that run focus groups but then do nothing to demonstrate they’ve taken on board views and genuinely listened.”

Even with this continuity, a lot of work needed to be done to prepare Britain for decimalisation. Labour peer Lord Fiske, chairman of the Decimal Currency Board, which oversaw the changeover, estimated that five million machines – including cash registers, parking meters, public telephones and amusement machines – needed to be adjusted. The cost of conversion was put at £1.3 billion in today’s terms.



1. Schoolchildren in Surrey learn about decimalisation in preparation for D-day. 2. Matthew Dent's designs for UK coins form a shield. 3. Christopher Ironside (right) shows his designs to John Hastings James, Deputy Master and Comptroller of the Royal Mint.



The idea behind decimalisation was centuries old. In 1696 architect Sir Christopher Wren proposed a currency based on a silver ‘noble’ made up of 10 primes and 100 seconds.

Few in Britain took notice, but elsewhere others were having similar ideas. The Russian rouble was born in 1704, the American dollar in 1785 and the French franc in 1795.

In 1824 Parliament voted down a motion for the UK to go decimal. One of the objections was that it would be impossible to educate the public about the change.

In the 1960s, as more Commonwealth countries adopted decimal currencies, pressure mounted in the UK. A Committee of Inquiry was set up in 1961, reporting in 1963. In 1966 the Chancellor of the Exchequer, James Callaghan, announced the planned changes, and the Decimal Currency Board was set up to oversee the transition.

There was a long process of educating and reassuring the public, too. Every household was sent a simple guide to the new system. Shops displayed conversion tables to show old prices next to the new, though these were soon unnecessary.

The government even produced a half-hour British Public Information Film, *Granny Gets the Point*. Shot in black and white, it shows a three-generation family relaxing after Sunday lunch. Granny, having dozed off in her armchair, has just emerged from a bad dream about the perils of modern-day shopping.

“They nearly got me that time,” she says, flustered. “Them decimals – comin’ at me from all sides, they was. Decimals by the dozen.” Her young grandson interjects: “By the tens, Grandma. Decimals always come in tens.”

“It was gently done,” says sociologist Professor Robert Dingwall. “They built consensus and engaged younger generations to help.”

Dingwall, now 70, was taught the old currency at school and was delighted to change. “I learned all the pounds, shillings and pence stuff, and it was an absolute nightmare,” he says.

The decimatisation programme fitted with a wider modernising mission of government at the time – Wilson’s “white heat of technology” strategy to advance science. “Science was becoming metric, too, though not uniformly,” says Dingwall. “My wife trained as a pharmacist, and they were using troy measures – which went back to the days of the medieval alchemist!”

A common fear was that shopkeepers would use decimatisation to cheat confused customers and surreptitiously raise prices, but Dingwall insists this fear was largely unfounded. “It was a lot easier to cheat people when you had 240 pennies in the pound and 12 to a shilling,” he says. “Decimatisation was much simpler!”

So much so, in fact, that some claimed it would save six months in school teaching time for pupils who didn’t have to learn to add in pounds, shillings and pence. It saved accountants time, too.

Today Dingwall is a government adviser on the management of the COVID-19 pandemic. Inevitably, he draws parallels. “One of the things that worked well with decimatisation was having a very clear endpoint,” he says. “One of the reasons behind the success of the vaccination programme is that it has a clear objective, too.

“With decimatisation they built on the existing infrastructure. Similarly, the vaccine builds on something that older people have become familiar with over the past 10 years – regular flu jabs. In contrast, track and trace ignored any existing infrastructure and didn’t have a clear goal – it was a patchwork organisation with no core direction.”

Duncanson says COVID-19 has presented a very different challenge. “Decimatisation was planned change, whereas this has been a crisis,” she says “It’s a much more complex challenge, though it’s easier to understand the need for changes in behaviour with the pandemic. In change-management literature they talk about a sense of urgency being key to driving change. You didn’t have that ‘burning platform’ with decimatisation.

“Sometimes in organisations people can’t see the seriousness of problems.

“One of the things that worked well with decimatisation was having a very clear endpoint. One of the reasons behind the success of the vaccination programme is that it has a clear objective, too.”

The people at the top can, but the rest of the employees don’t see it so clearly. So you have to work hard at communication to create a sense of urgency.”

Duncanson is fascinated by the long-term changes that the past year has wrought on the country. “Humans are creatures of habit – our brains need routing and things we’re familiar with so they don’t have to think about everything afresh,” she says. “Organisations have habits, too – the way things are always done. To make change sometimes you have to ‘unfreeze’ an organisation and break down habits to reset them. COVID-19 has been a huge reset – a chance to think about how we work and where we work. That disruption can enable significant change.”

A penny for your thoughts

Today Kate Ironside is a university lecturer in journalism – an industry that itself has undergone enormous change. So has our coinage. Ten years ago her father’s coins were finally replaced by Matthew Dent’s more modern designs. The reverses each offer a fragment of a picture – if you sit them together they make a shield.

Kate likes the new coins but is still tremendously proud of her father’s work. “Dad’s designs were the longest-lasting set of coin designs in Britain,” she says.

Designing the coins was a four-year project for Christopher, who – perhaps ironically – was not paid a penny for his efforts. He was, however, awarded an OBE and later said: “Can there be a man so pompous and conceited... that he would not admit excitement beyond measure at the prospect of designing a coinage – frustration, fury, anguish and all. His work, which he has sweated blood over, will be published in vast quantities and gazed at by millions... not because he is a genius, a saint or a monster – merely because he is a coin designer.”

The science of sleeping on it

We all need our sleep – but why? What is actually happening to us once we have dozed off? And what are the pros and cons of a supposedly relaxing nap?

Rebecca Tunstall, Investment Director, **Rathbones**

Margaret Thatcher was often characterised as indefatigable, which is to say she never tired. This is not strictly true, of course, but she certainly had a reputation for tiring less than most. Famously, she was said to survive on only four hours' sleep a night.

Even the Iron Lady, though, was sedentary in comparison to Buckminster Fuller, the architect and futurist perhaps best known for designing the geodesic dome. Fuller existed on two hours' sleep a day, which he described as "plenty", and regularly condensed even this measly amount into half-hour naps.

Such extreme routines obviously benefit some individuals. Mrs Thatcher thought nothing of working into the early hours and then rising again at 5am to listen to *Farming Today*. Fuller was said to be "completely refreshed" after one of his 30-minute dozes.

So why is a regime of such severity unthinkable for so many of us? Did the likes of Mrs Thatcher and Fuller understand something about sleep that most people fail to grasp?

Our bodies and brains physically restore themselves during sleep. Waste products that gather in our cells during periods of activity are removed, and healing takes place. Also, when we are young, we grow. This happens mostly during deep sleep, when body temperature, heart rate and brain oxygen consumption are all lower.

Sleep also assists the formation of long-term memory. It generally increases our ability to recall previous learning and experiences, with the types of memories consolidated depending on the sleep state.

The body cycles between two distinct sleep modes: rapid eye movement (REM) and non-rapid eye movement (non-REM). The majority of our sleep is non-REM, which starts as a light doze and steadily progresses to deeper levels – known as slow-wave sleep.

REM sleep begins about 90 minutes into a cycle. Heart rate and respiration accelerate, and brain activity increases. This is the phase of sleep associated with dreaming.

Dreams can last from a minute to half an hour, and the average person has three to five a night – most quickly forgotten. It is thought dreams prepare animals – including, in pre-history, humans – to



recognise and avoid danger by presenting simulations of threatening events.

There is a reason why our dreams are often so bizarre. The brain areas responsible for logical decision-making and focused attention shut down, while the sensory and emotional areas come alive. Ideas and images are uncoupled from their usual associations and allowed to recombine randomly, uninhibited by our waking logic.

But what else might be going on in our minds? Thomas Edison, who appreciated a midday snooze, thought he knew part of the answer.

Edison liked to settle into a comfortable chair, with a ball bearing in each hand and metal pie pans at his feet. Eventually, after he had dozed for a while, his hands would relax, sending the ball bearings clattering into the pans and waking him up – at which juncture he would immediately write down whatever thoughts came to him.

Edison believed many of his most inspired ideas emerged in the moments that precede deep sleep, and his napping programme was designed to harness more of this creative energy. He may have been on to something: a growing body of research indicates sleep helps reorganise information to facilitate creativity and problem-solving.

It is not hard to imagine a relationship between the random coming together of ideas and creativity. It resembles the brainstorming phase in creative thinking – what psychologists call free association. You do not have to search long to find further examples of famous people who have used dreams in this way.

Paul McCartney said he came up with the melody for *Yesterday* in a dream. Novelist Stephen King turned a childhood nightmare into *Salem's Lot*. Salvador Dali credited dreams with inspiring his surrealist paintings.

One theory links specific personality characteristics, such as openness and proneness to fantasy, with the ability to remember and report dreams. Another connects the same traits with creativity. The findings suggest 'creatives' may naturally

take in more extraneous material than others – perhaps including the inspiration for their dreams.

Nonetheless, whether taking a nap in the middle of the day can help each of us be as creative as Edison remains a moot point. There is plenty of evidence to suggest naps do most of us very little good at all.

A study by NASA suggested they can improve short-term memory, but another indicated they do not enhance alertness. They may even increase the risk of type 2 diabetes. Too long a nap can leave us feeling groggy and make insomnia worse, as it does not replace 'proper' night-time sleep.

So is it really possible for anyone to harness the power of sleep, in the style of Edison, Mrs Thatcher or Fuller? Can we genuinely use it as a means of solving problems and dealing with challenges?

Crucially, the starting point for most of us is simply to get sufficient shut-eye in the first place. Even losing one night of sleep has been shown to impede cognitive ability, while sleeping six to seven hours a night correlates with longevity.

Second, we should avoid alcohol and caffeine, both of which suppress REM sleep. Then we need to think about our chosen dilemma just before bed to encourage the brain to work on it – and, like Edison, we need to write down what we can remember as soon as we awake.

These activities cannot guarantee any of us will suddenly become a great songwriter, author or artist – less still an era-defining politician or an engineering genius. But we all have problems every day, and our sleeping brains might just hold the key to solving some of them.

Sleep clearly remains something of a mystery – an endlessly fascinating one. Ultimately, perhaps the only thing we can be truly sure of is captured in a memorable quote from another visionary, Anthony Burgess, creator of *A Clockwork Orange*: "Laugh and the world laughs with you. Snore and you sleep alone."

"A growing body of research indicates that sleep helps reorganise information to facilitate creativity and problem-solving."

Sleeping on it

The need for sleep varies between species and even depends on your age.

Average total sleep time
(hours/day)

Brown bat
19.9



Human infant
16



Cat
12.1



Human adult
8



Elderly human adult
5.5



Giraffe
1.9



Source: faculty.washington.edu

How to pass wealth on to the next generation

Most of us aspire to pass wealth on to the next generation, but unless you manage the process carefully you can end up needlessly losing hundreds of thousands of pounds to taxation. Though it pays to take professional advice, here we suggest some general issues to consider.

Emma Watson, Head of Financial Planning, **Rathbones**

James and Rosie Bamford never imagined Inheritance Tax (IHT) would be a problem for them, but when they read details of the recent Budget they realised this is something they now need to address.

James is an optician. Rosie is a head teacher. They are both in their mid-50s and plan to retire at 60. They have two young adult sons, Archie and Tom.

The Bamfords live in a detached house worth about £1 million. They have £800,000 in their Rathbones account and £50,000 in cash and savings. James has a pension pot of £1 million. He expects to inherit £600,000 from his mother's estate at some point.

That means IHT is definitely an issue they need to think about. Not all that money will be liable for IHT. Let's look at the core allowances.

Allowances

Savings in a money purchase pension usually do not count in your estate for tax purposes and are therefore currently exempt from IHT. So are any donations you make on death to a charity or community amateur sports club.

We each have an IHT tax-free allowance, known as the nil-rate band, of £325,000. If you leave your home to your children (including adopted, foster or stepchildren) or grandchildren your threshold can increase by £175,000. This extra allowance is known as the main residence nil-rate band.

These are individual allowances. If you are married or in a civil partnership and your estate is worth less than your threshold, any unused threshold can be added to your partner's threshold when you die. This means the surviving partner's threshold can be as much as £1 million.

However, for every £2 your estate is valued at over £2 million you lose £1 of your main residence nil-rate band. That IHT taper means couples with an estate valued at between £2 million and £2.7 million – and the Bamfords could easily find themselves in this area – will see their residence nil-rate band gradually eroded to nothing.

The impact of that taper is significant. If both the Bamfords were to die tomorrow, their estate would be worth £1,850,000. Their IHT bill would be £340,000 and the taper would not apply.

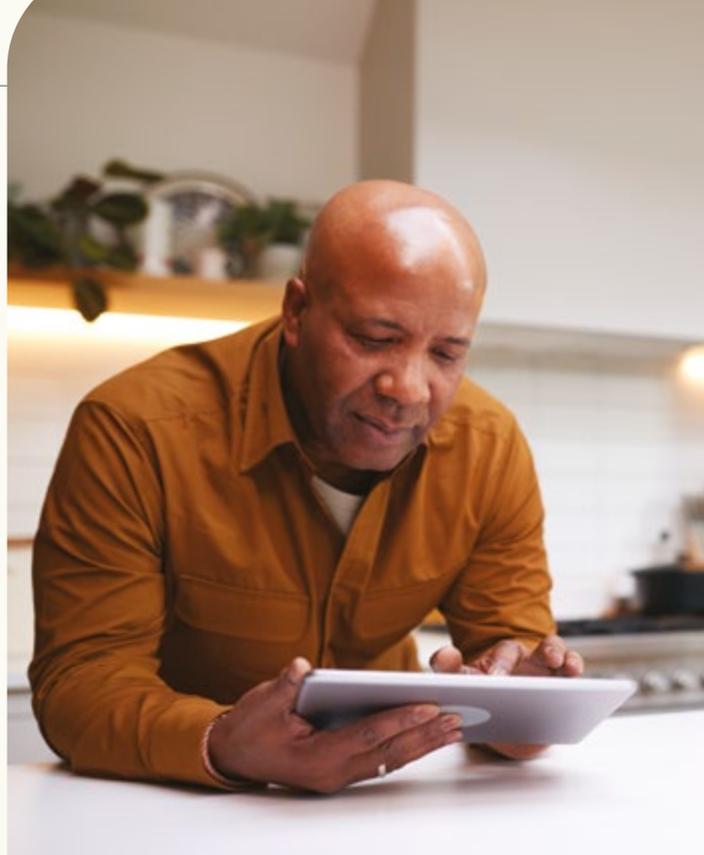
What is more likely to happen is that James's mother will die first and they will inherit £600,000. This inheritance will take them over the £2 million threshold, meaning that – assuming the other numbers remain the same – the IHT bill on their death would nearly double to £670,000. In reality they are being taxed 55% on that inheritance.

Coronavirus and the fiscal drag on finances

HMRC receives over £5 billion a year from IHT, and this figure is likely to increase. The Chancellor has a budget deficit of £280 billion this year. In the March Budget he froze many allowances as he began looking for ways to repair public finances.

As a result, it is inevitable that more families, like the Bamfords, will find themselves caught by IHT. Inflation alone will be sufficient to tip many households into the IHT trap.

Around the world central banks have printed money to help combat the impact of the coronavirus on the economy. Many economists are concerned that this will ultimately lead to serious inflation. The current inflation target for the UK is 2%.





“HMRC receives over £5 billion a year from IHT, and this figure is likely to increase.”

Let's imagine the government manages to contain inflation to 2% here but it still leaves those IHT allowances frozen at their current level. In 10 years the Bamfords' £1 million house would be valued at over £1.2 million. Investments that are well managed and growing and surplus income all add to the issue.

Frozen pensions

I mentioned earlier that pensions are exempt from IHT, but these were also caught in the allowances freeze. The standard Lifetime Allowance – the amount you can accumulate in pension savings over your lifetime without incurring tax charges – was frozen at £1,073,100.

If James's £1 million pension grows by 5% a year it will be worth £1,276,000 when he retires in five years' time, taking him beyond the limit. He will pay 25% on any money he withdraws as income from his pension that is over the Lifetime

Allowance – on top of income tax – or 55% on any lump sum.

However, he can currently leave his pension to loved ones. This is a great way of helping children and grandchildren with their own pension savings plans. And it may be worth considering giving some other surplus money away now.

Giving money away

- Under Potentially Exempt Transfer (PET) rules, you can pass on property, assets and possessions free of IHT as long as you do not die within seven years.
- You can give away £3,000 worth of gifts each tax year (so £6,000 for couples) without triggering the PET clock.
- Each year you can also give away wedding or civil ceremony gifts of up to £1,000 per person (£2,500 for a grandchild or great-grandchild, £5,000 for a child).
- You can give payments to help with another person's living costs, such as an elderly relative or a child under 18. You can also support a child's higher education cost.
- You can give away the family home, but to carry on living in it you will need to pay the new owner the market-rate rent and continue paying the bills. We certainly would not recommend this without advice.

Gifts out of normal expenditure

One of the best ways to give is out of your income. This is particularly attractive, for example, for those with high final salary pensions that they cannot avoid receiving and that exceed their expenditure. You have to show that you can maintain your standard of living after making the gift. You should keep good records. It may be prudent to set up regular payments. You can give

as much as you can afford through this mechanism. And, again, it does not trigger the PET clock.

One attraction of this is that it allows you to give gradually over time. Few of us know how long we have got or how much we will require. This mitigates the need to make a big decision on gifting too early.

Charitable giving

One final thing to consider is that if you leave 10% of your net estate – the element liable for IHT – to charity your IHT rate will fall from 40% to 36%. As a result of this, if you are planning to leave between 4% and 10% to charity anyway, your beneficiaries will be better off if you lift your gifts to the 10% mark.

Establishing a personal charity and making larger gifts to benefit a specific cause may also be a consideration for larger estates.

I must stress again that IHT planning is complicated and that it is worth taking professional advice if you are concerned about this issue.

A good adviser can help you devise a sound gifting plan. They can help you make best use of tax-efficient savings tools, like ISAs and pensions, as you are accruing wealth. And they can advise on taking money from the right pots in the right order in retirement.

At Rathbones we can help manage any significant gifts you make to children and grandchildren, to ensure the money is invested appropriately and wisely until they need it.

You may not be able to avoid paying IHT, but with careful planning you can reduce the bill so that loved ones receive more of your wealth.

Rathbone Financial Planning is part of Rathbone Investment Management Limited.

Faster, further, stronger

Sports scientists have made huge advances since helping Japanese swimmers to Olympic success in the early 1930s, but are we finally reaching the limits of human endeavour?

Tim Shaw, Investment Director, Rathbones

Many athletes preparing for this summer's Olympic Games in Tokyo may not realise they owe a debt of gratitude to the Land of the Rising Sun. It was Japan's swimming coaches who first put sports science on the map nearly 90 years ago.

Japan sent only a handful of swimmers to the 1924 Olympic Games in Antwerp. The country had so little interest in the sport that it boasted just two swimming pools. Then Yoshiyuki Tsuruta, who had grown up on the coast before joining Japan's navy, won a gold medal in the 200m breaststroke at the 1928 Games in Amsterdam – and people back home began to take notice.

As participation in swimming boomed, Japan's coaches began studying the techniques of the stars of world swimming – notably the US team, led by Johnny Weissmuller. Based on analysis of film of Weissmuller's stroke mechanics, Japan's sports scientists theorised that subtle changes might improve performance. They began coaching accordingly, and in 1932 Japan dominated the swimming events at the Los Angeles Olympics – picking up 12 medals, including five golds.

Still winning medals

There have been many such breakthroughs in sports science. One modern-day equivalent of those Japanese

“The idea that a scientific approach to sporting endeavour can produce such dramatic results has not gone unnoticed.”

pioneers is Peter Weyand, a professor in applied physiology and biomechanics at Southern Methodist University, Dallas. Weyand's work has revolutionised sprinting in athletics. “Twenty-five years ago,” he says, “there was no understanding of what was critically important in sprinting performance, so coaches didn't know how to direct their training.”

Weyand's research found that what really matters is not so much an athlete's form but the force with which he or she can hit the ground on each stride. “The biomechanics of running turn out to be counterintuitive,” he remarks modestly of findings that helped athletes such as Usain Bolt to smash sprinting records.

The idea that a scientific approach to sporting endeavour can produce such dramatic results has not gone unnoticed: athletes and sporting bodies have embraced sports science with ever-increasing fervour. By the 2012 Olympics in London the English Institute of Sport was operating 15 high-performance centres across the country, with 250 specialists providing more than 4,000

hours of support to 1,500 potential British Olympians every week. That kind of investment produces results. The UK began investing in sports science at scale after a dismal showing at the 1996 Games in Atlanta, which produced just one gold medal. In London the UK won 65 medals, including 29 golds.

More broadly, sports scientists have supported record-breaking achievements. Roger Bannister broke the four-minute mile in 1954; within 45 years, thanks to modern coaching techniques and better equipment, the world record was down to three minutes 43 seconds – 7% lower. In the highly technical sport of swimming, the 50m freestyle record has fallen 12% in the past 45 years.

At the limit?

However, the advance of sports science gives rise to a tantalising question: is there a limit to the improvements possible? Many scientists think there is. Thirty years ago physiologist Michael Joyner published research on the science of long-distance running, concluding that the limitations of the human body meant the fastest theoretically achievable time for a marathon would be one hour, 57 minutes and 58 seconds.

More recently, physiologists have calculated that even if Usain Bolt had delivered perfect technique when in top condition he would only have lowered his 100m world record – currently 9.58 seconds – to 9.27 seconds.

“In many cases we are now reaching our limits,” says Dr Gary Brickley, a senior lecturer at the School of Sport and Service Management at the University of Brighton. “Records will keep falling, but it's likely to be by smaller and smaller amounts, at least in the absence of breakthroughs we don't yet know about – perhaps something genetic or a legal way to trick the brain into not registering pain or fatigue.”

Three of the six finalists in the men's 400m freestyle event at the 1932 Olympics were Japanese swimmers who benefited from the emerging field of sports science.



It is about the bike

In fact, the biggest advances from today's sports scientists are coming from their work on equipment. Two decades after Joyner's research, the official world marathon best stands at two hours, one minute and 39 seconds; but last October the holder of that record, Kenya's Eliud Kipchoge, ran the distance in one hour, 59 minutes and 40 seconds – much closer to the theoretical best. His breakthrough did not count for world-record purposes because the run was deemed to have been artificially enhanced. Kipchoge was supported by 42 pacemakers, had water and nutrition gels handed to him by coaches riding alongside him and, above all, wore a pair of prototype trainers now banned by World Athletics.

Those trainers are the latest in a long tradition of innovative equipment that has produced such dramatic gains that sporting bodies have felt compelled to intervene. Nike itself claims its Vaporfly range – of which Kipchoge wore an extreme version – can improve an athlete's performance by 4%, a much bigger gain than any recent reduction in an athletics world record.

Swimwear manufacturer Speedo suffered a similar fate. Its LZR full-body swimsuit, designed in its 'Aqualab' in Nottingham, was banned after swimmers wearing the gear at the 2008 Olympics in Beijing smashed a series of world records.

Cycling is another sport where such controversies have raged. In 1997 the UCI, the governing body, changed the system governing its prestigious hour record – a simple test of how far someone can ride in 60 minutes. A year earlier Chris Boardman had asked engineering company Lotus to build the perfect bike for the task and had ridden 56.375 kilometres, smashing the previous record on a machine unsuitable for use elsewhere in the sport. The UCI introduced a new hour record, restricting competitors to equipment similar to that which Eddy Merckx had used to clock up 49.431 kilometres in 1972.



“The problem with marginal gains is that competitors very quickly catch on.”

1. Kenya's Eliud Kipchoge, the world record holder, proves it is possible to run a marathon in under two hours – with the right help. 2. Paralympic cyclist David Stone training at the University of Brighton altitude lab in Eastbourne, with Dr Gary Brickley. 3. Nike's controversial Vaporfly trainers.

A hundred years of record-breaking

100m sprint

1909	2009
Knut Lindberg Sweden	Usain Bolt Jamaica
10.6 seconds	9.58 seconds

100m freestyle swimming

1909	2009
Charles Daniels US	César Cielo Brazil
1 minute 5.6 seconds	46.91 seconds

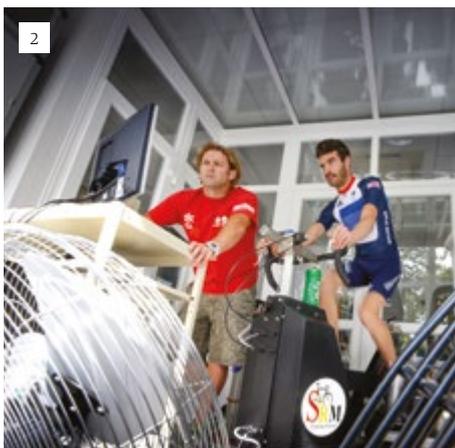
Neither record has been improved upon during the past 12 years – lending weight to the argument that some limits might already have been reached.

This is not to devalue the phenomenal ride put in by Boardman, who was given the UCI's 'Best Human Effort' record instead. But the fact that no-one has since come near his mark underlines the reality that his record was a triumph of engineering as well as athletic prowess.

Into new territory

From where might the next gains come? “One interesting area is the recent work done on the metabolic rate of the human body and how to maintain performance,” says Brickley. “We’re seeing genetics knowledge evolving all the time, and we’re still learning about what’s possible through nutrition.”

Advances in other technologies are providing sports scientists with fertile new areas to explore. Sophisticated



video analysis, combined with augmented and virtual reality tools, is helping coaches work on movement and technique more precisely than ever. Wearables provide a constant read-out of how the body is performing. Data and analytics tools give access to more information – and the ability to generate actionable insight from it.

Many of these technologies underpin the extension of sports science into team games, where performance is dependent on skills related to hand-eye coordination as well as athletic strengths such as endurance and speed. In football's Premier League, for example, Arsenal now employ 15 people in their performance analysis and data science team. Globally, the sports analytics industry was worth \$775 million in 2018 and is expected to grow by over 30% a year until 2025.

Marginal gains

Still, sports scientists also express caution. "The concept of marginal gains is now coming under scrutiny," says Dr

Crossing the line

Sports science has a history of overstepping the mark. There are stories of cross-country skiers shaving their septa to increase nasal oxygen intake, for example.

Others instances are more sinister. Ben Johnson was stripped of the 100m Olympic gold medal in 1988 after testing positive for illegal steroids; five other finalists that day would fall foul of doping rules in future races. The Tour de France's roll of honour for the years 1999 to 2005 stands blank, with Lance Armstrong forfeiting his yellow jerseys for taking illegal drugs to boost his performance.

But are such practices really so terrible? Many people believe the use of chemicals to improve performance is just another way in which sports scientists help give athletes an edge.

Julian Savulescu, a professor of ethics at the University of Oxford, believes bans on some performance-enhancing drugs make no sense. "By allowing everyone to take drugs, we level the playing field," he argues in a much-quoted paper. "We remove the effects of genetic inequality. Far from being unfair, allowing performance enhancement promotes equality."

Those who disagree point out that many performance-enhancing drugs are detrimental to human health.

For now there is no prospect of an end to such bans. But plenty of sports scientists found gainful employment in various state-sponsored doping programmes during the 1970s and 1980s – and suspicions persist that some still do.

"The biggest advances from today's sports scientists are coming from their work on equipment."

Ibrahim Akubat, chair of the Sport & Performance division of the British Association of Sport and Exercise Sciences, the professional body for sport and exercise sciences in the UK.

The idea, championed by Sir Dave Brailsford, former performance director of British Cycling and general manager of the hugely successful Team Sky, is that making even very small improvements to factors that impact performance will, in aggregate, make the difference between failure and success. "That's fine, but it overlooks the reality that the vast majority of performance comes from training in the right way, eating well and resting properly," argues Akubat.

The other problem with marginal gains, Akubat points out, is that competitors quickly catch on. "Sam Allardyce pioneered sports science in football at Bolton Wanderers, and his incredibly progressive approach was initially very successful," he says. "But then others caught up." Bolton were relegated in 2012.

It is a reminder of another reality of sport: resources make all the difference in the end. If making it to the top of athletics or swimming, say, is impossible without a specialist in biomechanics, a nutritionist and a data analytics engineer, then athletes from large parts of the world stand little chance of competing.

Sporting bodies may do what they can to redress the balance, but the truth is that sport is not fair. After all, some people are born with physiological advantages such as above-average lung capacity or superior fine motor skills. Ultimately, while all athletes should be on the start line as equals, the job of sports scientists is to give their charges every possible legal advantage.

Dealing with a load of rubbish

The government wants us to recycle two-thirds of household waste by 2035, but more and more countries are refusing our refuse. What are we going to do with it all?

Nick Swales, Investment Director, Rathbones



Image: iBiffa

Waste disposal has been an issue for humans since ancient times. Archaeologists have found rubbish tips dating as far back as 3000 BC in Crete. 'Middens', as they are called, offer valuable glimpses into patterns of human behaviour from the distant past.

Our modern middens are landfill tips. In the UK landfill use became ubiquitous after the 1848 Public Health Act, which legislated for the removal of all rubbish from homes and streets. London's 'pea-souper' fog of 1952 instigated the 1956 Clean Air Act, which sought to control emissions from domestic and industrial incineration.

For a while this model worked, but we threw away more as we became more affluent – and the landfill sites filled up. In 2017 it was estimated that under seven years' worth of non-hazardous landfill capacity remained in Britain.

The UK uses a range of waste strategies – prevention, reuse, recycling, recovery and, finally, disposal. Our shrinking landfill capacity places extra demand on other elements of this hierarchy, and its decline has been faster than alternative waste-management strategies have been able to compensate for. We have what experts call a 'waste capacity gap'. Can we recycle our way out of this problem?

Mixed rules

A good starting point would be to encourage people to separate more rubbish that can be recycled within the household. It might help if we all worked to the same guidelines. In 2018, for instance, there were 39 different sets of rules across Britain relating to which plastics could and could not be recycled, depending on the local authority.

Look at any plastic container and you should find a triangle with a number in it. This is the plastic's 'resin code', an identifier of its composition. As a rule of thumb, lower numbers have a higher

likelihood of being recycled. If your council recycles multiple types of plastic you may be able to put mixed plastics into your recycling. If not then you risk contaminating the plastic that *can* be recycled, condemning it to landfill or incineration instead.

Although the 'Blue Planet effect' has led to a genuine sense of a plastics emergency, local differences in facilities, guidance and infrastructure can exacerbate confusion – risking apathy



The answer to making good use of our waste could lie closer to home in many instances.

“Diminishing landfill capacity, inconsistent local recycling outcomes and tightening international waste exports all beg the question of what will happen to our rubbish in future.”

and scepticism. Environmental charity Greenpeace has warned: “If we want people to do more and better recycling then we need to simplify this confusing patchwork of different rules.”

Pick of the litter

There are a number of ways of recycling waste. Open-loop recycling refers to the technique of turning one product into another. This sounds attractive, but the difficulty is that it can sometimes degrade or 'downcycle' the raw material to a point where it effectively creates another single-use product that cannot be recycled and ends up in landfill anyway. For example, your plastic bottles can be used to make insulating fibre for sleeping bags, ski jackets or even fleeces – none of which can be recycled again.

Closed-loop recycling turns the used product back into the original product. A glass bottle, for instance, retains its integrity no matter how often it is recycled, so it can enter a closed-loop of continual use and reuse. Aluminium cans can also be recycled without degrading, as can some plastics.

Where there's muck there's brass?

From the kerb, your mixed recycling travels to a Materials Recycling Facility (MRF). There it is subject to myriad sorting processes. Recycling travels over conveyor belts, separated perhaps by magnets (for steel and aluminium cans), weight or even infra-red (to distinguish the types of plastic present). Staff stand by to remove contaminants such as dirty nappies before the separated waste is then transported for recycling. But where does it go?

Approximately two-thirds of the UK's plastic waste is sent to other countries. China once took much of it off our hands. It had a wealth of cheap labour that could profitably refashion scrap plastic into sandals, phones, bottles and other products. Often this waste plastic was of a higher quality than that available

domestically, so ships carrying manufactured goods from China to the West would be returned full of recyclable rubbish.

But in 2018 China stopped importing plastic waste that was less than 99.5% pure – a standard the UK's exports were not always meeting. Much like your local council, China was effectively asking us to ensure we were putting the right sort of plastic out for recycling. Although other Asian countries continue to accept exports, trade is choppy. Malaysia also now restricts imports on the grounds of quality. Where countries themselves lack the capacity to recycle our waste, there is a very real risk that our domestic recycling is simply incinerated overseas.

Some feared that Brexit might result in less waste being sent to the EU, which accounted for over 10% of our waste exports in 2017. One North-East textile company has reported a halt to exports of second-hand clothing due to the threat of rules-of-origin tariffs – the clothes having originally been made in China. The longer-term impact remains to be seen.

Closing the loop

Diminishing landfill capacity, inconsistent local recycling outcomes and tightening international waste exports all beg the question of what will happen to our rubbish in future and what we can do to help. After decades of others taking out our trash, is it time to recycle some old-fashioned ideas and look closer to home?

Scavenging was banned in the 19th century, but in the 21st century it has gone digital. Traders now scour websites such as Freecycle and Gumtree for furniture to upcycle and sell at a profit on sites such as Etsy. Organisations including Greenpeace and the British Heart Foundation encourage donations of furniture and upcycling as part of the 'Reuse Revolution'. Homelessness charity Emmaus provides upcycling workshops to offer 'companions' a chance to learn

“In 2018 there were 39 different sets of rules across Britain relating to which plastics could and could not be recycled, depending on the local authority.”

What a load of rubbish!

26 million tonnes

amount of household waste produced each year

390kg

amount of waste produced per person a year

45%

proportion of waste recycled

£700

value of food thrown away by the average family

600 million

number of batteries disposed of each year

Sources: ONS, Waste and Resources Action Programme, UN, recycle-more.co.uk; all figures for the UK



new skills and breathe new life into old furniture, saving more than 12,000 tonnes of goods from landfill in 2017-2018.

Returning our used bottles to the shop for a few pennies will make many nostalgic. The government plans to roll out a Deposit Return Scheme (DRS) across the UK in 2023. Scotland already has plans to implement a DRS in 2022, with a 20p surcharge added to single-use drinks containers that can be claimed back at new 'reverse vending machines' across the country. This will complement rather than replace kerbside recycling, with the aim of capturing more plastic and aluminium and recycling it properly first time.

Another old favourite returning is the 'milkman'. The pandemic meant one business, Milk & More, signed up more customers in the first eight months of the year than in the whole of 2019. As its name suggests, it delivers far more than milk to the doorstep. It carries 200 items, nearly all in reusable, recyclable or compostable packaging, including a new range of cleaning products such as laundry detergent in refillable glass bottles.

Meanwhile, working in partnership with Tesco, online grocery store Loop allows you to shop for zero-waste versions of popular and branded household goods in attractive reusable packaging. Each container is made of durable material resilient enough to be reused at least 10 times. You return the packaging to the store after use in a tote bag that is picked up with your next weekly shop delivery. This reduces the production of plastic and means you know exactly where your packaging waste ends up – cleaned, refilled and back on your doorstep.

Public health crises in the 19th and 20th centuries led to our rubbish being taken from us and even traded overseas. The current pandemic may mark the advent of another refuse revolution. The loop is closing, and responsibility for our rubbish is coming home.

The TikTok Trojan horse

Chinese-owned social media app TikTok has made its way into homes around the world – or at least in those countries that have yet to ban it. We ask why it is so popular among young people and whether it is harmless entertainment or a hidden threat.

Georgina Hand, Investment Director, Rathbones



A TikTok live broadcast on the banks of the Yangtze River in Yichang, Hubei province, China.

A man stands with a phone by his window for hours on end, filming the traffic lights changing on the dual carriageway below. In the videos, streamed through TikTok, he provides voiceover commentary, urging viewers to guess which car at the lights will be the first to set off when they turn green.

In the world of TikTok, the social media platform that specialises in short-form videos that often last no more than 15 seconds, this counts as entertainment. The creator of @redlightracinguk has 67,000 followers, and his guessing game attracts hundreds of viewers at a time. This form of bizarre distraction is exactly what TikTok's predominantly young userbase is looking for.

What is TikTok?

The most recent social media sensation, TikTok is a video-sharing app developed by Zhang Yiming, founder and CEO of Beijing-based tech company ByteDance. It is the second iteration of the now-defunct Musical.ly, an app used primarily to share lip-sync and dance content.

Musical.ly was the recipient of the largest fine ever issued by the Federal Trade Commission, handed down for mishandling the private data of young users. ByteDance bought the app for around \$1 billion in 2017 and officially merged it with TikTok in August 2020.

TikTok retains some of its predecessor's fundamental elements – as well as its data concerns. It is still full of lip-sync content and dance challenges. But the variety of content has expanded to include anything from niche humour and viral memes to educational clips and cookery demonstrations.

How does it work?

You do not need an account to access the app and watch other people's videos, but you do need one to create and post videos of your own. As a creator, you can film videos of up to 60 seconds and edit them to include visual filters, text, special effects and audio from songs, movie clips or other sources.

You post videos on to the app and wait for other users to watch, like and comment on them – and you hope they 'follow' your account. Your 'followers' are more likely to see your new content, thus encouraging engagement.

You can film original content or recreate a popular trend or challenge. A recent trend saw the revival of sea shanties – and if this is not to your taste then there will be something else that is. You will not even have to search for it – TikTok will find it for you.

The algorithm

It may have felt unsettling when social media apps began generating adverts seemingly tailored to our specific interests, but it is now commonplace to collect and use data in this way. That said, TikTok takes the concept to a new level.

It monitors what you are watching and promotes content from other accounts you might enjoy – and it does so with uncanny accuracy.

In a blog post from June 2020, the company explains how its ‘For You’ page works. The content each user sees is curated using a wealth of data, including interactions (videos you like/share, accounts you follow and content you create), video information (captions, audio, hashtags) and device/account settings (language/country). Even the tiny detail of how long you watch each video for is noted and used.

Anyone who has browsed this ‘For You’ page – even for research purposes – will attest to just how quickly the content starts to follow a certain trend. The effect is that you keep getting pulled back in. Why stop at one video when the following clip is also entertaining and to your taste? It is easy to while away an hour without moving – except to scroll with your thumb.

How does it make money?

The app is free to download, but by February 2020 TikTok users had spent \$300 million within the app through Google Play and Apple’s App Store. Users have the option of in-app ‘coin’ purchases, which they can gift to friends or to favourite creators as recognition for quality content.

“With an estimated 1.1 billion active monthly TikTok users worldwide, the potential audience for advertisers is huge.”

Then there are the ads, which brands can pay to run among the regular content. With an estimated 1.1 billion active monthly TikTok users worldwide, the potential audience for advertisers is huge.

However, many companies take a different route to advertising, instead sponsoring creators with large followings – TikTok ‘influencers’ – to promote their products.

Meet the stars

A number of content creators have become viral sensations, casting the likes of @redlightracinguk in the shade. As of January 2021, Charli d’Amelio had the highest number of followers, with 107 million. Fellow dancer Addison Rae came in second, at 75.2 million. Their estimated annual earnings as of June 2020 were \$4 million and \$5 million respectively.

The main income stream for these influencers is sponsored content, but d’Amelio and Rae have also benefited from outside opportunities as a result of their celebrity. After her videos went viral on TikTok, d’Amelio was invited to join American singer-songwriter Bebe Rexha in opening a concert by the Jonas Brothers, a hugely popular US band. She then agreed to be the new ‘face’ of clothing brand Hollister.

A Trojan horse?

The success of these individuals, however, may not send the best message to their audiences. Statistics suggest a change in young people’s career aspirations and expectations as a result of exposure to platforms like TikTok. A handful of influencers may

rake in millions – but not the vast majority of users. Even if individuals do manage to make money, the early months of the pandemic highlighted just how unreliable the most common influencer income sources are, as brands pulled sponsorships in an effort to reduce ad spending.

Another worry concerns the long-term effects on users’ brains. The short-form content purposely caters to young people’s attention spans, making them ever shorter.

Politicians have more pressing concerns, as they deliberate the potential threat to user data and national security. In an interview for *The Atlantic*, Yiming said he wants TikTok to “become a window into a bigger and bigger world”, but authorities are asking whether the app is really a surveillance window for the Chinese government. India banned it in June 2020, and Donald Trump signed and then backtracked on an executive order to ban it in the US.

TikTok claims to store American data in the US and Singapore, and there is no evidence that it shares private data with China. However, it is considered a potential threat because Chinese companies must hand over data to the government by law.

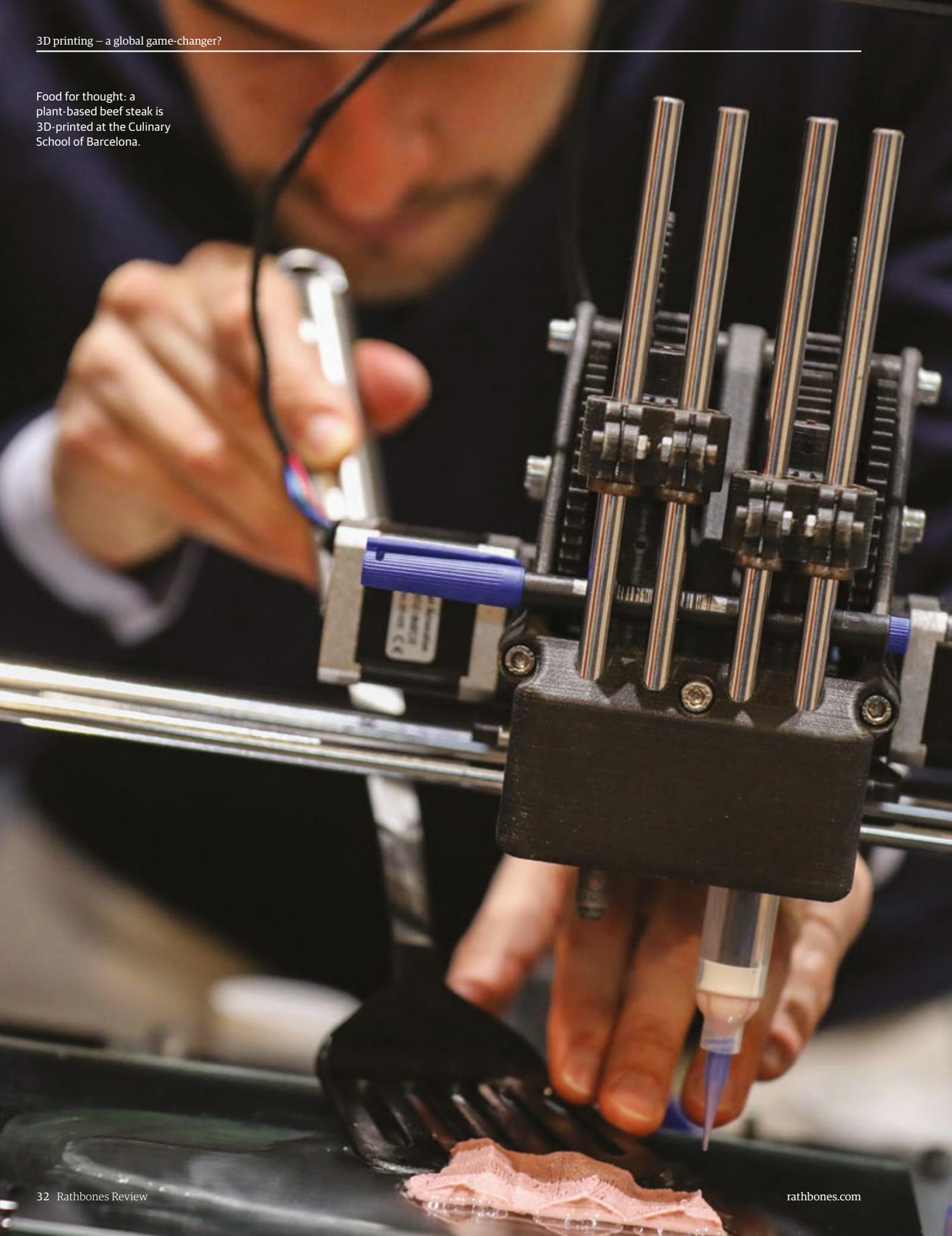
Moderating your children’s TikTok time

While policymakers debate the geopolitical threat, parents may be more concerned simply by how much time their children are spending on TikTok. Most phones have a function to help tackle this problem.

For iPhones, you can go into Settings > Screen Time > App Limits to set daily time restrictions on certain apps. Android has similar options under Settings > Digital Wellbeing & Parental Controls. Set a one-hour limit and your child will need a passcode to enter the app once that hour has been used up.

It may be reassuring to know that you *can* stop the clock on TikTok.

Food for thought: a plant-based beef steak is 3D-printed at the Culinary School of Barcelona.



3D printing – a global game-changer?

Grand claims have been made for the potential of 3D printing for nearly 20 years, but is the technology now on the brink of being truly world-changing?

William Day, Investment Director, Rathbones

In 1999 an eight-year-old schoolboy at the Boston Children's Hospital in America underwent pioneering transplant surgery that changed his life and inspired new research that could change thousands more.

Luke Massella was born with spina bifida and had already survived a dozen operations when his kidneys began to fail. Dr Anthony Atala and his team built a biodegradable scaffold for a new bladder. Using cutting-edge technology of the time, they encouraged cells from Luke's bladder tissue to grow around the scaffold to build a new, healthy bladder.

The success of the groundbreaking operation opened the eyes of Atala's team and the medical world to the potential for this type of transplant. But the process was slow. The challenge was to speed and scale up the manufacturing processes to create these engineered tissues and organs.

"It is estimated that every 30 seconds a patient dies from a disease that could be treated with tissue replacement," says Atala. "There are simply not enough donor tissues and organs to meet demand.

"We have printed bone, cartilage and muscle tissue that, when implanted in experimental models, develops a system of nerves and blood vessels."

Regenerative medicine offers the hope of engineering replacement organs in the lab to help solve this shortage. Because these organs are made with a patient's own cells, there is no issue with rejection."

At the time there was much speculation in the media about the potential for 3D printing. Atala and his team started experimenting – first with a simple desktop inkjet printer. Eventually they created their own proprietary 3D printers.

Today Atala is the director of the Wake Forest Institute for Regenerative Medicine in North Carolina. After 14 years of intense research the team are close to being able to 3D print a range of body parts for transplant. Atala says: "We have printed bone, cartilage and muscle tissue that, when implanted in

experimental models, develops a system of nerves and blood vessels. These structures have the correct size, strength and function for use in humans, proving the feasibility of printing living tissue structures to replace injured or diseased tissue in patients.

"We are developing cell therapies and replacement tissues and organs for more than 40 different areas of the body, including cartilage, bladders, muscle and kidney organs."

It is not just internal body parts being bioprinted. Researchers at New York's Rensselaer Polytechnic Institute have developed bioprinted skin, to be used in place of skin grafts. Conventional grafts are currently the most effective treatment for burn victims, but they come with downsides. The grafts need to be taken from elsewhere on a patient's body, such as the thigh. The skin can scar badly, recovery is lengthy, and the graft tends to fall off eventually instead of integrating with the host cells.

Bioprinted skin, on the other hand, can be created more quickly than conventional grafts and applied straight to the wound,

allowing significantly better recovery. This skin also features functional blood vessels, which grafts usually lack, meaning it has a much greater chance of integration with the existing skin.

There are potential applications for bioprinted skin outside the medical field. It could enable skincare and make-up products to be tested without using humans or animals. It could even provide realistic canvases for tattooists in training – and prevent them from practising on reluctant friends.

Elsewhere, 3D printing is helping people who have lost limbs, with the printing of tailor-made prostheses that fit perfectly.

Bumbling beginnings

Hideo Kodama, of the Nagoya Municipal Industrial Research Institute, was the first person to produce an account of how resins that hardened when exposed to UV light could be used to create solid prototypes. His paper, published in 1981, laid the groundwork for 3D printing.

In July 1984 a team of French engineers filed a patent for 3D printing technology – only to abandon the endeavour, as there was little interest in the technology “from a business perspective”.

Three weeks later American inventor Charles ‘Chuck’ Hull filed the first successful patent for ‘stereolithography’ – the successive printing of thin layers of ultraviolet curable material, one on top of the other, to make solid objects. He founded 3D Systems in California and in 1987 released the world’s first 3D printer, the SLA-1.

Early printers were expensive, and objects were difficult to perfect – often warping as the material cooled and hardened. 3D printing had a way to go before making mainstream news. The first printers became commercially available in the mid-2000s. Groundbreaking developments have since been made

“Machines squeeze out a cement-based mix – it looks like grey icing sugar being squeezed out of the nozzle of an icing bag – layer by layer until a wall is built.”

within several industries, extending far beyond medicine.

Speed building

One of the most exciting applications for 3D printing in other industries is in construction. New Story, a not-for-profit organisation based in California, working with specialist builders ICON and ÉCHALE, has begun building the world’s first 3D-printed housing in Tabasco, Mexico.

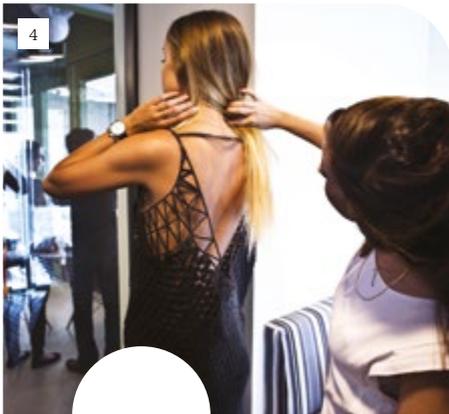
Two out of 50 500 sq ft homes have been completed so far, each taking only 24 hours to ‘print’. Machines pump out a cement-based mix – it looks like grey icing sugar being squeezed out of the nozzle of an icing bag – layer by layer until a wall is built.

These homes will be occupied by vulnerable families currently living in extreme poverty. They have been designed with the specific needs of the community in mind.

An estimated 2% of the global population – nearly 154 million people – is homeless. Another billion do not have adequate shelter. Housebuilding is usually an expensive and time-consuming process, which poses an obstacle to providing permanent homes for those in need. New Story and its partners believe 3D-printed houses offer a solution.

“Conventional construction methods have many baked-in drawbacks and problems that we’ve taken for granted for so long that we forgot how to imagine any alternative,” says Jason Ballard, co-founder of ICON.





1. The wall of an apartment house being printed by a 3D printer in Wallenhausen, Germany.
2. Zurich University of Applied Sciences is working with a bioprinter to produce different human tissues.
3. A completed New Story house in the world's first 3D-printed community in Tabasco, Mexico.
4. Danit Peleg, the first designer to produce an entire collection using 3D printers, helps a fashion blogger into one of her creations.

“With 3D printing, you have speed, next-level resiliency and the possibility of a quantum leap in affordability. This isn't 10% better – it's 10 *times* better.”

“With 3D printing, you not only have a continuous thermal envelope, high thermal mass and near-zero waste – you also have speed, a much broader design palette, next-level resiliency and the possibility of a quantum leap in affordability. This isn't 10% better – it's 10 *times* better.”

3D-printed houses have lower labour costs, as only one person is required to monitor the printer. And the ability to build a structure in a day speeds up the construction process considerably. The average house takes four to six months to build.

It is also more environmentally friendly. Concrete production is one of the most significant pollutants involved in the housebuilding process – 3D printing wastes less material.

Where's the beef?

Now 3D printing has reached the food industry. Israel-based Redefine Meat is printing animal-free 'meat' that has the same appearance, texture and flavour of animal meat – right down to the blood and fat.

The problem most alternative meat manufacturers face is that eating meat is not solely about taste and texture – it is a complicated, sensory experience. 3D printing allows Redefine to recreate complex structures that are found only in animal muscle, precisely replicating each fibre to create whole cuts of meat. The company claims its products have a 95% smaller environmental impact than animal meat.

Redefine has created alternative tenderloin, rib-eye and sirloin steaks, just by changing the digital file of the products.

The future of fashion

Danit Peleg is a designer pioneering 3D-printed fashion. In 2015 she became the first designer to produce

an entire collection by using desktop 3D printers for her graduate project.

Now she is launching the first online 3D-printed clothing store, allowing customers to purchase digital files of garments, customise the measurements and then download them at their nearest 3D printer. The files come with assembly instructions. While some may be put off by the idea of constructing their clothes, Peleg's work is an exciting indication of the future of fashion. We have conquered Ikea bookshelves – how hard could a jacket be?

The benefits of 3D-printed fashion include the small batch sizes. These could reduce waste, as brands will not have to commit to huge inventory orders that may not sell. And if stock does sell out then customers will not have to wait weeks for the next shipment – only 24 hours for the garment to be printed.

A huge benefit for many would be the customisation options. Bodies come in various shapes and sizes, but clothes are usually made to fit a handful of measurements. 3D-printed clothing offers custom sizing without the expense of a tailor.

Making waves

The possibilities of 3D printing are not limited to purely practical applications, as artists like Jeremy Burnich demonstrate. The founder of Joy Complex – a “content studio and showcase of joy” – created a conductor's baton from the visual representation of sound waves to commemorate Beethoven's 244th birthday. The baton was crafted using the first four notes of Symphony No. 5.

The advances made in 3D printing in the 40 years since the first failed patent are astonishing. From life-changing organ transplants to a print-at-home dress, additive manufacturing technology continues to influence myriad industries. In every sense, it is shaping our world.



Getting some financial satisfaction: the Rolling Stones performing in Seattle during their *No Filter* tour in August 2019.

Image: San Francisco Chronicle/Hearst Newspapers via Getty Images

The economics of rock and roll

Modern recording technology and digital streaming have changed the economics of the music industry. Have they made it easier or harder to become a wealthy pop star?

Nick Cliffe, Investment Manager, Rathbones

Beatles manager Brian Epstein could have taught today's music stars a thing or two about marketing. It is 60 years since he first heard the Fab Four play, but the strategies he deployed to turn them into global superstars still resonate. Everything from the band's iconic suits and haircuts to their use of the latest technology – the transistor radio – was about building a brand.

It is a reminder of something that has always been true of the music business: the road to fame and fortune might start with a catchy tune, but becoming a rock-and-roll star is ultimately a sales job.

"The big question has always been 'How do you rise above the noise?'," says Keith Ames, head of PR at the Musicians' Union, which represents more than 30,000 musicians in the UK.

The trouble is that in today's marketplace there is much more of that noise competing for attention. There was a time when only those artists who caught the eye of a label got to make a record – studio time was out of reach for everyone

"Affordable and easy-to-use technology can turn your back bedroom into a recording studio capable of producing a near-professional sound."

else. Now affordable and easy-to-use technology can turn your back bedroom into a recording studio capable of producing a near-professional sound.

Distribution is easy, too: the big streaming services – Spotify, Apple Music and their peers – typically allow anyone to post their tracks for others to consume. YouTube is another possibility. So is social media, particularly in the age of TikTok.

Creative democracy

The democratisation of the creative process is to be welcomed, of course, but it is a tough way to earn a living. The economics of streaming simply do not stack up for most people, warns Helienne Lindvall, a director of the Ivors Academy, one of the largest professional associations of music writers in Europe.

"Most musicians aren't going to be able to rely on streaming sales," says Lindvall, a professional musician in her own right. "Even a fanbase of 5,000 to 10,000 isn't going to be enough. A song that's streamed a million times is probably going to make the singer around £3,000 and earn the writer only £500."

The problem is the fees paid by streaming services. The explosion of streaming has been remarkable – Goldman Sachs research suggests nearly one in five people in developed markets streamed

music on their phone or a similar device in 2018 and that this will rise to more than one in three by 2030.

That should help the music industry double its revenues. But individual artists do not earn much when a fan streams their music – less than half a cent on some of the most popular services.

The big streaming services change their royalty models fairly frequently, and what artists earn depends on a variety of factors. Music streamed by premium users may command higher rates, and rates are higher in certain territories. Independent research suggests an artist's song would have to be streamed more than 200 times to generate \$1 of revenue; even then the cash might have to be shared with other contributors who have a stake in the song.

The biggest stars do make decent money from streaming. Billboard's charts show that Canadian rapper Drake made \$12.1 million last year. American rapper Post Malone and American singer-songwriter Taylor Swift earned \$11.3 million and \$8.3 million respectively. But many well-known music stars are earning far less – and for musicians just starting out the numbers look horrible.

"It's ironic," says Tom Kiehl, deputy CEO of UK Music, the industry trade body. "It has never been easier to put your music out there for people to listen to. But the challenge is making money from that music."

The songwriting on the wall

Many established musicians have found a solution – selling the rights to their music. In December 2020 Bob Dylan agreed a \$300 million deal with Universal Music, which acquired the rights to his entire catalogue of 600 songs, including classics such as *Blowin' in the Wind* and *Knockin' on Heaven's Door*.

Other artists are following suit. Barry Manilow, Blondie, Chrissie Hynde, Dave Stewart of the Eurythmics, the Killers and

"Those buying music rights are purchasing a stream of income that should be unaffected by swings in traditional financial markets."

Record figures

£5.8 billion contributed to the UK economy



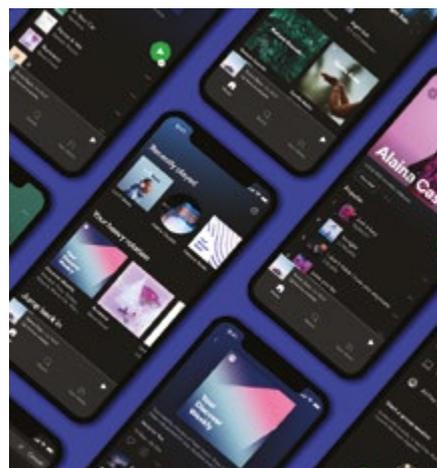
£2.9 billion generated in export revenue



197,168 jobs sustained



Source: UK Music; figures for 2019



Spotify is one of the world's largest music streaming service providers, with more than 345 million monthly active users.

Imagine Dragons have all done similar deals. In all, according to MIDiA Research, rights acquirers have spent \$4 billion on the back catalogues of music stars. For the buyers this is an alternative investment – they are purchasing a stream of income that should be unaffected by swings in traditional financial markets.

For the stars it is a chance to cash in future sales of their music for money upfront. And this may be crucial for those who do not expect to benefit from the rise of streaming. The Bob Dylan deal prompted David Crosby, of Crosby, Stills and Nash, to admit he was selling his rights. He tweeted: "I can't work... and streaming stole my record money... I have a family and a mortgage and I have to take care of them so it's my only option."

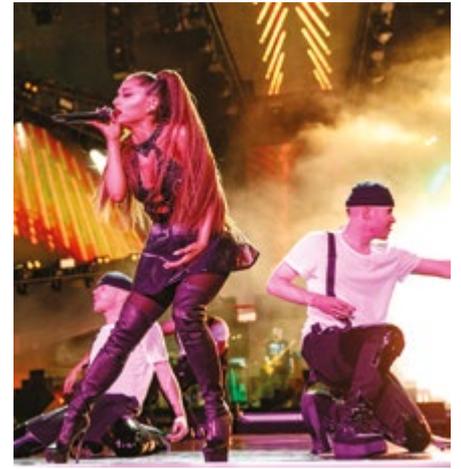
Up-and-coming stars, of course, do not have any rights to sell. They must explore other routes to building an audience and making a living. Might live music – at least in the post-COVID-19 world – be an answer?

Life on the road

At the top end of the industry, certainly, live music is big business. In last year's Billboard chart of the top-earning music stars – reflecting the pre-pandemic



Above left: Bob Dylan recording *Bringing It All Back Home*, part of a catalogue of music that sold for \$300 million last year. Above right: Ariana Grande, who earned tens of millions of dollars from a year of live shows, in performance at the Banc of California Stadium in Los Angeles.



industry – the Rolling Stones had made more money than anyone else over the previous 12 months. Of the \$65 million they earned, \$60.5 million came from touring, against just \$3.7 million from record sales and revenues from streaming. Ariana Grande, number two on the chart, earned \$44.3 million, and three quarters of that came from touring.

For most bands, however, life on the road is likely to be less profitable. “The big money in live music is going to the legacy artists,” says Lindvall. “Many bands struggle to break even when touring, and it’s certainly not glamorous. They’re sleeping on the bus or asking if anyone in the audience might put them up for the night.”

All of which brings us back to the sales job – and young artists are going to need to do it for themselves. “You rehearse, you develop live material, and you gig,” says Ames. “The gold dust used to be getting that record contract, because your label would then take charge of promoting you to help you break through. Today the labels expect you to promote yourself – they may not even take you on unless you can show you have an audience.”

That means being savvy about marketing, building an image that works visually as well as audibly and developing a social media strategy. “The artists we see

“Many bands struggle to break even when touring. They’re sleeping on the bus or asking if anyone in the audience might put them up for the night.”

breaking through are often more entrepreneurial,” says Kiehl.

And success is certainly possible. Among British contemporary stars, according to last year’s *Sunday Times* Rich List, Ed Sheeran is worth £200 million, while Adele has £150 million to her name.

Both artists are examples of what it takes to succeed in the music business. Sheeran had a number-one hit on the digital song charts before signing a record deal. Adele got her first deal after making a three-song demo for a class project that a friend posted on MySpace, where it caught the attention of XL Recordings. These are talented stars who have burned even brighter in the social media age.

Nevertheless, the music business is bound to remain polarised, with only a tiny number of artists making the big

time. Research from UK Music suggests there are around 140,000 full-time equivalent music creators active in the UK today – they earn an average annual salary of just £23,000, well below the national average of around £29,800. Like every generation of musician before them, many of these artists will be earning a living from other jobs while waiting for their big moment.

That moment may come at the most unexpected time and happen to the most unexpected artists. Nathan Evans, a 26-year-old postman, announced earlier this year that he was quitting his job to pursue a career in music after the sea shanties he posts on social media clocked up 7.5 million views. Evans concedes he may have to return to the Royal Mail if this success proves unsustainable – but he felt he had to go for it.

Welcome to the economics of 21st-century rock and roll. Andy Warhol’s observation that “everyone will be famous for 15 minutes” has never felt more prescient; the challenge for young artists is making that 15 minutes happen in the first place and then converting short-term success into something more enduring – and financially rewarding.



The Rathbones Folio Prize

In March, Carmen Maria Machado won the 2021 Rathbones Folio Prize. While the competition has been open to books of any genre or form since 2017, this is the first time that a memoir has claimed the £30,000 award. Here, as we reflect on the history of the prize, the judges explain the importance of broad eligibility criteria.

Louise Willows, Marketing Manager, Rathbones

BC journalist Razia Iqbal is standing in front of the King's Library at the British Library, ready to introduce the Rathbones Folio Prize's judges and shortlisted writers. It is 24 March 2021, a year and a day after the first UK lockdown was announced, and for the second consecutive year nominees are attending the ceremony virtually.

"Wherever you're joining us from tonight," says Iqbal, "we wanted to bring you here to the traditional home of the Rathbones Folio Prize for the finale."

The setting is fitting. Even today publishers are legally obliged to send a copy of every book published in the UK to the British Library to be kept on record. Somewhere in the building will be pristine copies of each book nominated for the 2021 prize.

"Some of the best stories, being told in the most innovative ways, are non-fiction."

A brief history

The Folio Prize was founded in 2013 as the first major English language book prize open to writers from around the world. The only conditions initially were that the book should be a work of fiction, that it should be published in English and that it should be published in the previous calendar year.

The original aim of the Folio Prize was to champion literary fiction rather than popular fiction. It was a response to the populist direction the Booker Prize was taking. This year's chair of judges, Roger Robinson, explains the distinction.

"The analysis of the craft is a particularly important part of it," he says. "Reading the books, sometimes I would trust my instincts



As You Were

Elaine Feeny

Acclaimed poet Feeny's darkly comic fiction debut explores women's stories and struggles in present-day Ireland. Folio Prize judge Sinéad Gleeson says: "It feels like Irish writing has been waiting a long time for a voice as unique and insistent."



The Mermaid of Black Conch

Monique Roffey

Roffey's novel is a retelling of a Taino myth and won both the Costa Novel Award 2020 and the Costa Book of the Year 2020. "Roffey will have you think you always knew this story somewhere deep in the marrow of your bones," says Folio Prize judge Roger Robinson.



A Ghost in the Throat

Doireann Ní Ghríofa

Ní Ghríofa is the writer of six critically acclaimed poetry collections. In her bestselling prose debut she weaves together the stories of an 18th-century poet and a present-day young mother to tell a timeless tale about finding your own voice by freeing another's.



My Darling from the Lions

Rachel Long

Long is the founder of Octavia, a poetry collective for women of colour, and is one of this year's Folio mentors. Her highly anticipated debut collection was also shortlisted for the Forward Prize for Best First Collection and the Costa Poetry Award.



Winner of the Rathbones Folio Prize 2021

In the Dream House: A Memoir

Carmen Maria Machado

Machado is the artist-in-residence at the University of Pennsylvania and author of the prize-winning short story collection *Her Body and Other Parties*. *In the Dream House* is a breathtakingly inventive, unflinchingly honest examination of domestic abuse in a female relationship.



Poor

Caleb Femi

Femi was the Young People's Laureate for London 2016-2018. This debut collection combines poetry and photography to examine the lives of young black boys growing up in Peckham in the 21st century.



handiwork

Sara Baume

A contemplative short narrative from an award-winning writer and visual artist, *handiwork* is an exploration of the author's own artistic process during a year of unavoidable isolation. Baume's third book and first work of non-fiction, it offers observations both gentle and devastating.



Indelicacy

Amina Cain

Cain is the author of two short fiction collections, and her stories and essays have also appeared in publications such as *Paris Review* and *Granta*. *Indelicacy*, her debut novel, is about class, desire, friendship, art and the battle to find one's true calling.

"*In the Dream House* is an exceptional, important book. It upends and deconstructs everything a reader expects from a memoir."

— Sinéad Gleeson,
Folio Prize judge



and think: 'This is really good.' Then one of the other judges, who would be a specialist on the subject, would say: 'Okay, let me explain to you why this really isn't good.' It's not just about enjoyment or which book you want for your birthday."

The prize is unique for the way books are selected. An academy of over 300 members – including Margaret Atwood, A. S. Byatt and Bernadine Evaristo – nominate titles for consideration. The 60 most-nominated books, plus an extra 20 selected by the three judges from publisher call-ins, are whittled down to a longlist of 20, then to a shortlist of eight and finally to one winner.

Alongside Robinson, a former winner of the T. S. Eliot Prize for Poetry, this year's judges were writer, editor and broadcaster Sinéad Gleeson and novelist and short story writer Jon McGregor.

McGregor believes the distinctive selection method adds something to

"Non-fiction feels like the step I can take after I've paved the way with fiction."

Carmen Maria Machado's *In the Dream House* is the first memoir to win the Rathbones Folio Prize.



the judging process. "Every time I pick up a book," he says, "I think: 'This is somebody's favourite book of the year.'"

Crossing genres

Only fiction books were eligible for nomination in the Folio Prize's first two years. The competition was suspended for 2016, but when it returned in 2017 it was with broader eligibility criteria and Rathbones as its new sponsor. Since then the Rathbones Folio Prize has been open to any book published in English during the previous year, regardless of form. This year's longlist included fiction, poetry, non-fiction, memoir and even one book about mushrooms.

Rachel Long, shortlisted this year for her poetry collection *My Darling from the Lions*, explains why the inclusion of all genres is an important aspect of the prize. "We can move between genres if we want," she says. "Some of the best writers I know don't actually know what they're writing to begin with. It might take their agent or editor to say: 'Let's market this as a novel.' As writers, perhaps we are less concerned with strict dictations of form and genre."

The 2021 winner, Carmen Maria Machado, believes the intersection of different forms is vital to her process. "With fiction you can experiment in terms of reality," she says. "It's a good first step in writing about a subject I'm interested in broaching. Non-fiction feels like the step I can take after I've paved the way with fiction."

While reading the nominations this year, Robinson was most surprised by the quality of non-fiction. "I used to read non-fiction, and it always seemed to be about getting the information across," he says. "Now it seems like rock and roll. Some of the best stories, being told in the most innovative ways, are non-fiction.

"People are reaching for new ways to show you things. The forms were sometimes peculiar, sometimes

idiosyncratic... Everybody's trying to find new ways to let you see a story, as opposed to just telling it to you."

"What I loved about judging this year was reading above the categories," adds McGregor. "I was looking for excitement. I was looking for freshness. I was looking for story – but in a much bigger sense than just fiction."

The poetry this year most impressed Gleeson, who was shortlisted in 2020 for her essay collection *Constellations: Reflections from Life*. "A lot of the poetry that we saw this year was often quite experimental," she says. "It was extremely current and reactive to things that are going on in the world at the moment. So the poems felt really vital – kind of fizzy and energetic in many ways."

Books have undoubtedly been a source of comfort and a way to stave off boredom over the past year. If you find yourself in a rut, cast your eye over the shortlist included here or the longlist on the Rathbones Folio Prize website – and branch out. If you always head to the fiction section, perhaps pick up Rachel Long's poetry or Merlin Sheldrake's book on fungi. You might find yourself agreeing with Robinson – that some of the best stories are non-fiction.

Rathbones Folio Prize

The Rathbones Folio Prize rewards the best work of literature written in English, regardless of form. Entries are nominated by an academy of distinguished writers and critics (the Folio Academy). This year judges Roger Robinson, Sinéad Gleeson and Jon McGregor awarded the £30,000 prize to Carmen Maria Machado for her memoir *In the Dream House*.

Visit rathbonesfolioprize.com to find out more.

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