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LONGVIEW PHILANTHROPY

What if the 1% gave 10%?

A report on ambitious solutions to some of the world's most pressing problems — from global poverty to worst-case pandemics — and how one year of the 1% giving 10% could provide the funding to support them.

Longview Philanthropy

What if the 1% gave 10%?

How ambitious giving could begin to solve some of the world's biggest problems

Fin Moorhouse, Riley Harris, Tyler M. John,[1] Kit Harris, & Natalie Cargill

With significant contributions from Rory Švarc, Toni Adleberg, and Huw Thomas.

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[1] Corresponding author: tyler@longview.org ↗

Overview

At its best, philanthropy saves and empowers millions of lives.

This isn't just a hope, but a matter of historical fact. Take the American agronomist Norman Borlaug. Enabled by funding from the Rockefeller Foundation in the 1940s, Borlaug spent years researching how to improve crop yields in difficult conditions amidst a global food production crisis. His research led to new disease-resistant crops, and he worked in partnership with the Mexican government to kick-start the 'Green revolution'. Global cereal production tripled within fifty years, and entire countries were brought back from the brink of famine, saving hundreds of millions of lives.

Or take the philanthropically funded Pugwash Conferences↗, inaugurated in 1957. These meetings helped build the trust and understanding necessary to form agreements such as the Limited Test Ban Treaty and the Anti-Ballistic Missile Treaty, which limited the proliferation of nuclear weapons at a deeply dangerous time for the world.

Or consider the March of Dimes Foundation↗, supported by donations from 80 million Americans, which funded the development of the polio vaccine by Dr. Jonas Salk in the 1950s. Or Katherine McCormick, the suffragette, biologist, and philanthropist who funded the development of the first oral contraceptive pill.

Today, the world is just as full of opportunities for making radical improvements which might otherwise be neglected by governments or markets. In fact, in what could be humanity's most dangerous and most consequential century yet, we may need ambitious philanthropy more than ever.

Of course we have many reasons to be cautious of, and even cynical about, philanthropy. At its worst, it continues to be used for corporate gain; buying influence over and reliance from recipients, reputation laundering, 'greenwashing', and more. In other words, when the very wealthy do give, it is often in exchange for something else.

Our hope in this report is to show the potential of another kind of philanthropy. We show what one version of ambitious philanthropy could look like: how it could enable projects to begin *solving* serious global problems, and ignite optimism about the potential to make a real — and very big — difference through giving.

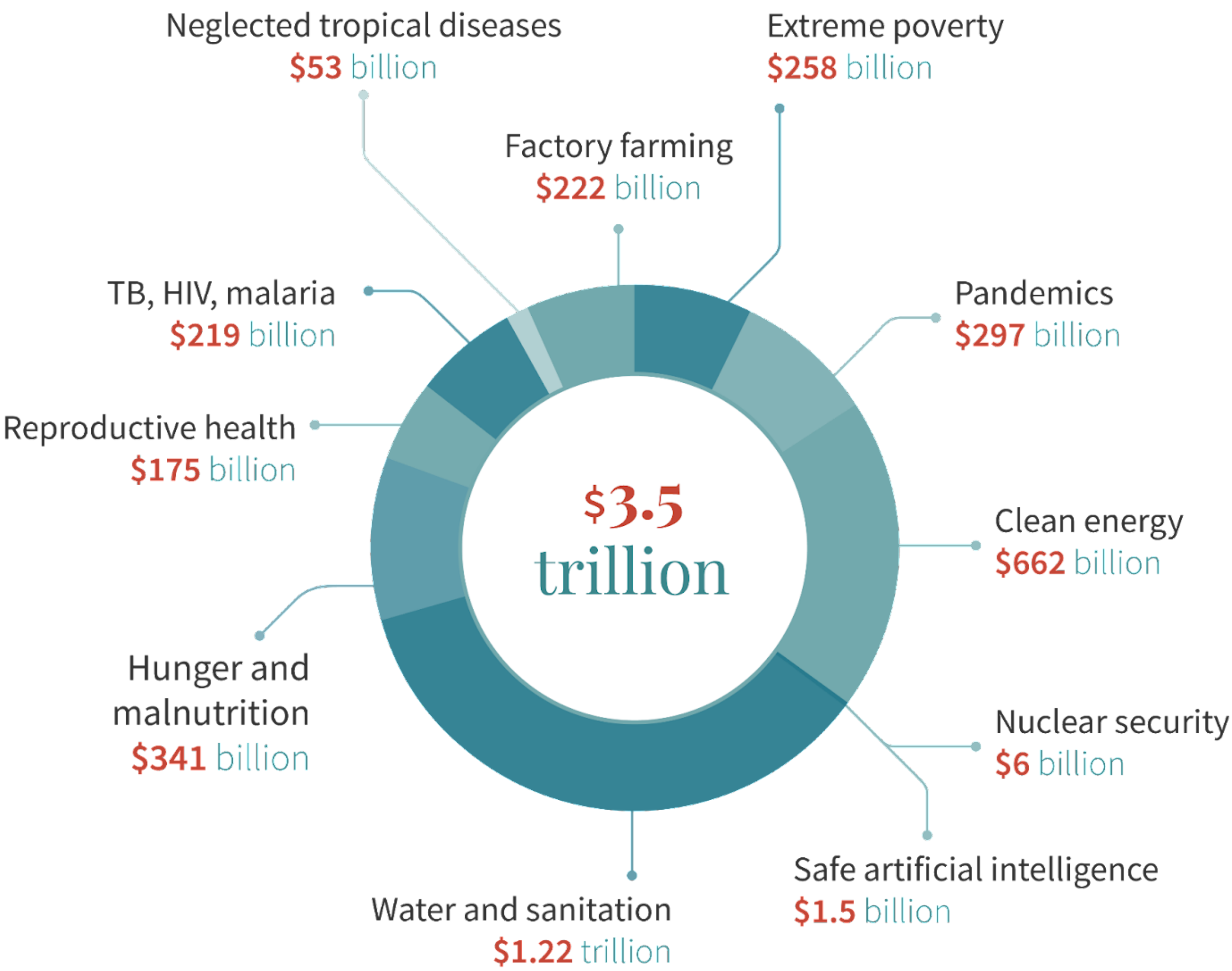
So we asked: what if the global 1% gave just 10% of their income in such an ambitious way? And, for those whose wealth outstrips their income, what if they gave just 2.5% of their net worth, aimed at making real progress? What could such a level of giving achieve?

The answer is surprising: in just the first year, this would result in an increase of at least $3.5 trillion↗ over and above what already goes to charity each year. If these resources were deployed to solve some of the world's most pressing problems, in just one year we could achieve the following:

Achievement	Costs[2]
Ensure no one in the world lives in extreme poverty for that year, and lift millions out of poverty for good↗	**$258** billion
Prevent the next pandemic↗	**$297** billion
Double global spending on clean energy R&D until 2050↗	**$662** billion
Quadruple philanthropic funding for nuclear weapons risk reduction in perpetuity↗	**$6** billion
Increase tenfold the funding for projects ensuring advanced AI is safe and beneficial↗	**$1.5** billion
Ensure everyone has access to clean water and sanitation, once and for all↗	**$1.22** trillion
End hunger and malnutrition↗	**$341** billion
Give women control over their reproductive health by funding contraception, maternal care, and newborn care for all women for at least 5 years↗	**$175** billion
Massively suppress or eradicate tuberculosis, malaria, and HIV↗	**$219** billion
Massively suppress or eradicate most neglected tropical diseases↗	**$53** billion
Halve factory farming by 2050↗	**$222** billion
Total	**$3.5** trillion

[2] Note that we have further refined the figures delivered in Natalie Cargill's TED talk given in April 2023, which discussed the same premise as this report. These small updates (usually only a few percentage points) ensure the numbers are accurate and consistent with our current knowledge. They have *not* significantly changed the overall picture.

From just one year of this level of giving, we could solve or massively suppress many of the world's most serious problems — without taking a penny from any existing philanthropic projects. Imagine what we could achieve in year two.



What if the 1% gave 10%?

If the global 1% started giving the higher of 10% of their income or 2.5% of their net worth to philanthropic projects, this would increase yearly philanthropic spending by at least $3.5 trillion over and above what already goes to charity each year.

This calculation has several components. **First, we estimate that if the wealthiest 1% of earners gave 10% of their income, this would amount to at least $1.8 trillion each year.** According to the World Bank's World Inequality Database (2021), the top 1% of income earners earned slightly more than 19% of the total world income between 2019-2021↗. Combining this with the World Bank's estimate of Gross World Product at $96.5 trillion↗ and the World Inequality Report's estimate of $122 trillion↗, this implies that the wealthiest 1% have an income between $18 trillion and $23.8 trillion (World Bank, 2022; Chancel et al., 2022). If they gave 10% of it away, this would amount to between $1.8 trillion and $2.38 trillion.

Second, we estimate that if the wealthiest 1% donated 2.5% of their wealth this would amount to at least $5.2 trillion each year. The Credit Suisse Global Wealth Report 2022↗ states that the wealthiest 1% own 46% of the world's wealth (Shorrocks, Davies, and Lluberas, 2022). And McKinsey estimate that the world's wealth is around $520 trillion↗ (Woetzel et al., 2021). This implies that the wealthiest 1% own around $237.12 trillion, although Oxfam estimates that it is $211.5 trillion↗ (Christensen et al., 2023). Putting these estimates together, 2.5% of the wealth of the wealthiest 1% is between $5.2 trillion and $5.9 trillion.

Third, we estimate that global charitable giving is very likely to be well below $1.6 trillion each year. Estimating how much money goes to charity each year *globally* is difficult, since there isn't a central source. However, U.S. philanthropy is just under $500 billion↗ (National Philanthropic Trust, n.d.)[3]. The U.S. represents 31%↗ of the world's wealth, and has higher rates of giving than most other countries (Shorrocks, Davies, and Lluberas, 2022). If we assume, optimistically, that every country gives as much to charity as the U.S., in proportion to their wealth, then global charitable giving is less than $1.6 trillion.[4]

Finally, we sum these results to conclude that our proposal would increase yearly philanthropic spending by *at least* $3.5 trillion. The previous calculations imply that if the global 1% gave *the higher of* 2.5% of their wealth or 10% of their income to

[3] Though other estimates suggest a figure closer to $300 billion↗ per year.
[4] We informally estimate the true amount to be significantly lower.

philanthropic work, this would amount to more than $5.2 trillion.[5] Given current giving of less than $1.6 trillion per year, this would represent an increase in yearly charitable giving of at least $3.5 trillion. That is enough to fund all of the projects below and more in a single year.

These calculations represent just one practically achievable way of greatly scaling philanthropic activity.

For the ultra-wealthy (centi-millionaires and billionaires), 10% of one's income is a negligible sacrifice to their quality of life↗, but an enormous sum in terms of the projects it has the potential to support. These people could give much more than 10% — raising even *more* money overall, or requiring fewer people to raise the same amount.

For instance, Bill Gates has pledged to give away "virtually all" of his wealth, and Warren Buffett similarly has committed↗ "more than 99% of my wealth". Through The Giving Pledge↗ many more have joined their ranks. These pledges are commendable, but they shouldn't be exceptional. As Buffett notes↗:

> "Were [my family] to use more than 1% of my [wealth] on ourselves, neither our happiness nor our well-being would be enhanced. In contrast, that remaining 99% can have a huge effect on the health and welfare of others."

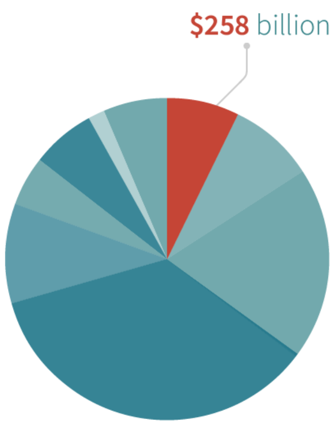
What follows are our ideas for how to spend $3.5 trillion to improve the world. We put them forward not as a comprehensive or definitive plan, but to show what impact-focused giving can achieve.

[5] The $5.2 trillion figure comes from wealth giving, which puts a lower bound on the total: the global 1% of income earners would donate *more* than this figure if they have lower wealth, and would donate *exactly* this number if they have higher wealth.

What we could achieve

Ensure no one lives in extreme poverty for the year

One in 12 people currently live below the international poverty line↗ of just $2.15 a day.[6]



Extreme poverty means struggling to afford clean drinking water, electricity, education, healthcare (Hasell et al., 2022), and even a basic adequate diet↗ (Ritchie, 2021). It can mean being unsure whether the water source your children drink from won't make them ill, and it can mean seeing easily treatable illnesses become life-threatening, for want of cheap medicine like antibiotics. This is life for more than 600 million people.

That so many people still live in extreme poverty is both unnecessary and unjust, because a world without extreme poverty is entirely achievable↗. While there are many ways to achieve this goal, one simple and direct solution is simply to **give cash to the poorest people in the world** — empowering recipients to choose for themselves how to improve their lives.

Over 300 studies have shown that cash transfers work.

A detailed review of 15 years of peer-reviewed papers↗ indicates that cash transfers reduce poverty, increase school attendance, and reduce child labour (Bastagli et al., 2016). A general finding of studies on cash transfers is that recipients tend to know what they need to improve their circumstances, and are often simply lacking money — rather

[6] The International Poverty Line used to measure extreme poverty is set by the World Bank at $2.15 per day – in 2017 prices, and adjusted for purchasing power (Hasell, 2022).

than knowledge or motivation — to make a start. Of course, many problems of poverty aren't so easily solved — for instance, increased school attendance does not always result in better education where schools are of particularly poor quality. But it is clear that cash transfers substantially improve the lives of the extreme poor.[7]

People save money and invest, especially into livestock and agricultural assets. One study↗ found that those who received cash transfers earned more than those who didn't, functionally doubling the effect of the initial transfer over the following decade (Blattman et al., 2020). Perhaps most excitingly, a recent large-scale trial of cash transfers in Kenya↗ on more than 10,000 households found that the positive effects on consumption spill over to non-recipients, and don't cause significant price inflation (Egger et al., 2022).

What's more, cash transfers don't promote reliance on aid. In fact, cash transfers in low- and middle-income countries tend to encourage people to work more↗, excepting parents and the elderly (Bastagli et al., 2016). And recipients of direct cash transfers rarely spend the money on tobacco, alcohol, or gambling↗ (Evans & Popova, 2016).

Image source: GiveDirectly (Anna & Widzy - Lilongwe District, Malawi, May 2022).

GiveDirectly↗runs the leading cash transfer programme focused on reducing extreme poverty. They operate by identifying a village in need, and giving every household in that

[7] There are mixed and uncertain results about the effect of cash transfers on those who don't receive them. However, giving money to more people would likely avoid many of those harmful effects. Our final estimate includes 50% extra coverage.

village mobile money, which can be received on a SIM card. The money can be withdrawn as cash at participating locations, such as shops, petrol stations, and supermarkets. They let the household decide who gets the money, and they provide a SIM card if needed. They typically give around $1,000 across two pre-arranged instalments. Often this represents a doubling of the income of a family of 5. It's enough to buy 5 years of secondary schooling, a year's worth of food for 5 adults, or metal roofing for 4 houses.

How much would it cost to completely eliminate extreme poverty for one year via direct cash transfer? The Brookings Institute estimates↗ that $100 billion in the hands of the right people would bring everyone out of extreme poverty (Kharas & Dooley, 2021). The true costs are higher, because this would also require identifying the exact incomes of over 600 million people, and transferring exactly the right amounts.

With logistical costs factored in, $258 billion is enough to lift everyone in the world out of extreme poverty for one year. This number is the result of the following adjustments to the $100 billion figure given by the Brookings Institute:

— GiveDirectly's overheads have been around 12% historically, so we conservatively assume overheads would be 15%.

— Given that it will be hard to identify the incomes of individuals precisely, we assume that ⅓ of the people included have incomes above the international poverty line, and payments are 50% higher than the absolute minimum amount to help people over the international poverty line.

— Finally, we adjusted for inflation in the years since the report was written.

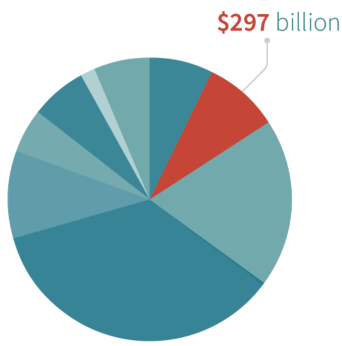
Beyond year one...

The effects of lifting half a billion people out of poverty would go beyond one year. A major study on cash transfers from leading economists↗ suggest that cash transfers create more jobs and increase local GDP, giving people a crucial opportunity to permanently escape poverty (Egger et al., 2022). GiveDirectly's unfiltered live feed of recipients' stories↗ confirm that many families invest in businesses and productive assets like livestock — not just short-term consumption — affording them the means to permanently escape extreme poverty. Of course others, such as some who are elderly or disabled, would still need continued support. But another long-run advantage of very large-scale cash transfer programs is that they could provide valuable data about exactly who needs that ongoing support — when collecting this data is normally a major hurdle↗ for the governments of low-income countries (The Economist, 2021).

Further still, philanthropy could fund programmes with large reserves to rapidly deliver cash transfers to regions that appear to be at risk↗ of encroaching natural disasters or conflict, acting like a global insurance policy. Going even further, there is enormous room to improve people's lives using cash transfers after just one year. Our proposal focuses on the very poorest people in the world, those who earn less than $2.15 per day. But there are many different definitions of poverty: nearly half of all people live on less than $6.85 per day, and 84% earn less than what we generally consider the poverty line in high-income countries, around $30 per day (Hasell et al., 2022).

Prevent the next pandemic

Covid-19 brought economies to a standstill,[8] and by 2023 it had likely caused over 20 million deaths.[9] We shouldn't have been surprised. Scientists had been warning of the significant yearly risk of a new pandemic and our inadequate global preparation.[10] Since the 1918 Spanish Flu — which killed over 25 million people — new pandemics have emerged and claimed millions of lives roughly every 20 years.[11]



Today, we find ourselves at an unusual time. Advances in biotechnology have made it possible for us to **dramatically reduce the risk from pandemics**, and avoid this generational recurrence of tragedy. But these same advances are also rapidly *increasing* the risk of worst-case pandemics, as the tools to synthesise new biology (including pandemic-capable pathogens) become cheaper and more accessible. This could mean that the next pandemic we see will be the worst yet.

Recently, an extinct orthopoxvirus called horsepox was synthesised↗ using mail-order DNA combined with genomic data available online. A cousin of this virus is smallpox, which claimed more than 300 million lives in the twentieth century alone, before it was eradicated.

This represents a risk that will likely become increasingly serious↗: someone with the right type of experience in bioengineering can go on the internet and order↗ the DNA needed to reconstruct the smallpox virus, or a disease equally devastating.

This risk will continue to grow, since it becomes cheaper and easier to synthesise DNA every year.[12] Simply extrapolating the rate at which these costs are declining suggests that — within a decade — many thousands of people will have access to tools capable of synthesising bioweapons, absent safeguards.

[8] For more data, see "Coronavirus (COVID-19) Deaths" from Our World in Data.
[9] This comes from a central estimate↗ of cumulative excess deaths↗ due to Covid-19, which is higher than the number of officially confirmed deaths. See The Economist (2021) for data and methodology.
[10] There were a handful of warnings from scientists, virologists, and experts on infectious disease. For example, see Smil (2008), Webster (2019), and Osterholm & Olshaker (2017). Bill Gates even gave a TED Talk↗ in 2015 arguing that we needed to prepare for the next epidemic.
[11] Between 1918 and 2018 we saw 6 pathogens↗ that killed over a million people each: Spanish Flu in 1918, Asian Flu in 1957, the Seventh Cholera pandemic in 1961, Hong Kong flu in 1968, Russian flu in 1977, HIV/Aids in 1981 (Cambiero, 2023).
[12] It cost hundreds of millions to sequence a human genome for the first time 20 years ago, but today it costs just $1,000 (Wetterstrand, 2021). The price of DNA synthesis has fallen by about 1000x↗ since the year 2000.

It may be instructive to look at the cost of sequencing (rather than synthesising) genetic material, since sequencing technology is more developed, and hence may indicate the path that synthesis costs may trace. The cost of synthesising a full human genome fell by factor of more than 100,000↗ over two decades — faster than even an exponential decline. Gene synthesis technology is relatively less mature, but the cost to synthesise a unit of genetic material has already fallen by a factor of roughly 1000↗, and that trend shows no signs of slowing.

Cost of sequencing a full human genome

The cost of sequencing the full genetic information of a human, measured in US$.
This data is not adjusted for inflation.

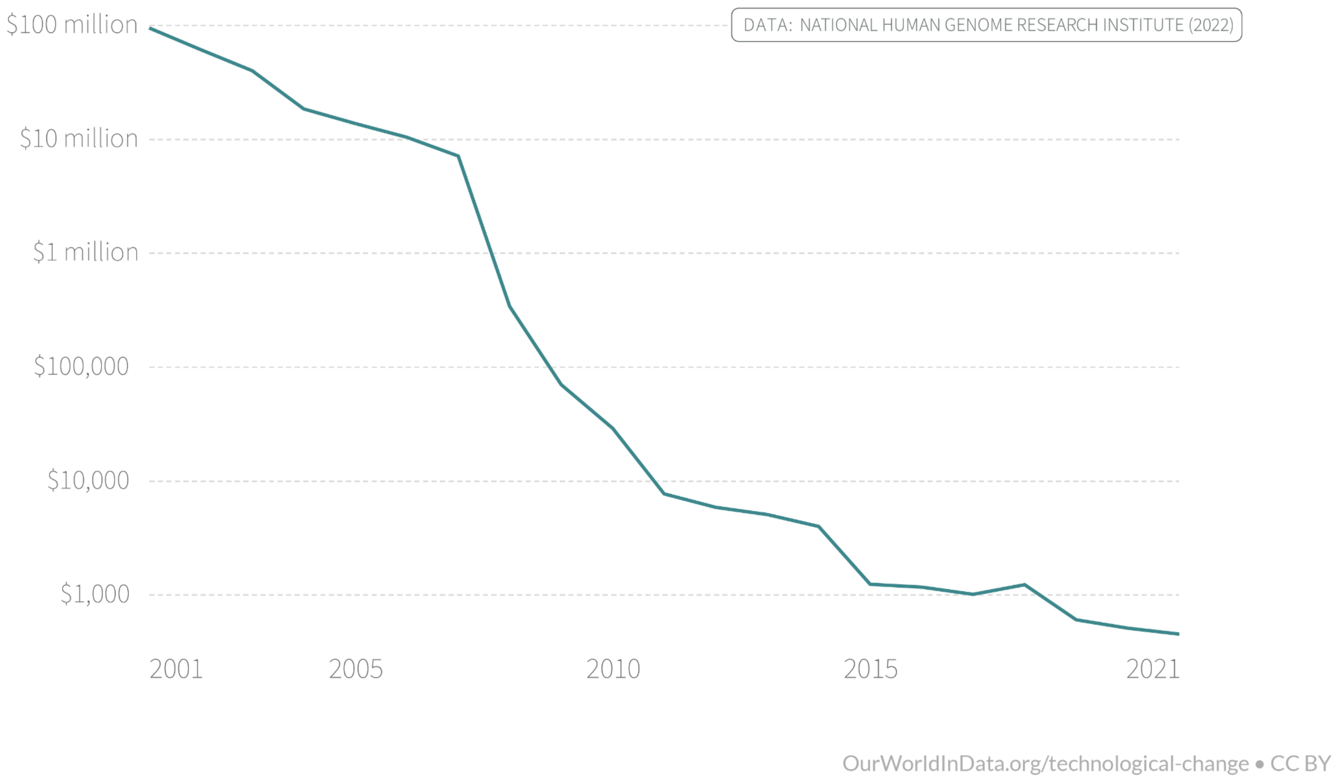


Image source: Roser, Ritchie and Mathieu (2023)

Prior to modern biotechnology, the Soviet biological weapons programme attempted to weaponise *yersinia pestis*, the pathogen which caused the Black Death.[13] In the past, the U.S. and Japan also had extensive biological weapons programmes (Carus, 2017). Infectious diseases that are used as weapons can kill civilians and soldiers alike — and are difficult to control once released. But without controls, the rapid fall in the cost and expertise required for synthetic biology suggests the threat will only grow. Yet, the agency

[13] For more information, see Tucker (1999).

in charge of ensuring that no country breaks the treaty on bioweapons has less funding than an average McDonald's.[14]

And the risk doesn't just come from malicious actors. In so-called "gain of function" research, many researchers are deliberately engineering ever-deadlier variants of the most dangerous pathogens, such as influenza or coronaviruses as scientific experiments, though these often have only dubious scientific usefulness.[15] Combined with a long history of confirmed lab leaks↗ — even at the highest levels of security — the risk from lab accidents alone is comparable to, and potentially higher than, the risk from naturally arising pandemics.

We don't have to live in the shadow of ever-increasing biological threats. **$297 billion would be enough to dramatically reduce the year-on-year chance of a new pandemic.** This funding would allow the world to build systems to detect a pandemic early, rapidly deliver vaccines to everyone in the world, prevent the disease from spreading via major hospitals and airports, and protect all essential workers in the event of a worst-case outbreak. Those initiatives might even put us on the path towards eliminating respiratory diseases entirely.

If such a program were in place 5 years ago, it could have prevented a pandemic which cost the United States alone around $16 trillion↗,[16] paying for itself more than 50 times over.

First, we could build a screening programme to detect new pathogens in wastewater, and sound the alarm early. A comprehensive plan might cost around $100 billion,[17] but focused monitoring on all 328 ports of entry to the U.S. would confer similar global benefits, since pandemic-capable pathogens are quick to cross borders from the country of origin. MIT biologist and CRISPR gene drive pioneer Kevin Esvelt↗ estimates that this minimal version would cost around $500 million upfront and $300 million per year (personal conversation). In total, monitoring for viruses for the next decade would cost around $3 billion upfront.[18]

Second, we could upgrade lab facilities worldwide so they can produce new mRNA vaccines for everyone who needs them within 6 months of a new vaccine discovery.

[14] The international body responsible for the continued prohibition of bioweapons has a budget of $1.4 million (BWC ISU, 2019) compared to an average $2.8 million to run a McDonald's (McDonald's Corporation, 2018, pp. 14, 20).
[15] For more information, see Jackson et al. (2001), Bussey et al. (2010), Cotter et al. (2014), and Tsetsarkin et al. (2007).
[16] Combining economic damages with monetised health and life loss. Remarkably, this includes more than $2 trillion of monetised damages from the effects on mental health alone.
[17] A report from the Nucleic Acid Observatory Consortium estimates the costs of setting up a nucleic acid observatory to monitor the wastewater and waterways of every major U.S. town and city, and most international airports at around $18 billion to set up and around $10 billion per year to run (Nucleic Acid Observatory Consortium, 2021).
[18] Assuming a 3% p.a. real return on investment.

During a pandemic, each day of delay in achieving immunity causes exponentially more infections, disrupted services, and lives lost. We could retrofit factories to produce 16 billion doses of vaccine in just 3 months, using plans from the Coalition for Epidemic Preparedness Innovations↗ (Hatchett, 2021). It would cost around $3.19 billion (around $3.6 billion after adjusting for inflation)↗ to retrofit facilities to be able to produce 8 billion mRNA vaccine doses in 6 months (Kis & Rizvi, 2021), and we would need about 4 times this capacity. In total, upgrading vaccine production would cost around $15 billion.

Third, we could stockpile enough next-generation personal protective equipment (PPE) to provide every essential worker in the world with near-perfect protection against pandemic pathogens in a worst-case outbreak. Air-purifying respirators would be key to protecting them from airborne viruses. Currently, they cost around $120 per system↗ (Nagel et al., 2021). The biosecurity organisation SecureBio↗ estimates that we could create, stockpile, and distribute *upgraded* versions of these respirators for $250 per system (personal conversation). Around $10 billion would be enough to provide protection for 40 million frontline workers in the U.S. and around $239 billion could protect around one billion around the world.[19]

[19] This more than covers the 31 million frontline workers in the U.S↗ and for $239 billion we could protect over 950 million workers around the world, around 1 in every 8 people (Statista Research Department, 2023). Insofar as prices are likely to be lower in other countries, this estimate is conservative, and we could likely provide protection for more than a billion essential workers globally. While it is difficult to precisely calculate the number of truly essential workers around the world, we feel confident that this would be enough to ensure basic services remain at least minimally functional during a worst-case pandemic.

Image source: Patrick Adams↗/RTI for the CDC

Finally, we could invest in the development of germicidal light and other technologies that could sterilise or remove pathogens in the air before we breathe them in. With filtration systems and chlorination, the developed world effectively ended waterborne diseases as a significant threat to public health. With germicidal light and better ventilation systems, we may be able to *end airborne disease* as well.

Many indoor spaces like hospitals use ultraviolet (UV) light to sterilise air and surfaces. A variant of this light called 'far-UVC' light appears to be unable to penetrate human eyes or skin, but can still eliminate 90% of coronaviruses every 8 minutes↗. There is promising evidence that this light is safe for human exposure (Buonanno et al., 2020). SecureBio estimates that it currently costs $10 per square foot protected using this germicidal light (personal conversation). This implies that we could install far-UVC lights for every hospital bed and the 100 busiest international airports for around $40 billion.[20] This is a small start, but it could trigger much wider adoption. Installing far-UVC lights in critical public spaces

[20] We estimate this would be around 3.98 billion square feet in total: Data from The World Bank (n.d.) indicate around 23.2 million hospital beds worldwide, each requiring around 150 square feet of space (Excel Medical, 2022), while international airports tend to have around 5 million square feet of indoor space: Beijing's Daxing International Airport is 7.5 million (McGregor, 2019) and London's Heathrow Airport is 4 million (Heathrow, n.d.).

would kickstart competition to design cheaper and more efficient lights; and as the costs fall then demand should increase from private buyers looking to install far-UVC to (for instance) protect employees from falling ill. That could lead to a virtuous cycle,[21] perhaps to the point where far-UVC is nearly as ubiquitous as fire sprinkler systems. Research funding for safety studies is one further, highly-leveraged way to encourage a successful and robustly beneficial roll-out of this technology.

> "With filtration systems and chlorination, the developed world effectively ended waterborne diseases as a significant threat to public health. With germicidal light and better ventilation systems, we may be able to *end airborne disease* as well."

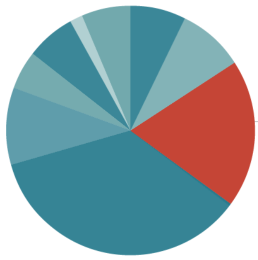
Moreover, simply integrating effective air filtration systems, and upgrading ventilation systems, could significantly slow the spread of a novel airborne pathogen. For instance, standalone filtration units can cause a 4- to 5-fold drop in pathogen dose in classrooms↗, and adding filters to existing ventilation systems has been shown to reduce the relative risk of infection of influenza by around half↗.

All together, $297 billion is enough to (1) kill airborne diseases with modern germicidal light before they take root, (2) detect a pandemic in the first weeks through wastewater monitoring, and — in the event of a pandemic — to (3) ensure essential workers are protected in even the worst cases, and (4) produce enough vaccines for everyone in the world within 6 months of developing the first vaccine. There are further investments that could reduce risks and burdens even more, but these investments alone could prevent the next Covid-level pandemic. If they do, we'd save millions of lives and trillions of dollars

[21] A comparison could be drawn to the process by which solar (PV) panels became so cheap↗ that they're now often cheaper than fossil fuels: government-led innovation and procurement created a demand pull, attracting entrepreneurs to step in and build a self-sustaining market.

Double spending on clean energy R&D until 2050

Since the industrial revolution, we have burned enough coal, oil, and gas to increase carbon dioxide levels in the air by about 50%.[22] There is more carbon dioxide in the air now than at any point in the last 2 million years (IPCC, 2023). Even before accounting for climate change, air pollution caused by burning fossil fuels kills over 3.6 million people every year (Lelieveld et al., 2019): more than the average yearly deaths from all murders, wars, and terror attacks combined↗ (Roser, 2020).



These emissions have already warmed the earth by around 1 degree celsius↗ (Ritchie et al., 2020), and global average temperatures are now higher than at any point in the last 2,000 years (IPCC, 2023).[23]

Climate change is not an abstract problem: it's already having effects around the world: effects like more frequent heat waves, cyclones, and droughts, according to the latest findings of the Intergovernmental Panel on Climate Change (IPCC)↗. These disasters claim lives directly, but they also indirectly increase disease, cause food insecurity, and displace millions of 'climate refugees' — typically among the poorest in the world. Without massive innovation and policy change, those effects will only worsen.

> "Even before accounting for climate change, air pollution from fossil fuels kills over 3.6 million people every year: more than all murders, wars, and terrorism combined."

Addressing climate change is one of the defining challenges of our time. Global emissions are still growing, but to meet the goal of the Paris Agreement — limiting global warming to 1.5 degrees Celsius — we would need to reduce our net greenhouse gas emissions drastically. The IPCC suggests↗ that emissions pathways compatible with this

[22] Burning of fossil fuels has increased carbon dioxide levels from around 280 parts per million before the industrial revolution to over 420 parts per million today↗ (Lindsey, 2018; National Oceanic and Atmospheric Administration, 2023).
[23] This is an oversimplification: there are several greenhouse gases that contribute to climate change. The other main contributor, methane, is addressed in part in the section on protein alternatives below.

goal will likely require roughly halving global net carbon emissions by 2030, and reaching net zero by around 2050[24]. It's hard to imagine how such a transformation could feasibly happen, especially without requiring major sacrifices from developing countries like India. Instead, assuming current policies, we might expect closer to 3 degrees of warming by the end of the century↗ (IPCC, 2023).[25]

This means that, over our lifetimes, rapid warming will likely result in further sea level rises, species loss, deaths from heat exhaustion, and the displacement of millions. And those effects will disproportionately affect the most vulnerable people in the world (IPCC, 2023). Moreover, increased atmospheric levels of carbon dioxide can persist for hundreds of thousands of years (Lord et al., 2016), harming many subsequent generations without intervention or costly adaptation (Halstead, 2022).

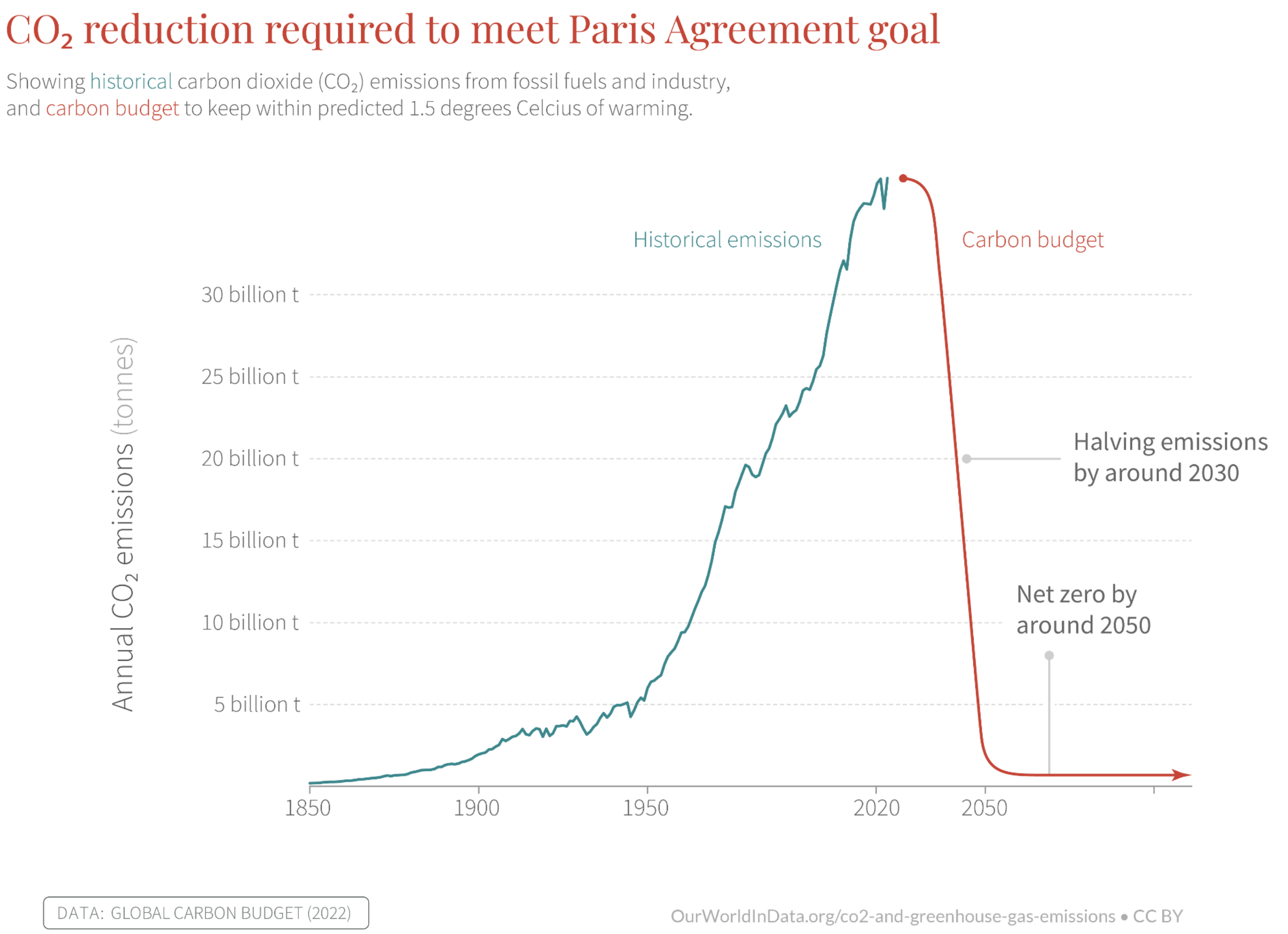


Image original source: Ritchie and Roser (2023).

[24] See also this report↗ from Climate Action Tracker (2022), and this longer report from the IPCC↗ on pathways consistent with 1.5 degrees Celsius of warming

[25] The latest Intergovernmental Panel on Climate Change report indicates that they have medium confidence that there is a 90% chance of warming falling between 2.2 and 3.5 degrees given currently implemented policies (IPCC, 2023).

At the same time, over 170 countries have adapted their planning processes and implemented climate policies to respond to climate change (IPCC, 2023). Without any attempt to mitigate emissions, we might face 4 to 5 degrees of warming[26] (Ritchie et al., 2020). But as long as these policy changes aren't reversed, these worst-case outcomes now appear highly unlikely (Halstead, 2022).

So while a best-case outcome may be unlikely, our decisions can still help avoid the worst effects of climate change. In other words, we haven't passed a "point of no return" where it's too late to act — we can and should do more to eliminate dependence on fossil fuels, and limit the harms we cause in the meantime.

Making progress on climate change requires major policy innovations, as well as non-governmental projects which can be philanthropically funded. One way to rapidly reduce net carbon emissions is to invest in clean sources of energy, making green technologies cheaper so that they will be widely deployed. This has been highly effective so far; over the last 10 years, the price of wind energy is down by 70%, and the price of solar is down by 90%↗ (Roser, 2020). When clean energy finally becomes ubiquitously cheaper than dirty energy, self-interest will point in the same direction as reducing emissions.

[26] We don't really know how bad things could get with this level of warming, because the damages from extreme warming are rarely studied (King et al., 2015).

Solar PV Module Cost

2019 International US $ per Watt

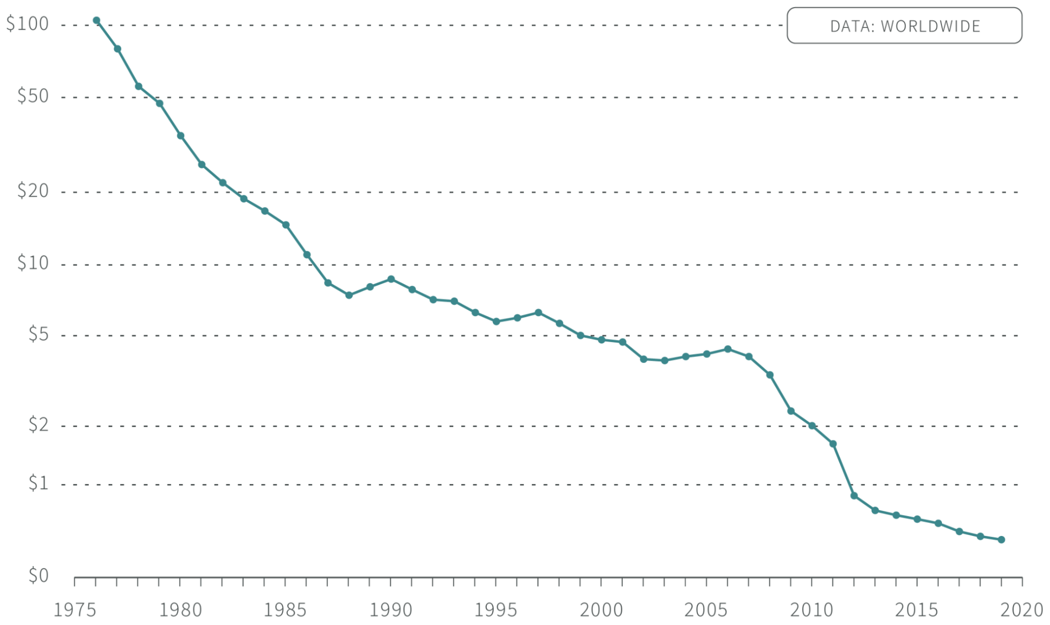


Image source: adapted from Roser (2020).

According to the International Energy Agency, the world spends about $30 billion↗ each year on clean energy R&D (IEA, 2020). For $662 billion we could double total spending on clean tech R&D until 2050.[27]

[27] In her TED talk, Natalie Cargill gives a figure of $840 billion. That figure was derived from simply multiplying the yearly spending estimate of $30 billion by 28 years (the years up to and including 2050). We believe that figure is a good conservative estimate. But we refined the figure for this report. First, we adjust for inflation to produce a yearly spending estimate of $34.5 billion in 2023 dollars. Second, we assume a 3% p.a. real return from unspent funds over the 28-year period. This assumption reduces the bottom line estimate to $662 billion.

Nellis Solar Power Plant, Nevada. Image source: U.S. Air Force↗

In fact, it may not even cost this much to double R&D spending. A dollar spent on speculative research — funded without expecting a return on investment — can help foster markets for emerging technologies, attracting additional investment dollars to clean energy. For instance, solar photovoltaic technology↗ emerged from (often publicly funded) basic research, before for-profit entrepreneurs drove down costs.

With such a large investment, we could greatly improve clean energy sources like solar, wind, nuclear, and geothermal power and drive down their price. Within the last half-decade or so, unsubsidised clean energy is finally becoming cheaper than carbon-emitting sources: for instance, almost two thirds of renewable power↗ added in 2021 had lower costs than the cheapest coal-fired options in G20 countries (IRENA, 2022). Targeted investments to make cheap, clean energy even cheaper and more widely available could maintain and hasten this trend, making sure clean energy wins out almost everywhere — even where fossil fuels are still subsidised↗.

But we shouldn't stop there. To fully transition to a net-zero carbon energy system, we'll need cheap and dependable ways to store energy and transmit it as electricity, especially when clean power sources only generate power intermittently. A hugely under-celebrated mark of progress towards net-zero is that the price of batteries has declined by 97% in the last three decades↗. And there's no reason to think costs can't fall dramatically again — if we redouble our investments.

While some parts of industry would still emit carbon, we should also scale up ways to capture those emissions at the source, before storing them where they won't cause environmental damage. This range of technologies is called 'carbon capture and storage' (CCS). CCS is especially useful for energy-intensive tasks which currently look distinctively difficult to electrify, such as cement or steel production. We might even be able to convert coal-fired power stations to clean sources of energy↗ (Ingersoll, Kirsty, and Aborn, 2023).

If the world reaches net-zero emissions, the carbon we have already emitted will remain in the atmosphere for centuries by default. But we could go further still, and eventually achieve *negative* emissions. How? By using some of the same CCS technologies, but adapting them to draw down and sequester carbon dioxide from the atmosphere and oceans, not just at the points of new emissions. One promising proposal is to use 'olivine'↗, a mineral which reacts with carbon dioxide to form a harmless silt.

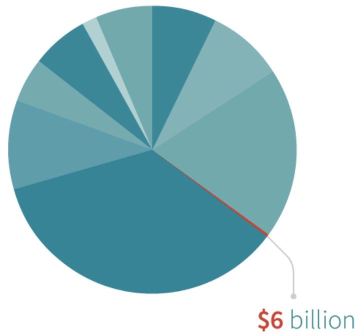
Finally, philanthropic spending to mitigate the harms of climate change could take a more systemic view, by funding organisations that research and advocate for evidence-based climate and green tech *policy*, as well as research into how to mitigate worst-case outcomes such as those from 'runaway' warming mechanisms.

If we allow ourselves to look further ahead, we could be even bolder. Entire countries and industries could become carbon *negative*. After bringing *yearly* net emissions to zero, negative emissions could make it possible to lower *total* net emissions also, preventing even more damage. And we could combine that with more comprehensive restoration projects: like cleaning up vast quantities of litter from land and waterways and, reversing desertification↗. Optimism without action on climate won't cut it, but if we aggressively scale up new and existing solutions — then we really would have grounds for optimism.

Quadruple nuclear security funding

A nuclear war, whether initiated through accident, miscalculation, or deliberate use, could result in fatalities on the scale of World War II in just the first few days↗ (Rodriguez, 2019). *Billions* more may face starvation due to crop failures from the associated climatic effects.[28]

Even in times when first strikes were unlikely, nuclear weapons have a shocking history of 'close calls'↗ (Roser, 2022a). For instance, in 1957 a nuclear bomb accidentally fell out of a bomber flying over New Mexico. Only by luck did the chemical explosives detonate, but not the nuclear payload. Or in 1983, the Soviet early-warning system designed to indicate nuclear launches from the United States reported five long-range missiles heading towards Russia. Protocol was to report the warning, and retaliate in kind with immediate effect. But by good fortune, the duty officer, Stanislav Petrov, decided to disobey orders and report the warning as a false alarm. One declassified document↗ from the U.S. Department of Defence lists 32 examples of similar incidents, but many more such incidents may be shrouded in secrecy. We don't know quite how many times the world narrowly avoided nuclear-scale disaster, but we know it has been several (DoD, 1981; Roser, 2022a).



[28] Nuclear winter would severely reduce our ability to grow most crops for five years (Robock, Oman & Stenchikov, 2007; Ord, 2020).

Estimated nuclear warhead stockpiles, 1945 to 2022

Stockpiles include warheads assigned to military forces, but exclude retired warheads queued for dismantlement.

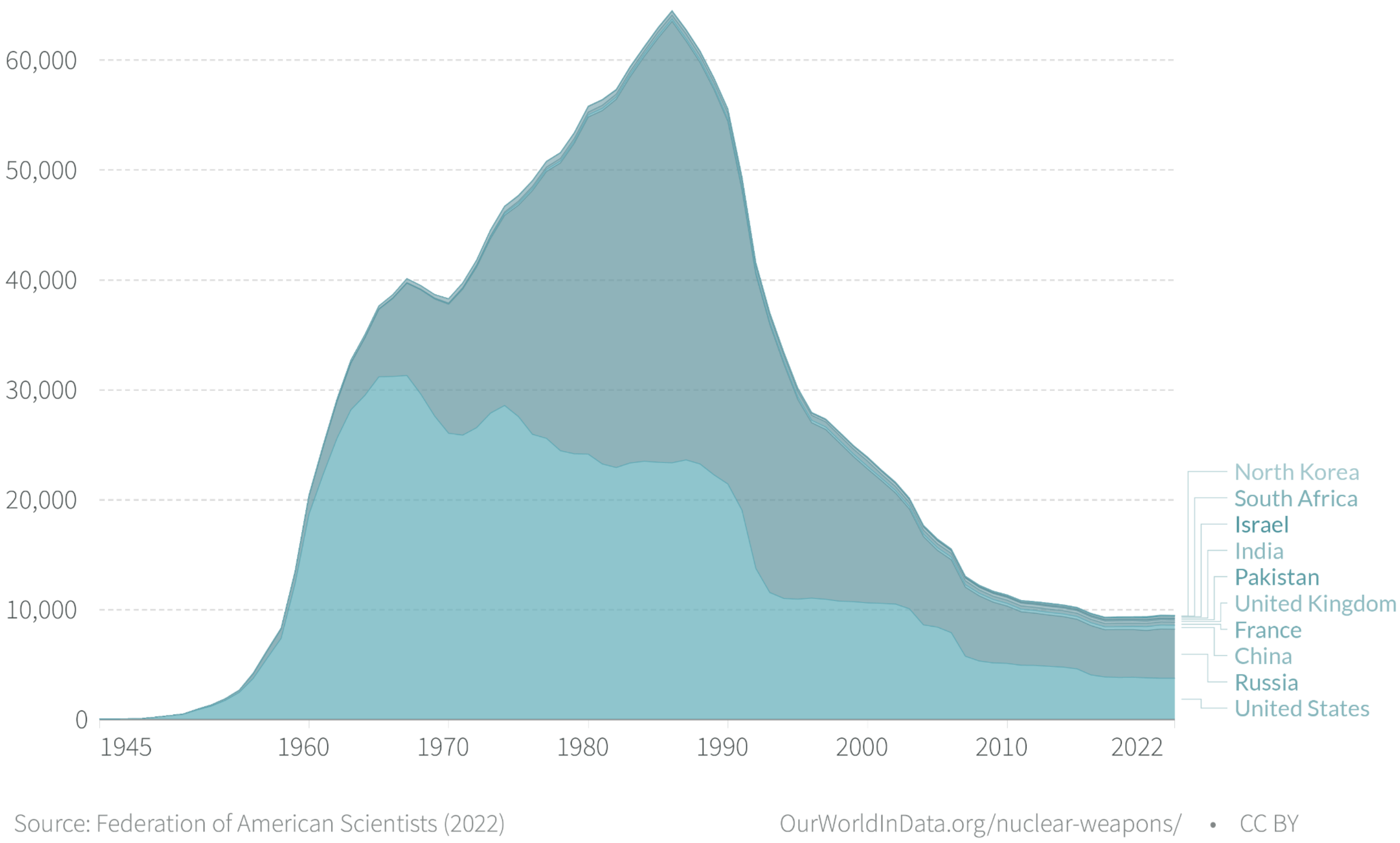


Image source: Roser, Herre and Hasell (2013).

Russia's nuclear threats↗ over Ukraine are a reminder that the nuclear threat is still entirely with us (Sanger and McKinley, 2022). Experts believe↗ we've entered a new nuclear age marked by greater geopolitical conflict and rapid technological change (Narang and Sagan, 2022),[29] and some analysts argue↗ this is the most dangerous moment since the Cuban Missile Crisis of 1962 (Haltiwanger, 2022). The forecasting platform Metaculus predicts a 33% chance↗ that a nuclear weapon will be detonated as an act of war by 2050 — the same platform that was weeks to months ahead↗ of the curve↗ in anticipating the emergence of Covid-19 as a pandemic. In any case: the U.S. and Russia maintain high-alert postures.

Further, advances in cyber weapons and remote sensing could create a "digital fog of war"↗ (Johnson, 2021), and increase the attractiveness of a first strike↗ (Lieber, 2017). To make it through this new age of nuclear risks, we can't afford to treat nuclear risk like a bygone problem.

[29] Several technological advances complicate strategic stability. Digital technologies have improved missile accuracy. Under certain scenarios, manoeuvrable hypersonic weapons increase speed and ambiguity of attack. Digitised command and control systems↗ promise improved reliability, but may also open new vulnerabilities to cyber attack. Technological uncertainties relate to missile defences, space and anti-space capabilities, and integration of artificial intelligence into surveillance, planning, and advising systems.

Given the enormous stakes involved in avoiding nuclear war, work to reduce nuclear risk and improve nuclear weapons policy is surprisingly neglected by philanthropists. The Peace and Security Funders Group (PSFG) estimates↗ that all philanthropic spending on nuclear weapons policy was less than $50 million in 2020 (PSFG, n.d.). That's about half of 1% of philanthropic spending on climate change↗ (Desanlis et al., 2022). **For a one-time endowment of $6 billion, we could quadruple philanthropic spending on nuclear security in perpetuity.**[30]

We don't have to rely on a small number of government decision-makers to help reduce the risks from nuclear weapons. Non-governmental groups can design and advocate for systems and policies that reduce false alarms, raise public awareness of the risks to build political opposition to reckless policy, and create platforms which bring together scientists and researchers to share thinking with decision-makers in government. And we could help prepare civilian decision-makers and military staff for the grave decisions they may face.

Non-governmental groups can make a difference through research, too. They can learn and summarise historical lessons from close calls, social movements, and attempts at nonproliferation. They can investigate and forecast relevant shifts in global politics and technology, helping suggest systems robust to times of rapid technological development.

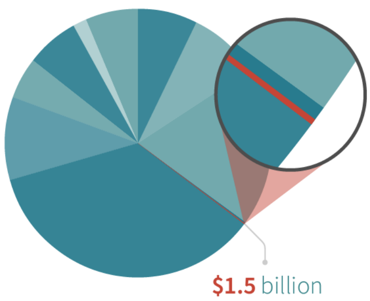
As an illustration, consider the Nuclear Information Project↗ at the Federation of American Scientists, which provides up-to-date information about nuclear weapons arsenals and countries' nuclear postures using satellite imagery, Freedom of Information Act requests, and other sources. Or look to the Council on Strategic Risks↗, which analyses and proposes concrete policy actions, drawing on its network with experience from the U.S. and global security communities.

We built these devices, and we can build systems to make them safer. By reigniting the promise of philanthropy focused on managing the continued reality of nuclear weapons, we can encourage a view of nuclear war as a threat to humanity, not just to national security.

[30] We assume spending on nuclear security has kept up with inflation since 2020, and that this investment will have a 3% p.a. real return on investment. The estimate given in Natalie Cargill's TED talk was for the cost of *doubling* funding, rather than the cost of *quadrupling* funding.

Increase AI safety funding tenfold

Artificial intelligence (AI) systems have developed new capabilities at regular, predictable intervals since their earliest development. But extrapolating these trends into the future suggest that we may be a decade or two away from AI systems which can outperform humans in most cognitive domains. This is a cause for excitement, but also for concern, given the ongoing problems of learning how to reliably control such powerful AI systems while avoiding unintended consequences — both in theory and practice.



In the past few years we have seen chatbots produce undergraduate level essays, write working code, pass bar exams with better results than 90% of lawyers↗, create photorealistic images, and beat most human players at strategy- and negotiation-based board games such as Diplomacy↗ (Meta Fundamental AI Research Diplomacy Team et al., 2022; OpenAI, 2022; 2023). These advances have taken the world by surprise, but the researchers who best predicted advances simply followed the trends↗.

Most modern advances in machine learning come from applying enormous amounts of computing power to enormous amounts of data. Breakthroughs do not come as a result of software improvements so much as because a lot of very powerful chips allow these systems to perform an enormous number of computations per second.

In general, since the advent of the deep learning revolution in 2012, the computing power of AI systems has grown by approximately tenfold every single year. Gains in computing power have led to significant breakthroughs. The transition from GPT2's 1.5 million petaFLOPs to GPT4's 21 billion petaFLOPS over four years took us from a system capable of presenting paragraphs of passable text to a multimodal system capable of writing working code, identifying images, and passing the bar exam. Increases in computing power effectively solved the "protein folding problem" in biology and allowed AI systems to create novel works of art.

But if these trends hold up for just another decade, we will soon have AI systems that have roughly as much computing power as the human brain. It's possible that these trends will not hold up, due to limits in available training data or the power of computer chips. But it's also possible that AI advances will lead to even bigger breakthroughs in AI, as machine learning is applied to areas that bottleneck AI progress, such as the development of computer chips and writing code.

AI researchers and expert forecasters agree that the coming decades will bring AI systems that are more powerful than humans. [In a widely cited 2022 survey↗] of AI researchers, half of the respondents stated that we are more likely than not to develop machines that can autonomously accomplish virtually every task better and more cheaply than humans before 2060 (AI Impacts, 2022). [A comprehensive literature review↗] of other quantitative models and expert surveys finds a combined median prediction of (roughly) 2045 for the arrival of transformative AI,[31] and roughly a 25% chance by 2030 (within around 7 years).

AI models will soon eclipse the compute a human brain performs in a lifetime of learning

Total compute used to train AI models and bioanchors are measured in total peta-FLOP, which is 10^{15} floating-point operations. [1]

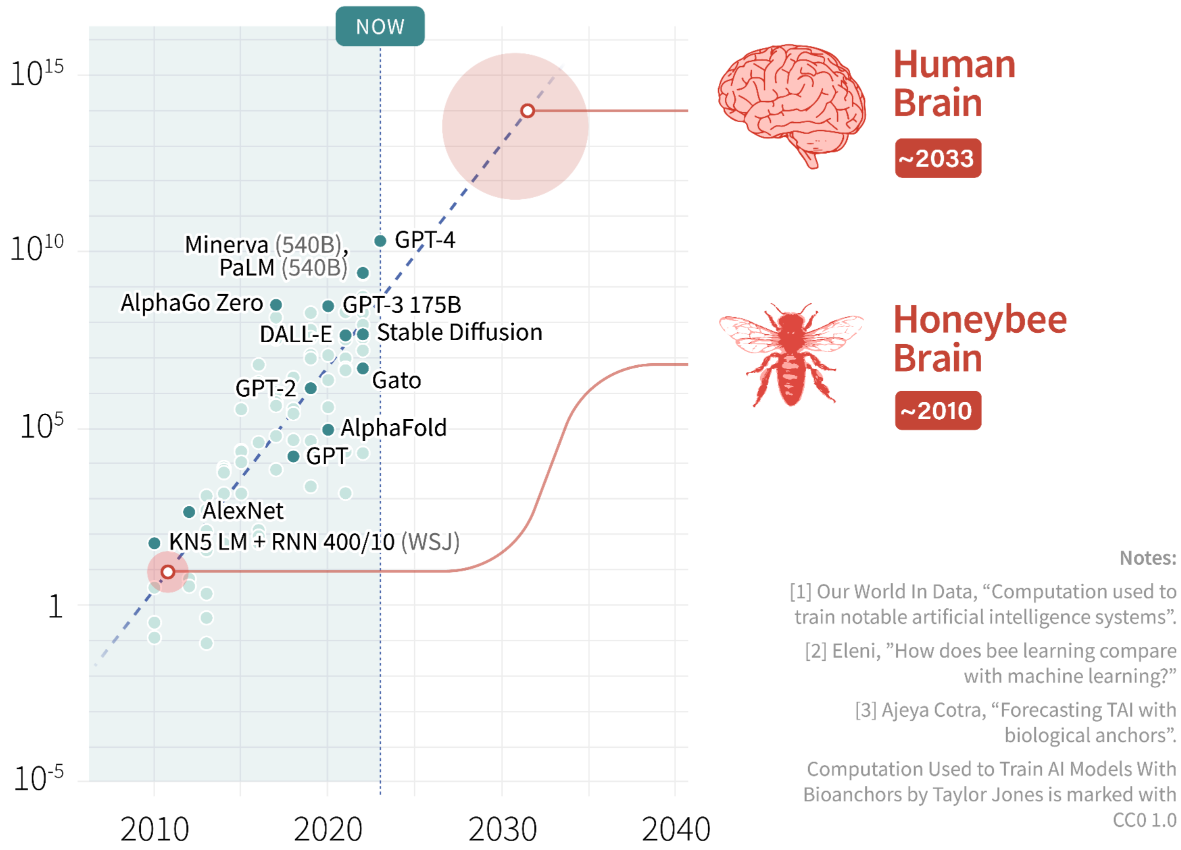


Image credit: Taylor Jones (various sources)

[31] Roughly understood as AI systems that are generally much smarter than humans, and which would lead a global transition comparable to (or more significant than) the agricultural or industrial revolution.

Consider, as an analogy, the relationship between humans and chimpanzees. Although chimpanzees are physically stronger than humans, they now have much less influence over the future than us, including over their own future. That's roughly on account of humanity's *intelligence*: our collective ability to make plans and act on them to get what we want. It's not that most humans especially care about subjugating other species for the sake of it — just that we ended up more effective at shaping the world to our goals, for better or worse. It's not a perfect analogy, but it shows the significance of imagining what could happen when powerful AI systems surpass humans on important dimensions of reasoning and planning ability, in the same way humans surpassed our primate ancestors.

Bearing in mind the amount of societal control that such AI systems may have, then, we should treat the development and integration of the most powerful systems with enormous caution. Already, we are handing off many societal decisions to computer algorithms, and we will do so increasingly as they grow in capabilities and perceived usefulness. This will be a serious problem if the AI systems of the future remain as unpredictable, uncontrollable, and incomprehensible as they are today.

The AI Incidents Database↗ catalogues nearly 3,000 reports of AI harms or near misses, ranging from vulgar mistranslations to lethal judicial failures. Some of the most notorious examples include:

— AI systems used in areas as disparate as judicial sentencing↗ and art generation↗ have demonstrated bias along lines of race and gender.

— Earlier this year the National Eating Disorders Association (NEDA) shut down its chatbot "Tessa" after it gave weight-loss promoting advice to users seeking help for eating disorders.

— Frontier large language models from OpenAI, Anthropic, and Bing have acted against their own codes of conduct, by lying, hallucinating, threatening users↗, and sharing dangerous information like ingredients for biological weapons↗.

Some of these problems were known issues before release, while others surprised developers despite extensive testing.[32] Despite sophisticated work from labs to try to align AI systems with human intentions, the basic safety of these systems remains unsolved. And unfortunately, existing evidence suggests↗ that even if these safety problems can be solved in today's systems, brand new problems will emerge for more powerful systems which cannot be solved by existing methods.

Since these basic technical challenges remain unsolved, many experts working on them have argued that the default path forward for artificial intelligence results in failure to

[32] Compare with the related problem of "deceptiveness" in AI safety↗, where current techniques such as human feedback and user rating maximisation incentivise AI systems to lie to their users and developers about their beliefs, goals, and values, making it impossible to know how they will behave in the real world. Deceptiveness is a major research area of frontier AI lab Anthropic↗.

understand and implement↗ ways to ensure those AI systems act in line with human values. The consequences of such an outcome could be catastrophic. The people building these systems themselves think that successfully building human-level AI is 14% likely to be “extremely bad (e.g. human extinction)”↗ (AI Impacts, 2022). By comparison, no one would get on an aeroplane with even a 1% chance of crashing.

Reflecting these concerns, a recent statement from the Center for AI Safety (2023) reads “Mitigating the risk of extinction from AI should be a global priority alongside other societal-scale risks such as pandemics and nuclear war.” It was signed by leading AI pioneers such as Geoffrey Hinton and Yoshua Bengio as well as CEOs of nearly all of the leading AI labs.[33]

The challenge ahead is enormous: it could take hundreds of millions of dollars, thousands of people, and many years of careful work. Currently, only a few hundred researchers work on questions related to safety.[34]

> “Mitigating the risk of extinction from AI should be a global priority alongside other societal-scale risks such as pandemics and nuclear war.”

All in all, the group of scientists and researchers focused on ensuring that advanced AI systems are safe and aligned receive less than $150 million[35] in philanthropic funding each year. Further philanthropic investment could create a more prudent and balanced approach, where we invest appropriately in ensuring that emerging, world-altering technologies are managed safely — without leaving most of that work to the AI companies themselves. **In one year, $1.5 billion of spending would mean that 10 times as much philanthropic funding goes towards efforts to ensure that advanced AI systems are safe and beneficial.**

We need to get many things right in combination. That means supporting technical work on devising new ways to ensure AI systems are aligned and secure against misuse, but also encouraging governance measures that ensure coordination between frontier labs and minimise the chances of a race to the bottom. We also need to prepare for the radically new world to come if humanity can safely transition to human-level AI systems,

[33] Signatories include the CEOs of top AI labs: Sam Altman, Demis Hassabis, and Dario Amodei; the authors of the standard textbook on Artificial Intelligence: Stuart Russell and Peter Norvig; two authors of the standard textbook on Deep Learning: Ian Goodfellow and Yoshua Bengio; an author of the standard textbook on Reinforcement Learning: Andrew Barto; three Turing Award winners: Geoffrey Hinton, Yoshua Bengio, and Martin Hellman; and the scientists behind famous AI systems such as AlphaGo and every version of GPT: David Silver and Ilya Sutskever.
[34] Globally, we invest around $50-100 billion per year into AI↗ (McKendrick, 2022). Less than $150 million is spent on AGI safety — by far the biggest funder, Open Philanthropy, gives around $50 million per year↗ (Sempere, 2022; McAleese 2023), and other funders such the Survival and Flourishing Fund↗ and the Long-Term Future Fund↗ give single digit millions.
[35] See previous footnote.

ensure such a world is fair and equitable, and work to protect the most vulnerable groups in society.

Most crucially, we need to ensure the development of safety-promoting technologies and methods fast enough to keep up with developments in AI capabilities.

What could these projects look like, more concretely? Funding could support:

— Organisations developing methods to evaluate frontier systems for dangerous capabilities. One outstanding example is the 'Evals' project↗ housed at the Alignment Research Center, which tested OpenAI's ChatGPT and Anthropic's Claude chatbots for dangerous capabilities before their release. These evaluations can then be integrated into broader processes to build an 'early warning system'↗ for emerging risks from AI

— Research contributing to the emerging field of "mechanistic interpretability": reverse-engineering trained AI systems to understand how they 'think', similar to how neuroscience seeks to understand human thought. Existing work is highly promising, but still mostly concerns 'toy' models↗, or comparatively small and less sophisticated systems↗. We still lack anything approaching a holistic understanding of what is going on inside the leading AI models, which are set to only become more complex. But supporting these burgeoning efforts could change that.

— Organisations working to develop ingenious governance solutions for preventing powerful AI from being misused. For instance, researchers at the Centre for the Governance of AI↗ have: reviewed risk-assessment techniques↗ from safety-critical industries, found broad consensus↗ on safety practices among leading experts, proposed mechanisms for distributing the economic benefits of AI↗ for the common good, and investigated ways to monitor and encourage transparency around the sale and use of hardware necessary to train new models.

— Initiatives aimed at finding and training talented individuals to contribute to the AI-related problems discussed in this section. For instance, the SERI MATS↗ program provides mentorship for young technical researchers, on topics from mechanistic interpretability to understanding AI hacking.

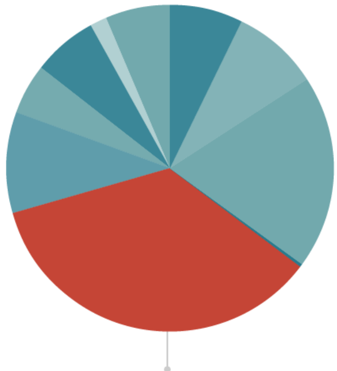
— Groups trying to forecast the development of key trends for AI, so that decision-makers can be better informed. One outstanding example is Epoch↗.

Collectively, these and many more measures could make a significant dent in the risks posed by artificial intelligence, helping to ensure a safer and more deliberate future for humanity.

Ensure everyone has access to clean water and sanitation, once and for all

Around 1 in 3 people do not have safe drinking water↗ and billions lack access to sanitary toilets and hand washing facilities (UNICEF & WHO, 2019). Unsafe water kills over one million people each year↗, and providing clean water and improved sanitation is a crucial factor in reducing the burden of tropical diseases (WHO, 2015; Ritchie and Roser, 2021).

In most of the developed world, you're rarely far from a tap, and you don't need to think twice before assuming the water that comes out is perfectly safe to drink. We have innovators of the past to thank for this — people like the engineer Joseph Bazalgette, who oversaw the construction of London's sewage system in the late 19th century, saving thousands of lives from regular outbreaks of cholera and other waterborne diseases.

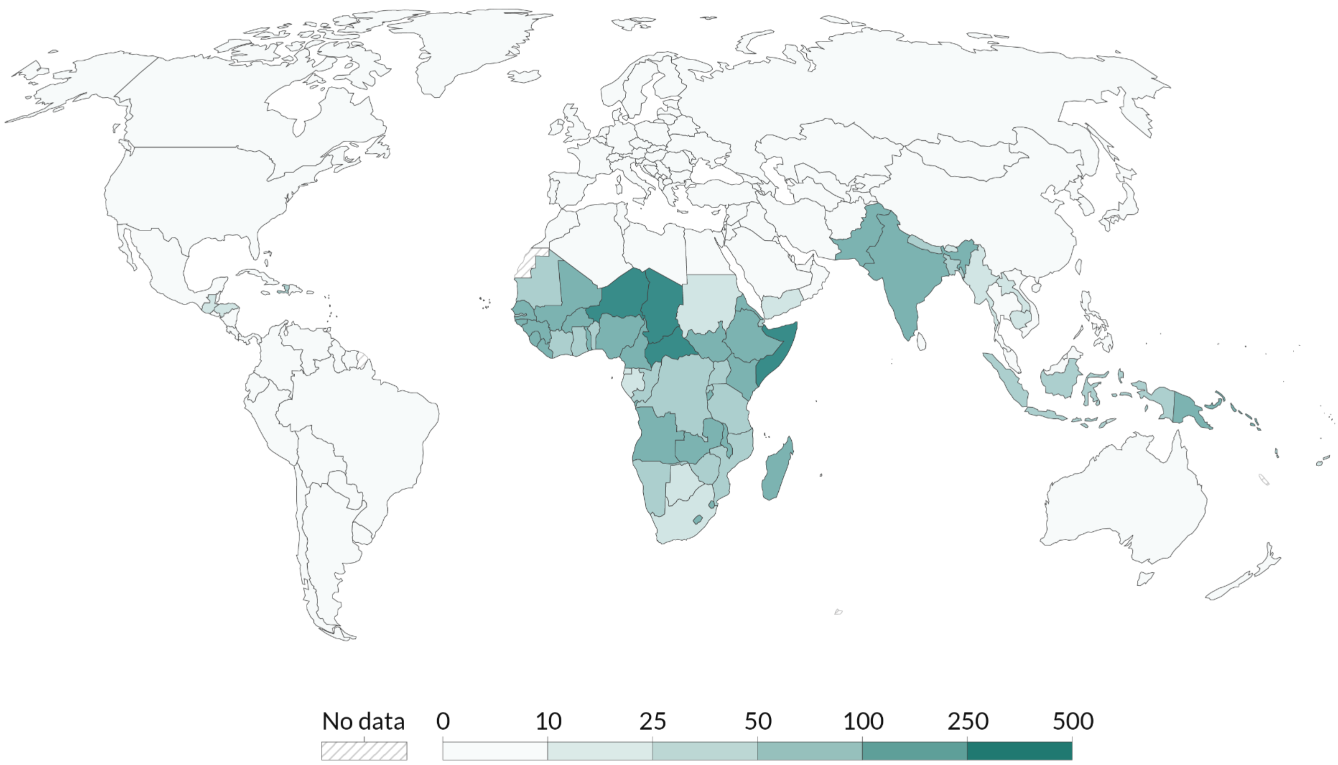


But now that we know exactly how to build the infrastructure for clean water and sanitation, we know it is a problem that can be solved for good, everywhere. Funding can help build toilets and plumbing that can safely manage faecal waste, handwashing stations with soap, and eventually the full infrastructure needed to deliver piped clean water to every community.

Access to clean water and sanitation is expanding over time, but major philanthropic contributions, unconcerned about getting a return on investment, can get us there sooner, saving millions of lives in the process.

Death rate from unsafe water sources, 2019

Estimated annual number of deaths attributed to unsafe water sources per 100,000 people.



Source: IHME, Global Burden of Disease (2019)

OurWorldInData.org/water-access • CC BY

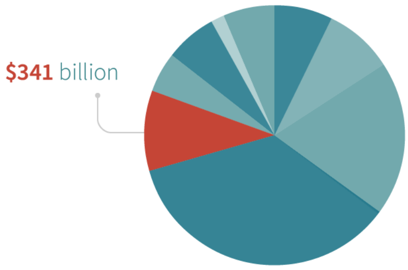
Image source: Ritchie and Roser (2021)

The World Bank's Water and Sanitation Partnership↗ estimates that ensuring universal access to water and sanitation would cost about $114 billion per year↗ for 15 years, of which around 31% is already funded (Hutton & Varughese, 2016). This implies that **a one-time investment of around $1.222 trillion would be enough to achieve universal access to clean water and sanitation**, when adjusted for inflation and investment returns.[36]

[36] Assuming a 3% p.a. real return on investment. If investment was put entirely towards meeting universal access without an intermediate stage of providing more minimal services, then the cost would be around $1.157 trillion (with a range of $761 billion to $1.693 trillion). Hutton and Varughese (2016) note that in order to effectively install and maintain infrastructure everywhere it would also be necessary to strengthen some relevant institutions and regulations.

End hunger and malnutrition

750 million↗ people have gone without food for a day or more in the past year (FAO et al., 2020). That's around 1 person in 10. Globally, around 50 million children under 5 are severely underweight, malnourished, and consequently are 12 times more likely to die than other children↗ (FAO, 2022), all because their families do not have enough food, lacking either calories or specific micronutrients.



Moreover, when malnutrition occurs during childhood or pregnancy, the result is stunted development↗ — often seriously curtailing that person's prospects for educational achievement, wages, and life expectancy.

Food shortages have obvious, short-term solutions, especially useful in crises or areas of acute need: such as delivering food directly, or giving families the money they need to buy food from elsewhere.

However, ending hunger, food insecurity, and malnutrition calls for more than short-term relief. Often stunting results not just from insufficient calories, but from so-called 'hidden hunger': deficiencies in micronutrients, like iron, zinc, and vitamin A. This is especially prevalent in areas with poor dietary diversity. But these vitamins and minerals are often very cheap, and so preventing life-impairing deficiencies can be shockingly inexpensive. There are three main approaches: supplementation (like multivitamin pills), food fortification (adding essential nutrients to staple foods as they are processed), and biofortification (cultivating crops to increase nutrient levels).

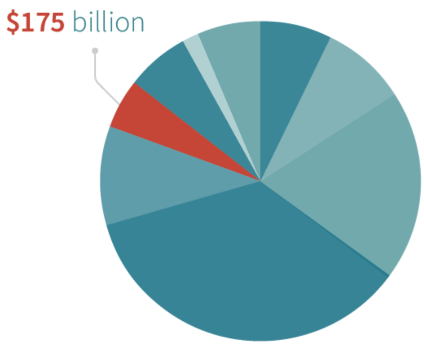
For instance, golden rice↗ was developed as a new variety of rice to address vitamin A deficiency, which affects more than 200 million↗ preschool children (WHO, 1995) and accounts for around a third of all under-5 deaths. Research for its development was funded by philanthropy, and now free licences are granted to developing countries. We could still do much more to develop and distribute biofortified crops. Vitamin A supplementation programs in sub-Saharan Africa, supported by charities like Helen Keller International↗, provide a round of supplementation at an estimated cost of around $1.10↗ per supplement. Then there are organisations like Fortify Health↗, which works with state governments to add iron, folic acid and vitamin B12 to atta (wheat flour) in India, and the Iodine Global Network↗, which protects cognitive development in children through 'salt iodization' to target iodine deficiency. All of these programs have significant room to scale.

Image credit: Helen Keller International↗. From a program to introduce a new strain of sweet potato fortified with vitamin A to Nepal.

But we could achieve much more than just supplementing micronutrients. Funding could also provide training and investment in farming to grow more food and ensure reliable and sufficient access for everyone. Ceres2030↗ provides a comprehensive estimate of the cost of preventing hunger worldwide (Laborde et al., 2020). It suggests that private and public investment totalling $33 billion per year for 10 years would be enough to end hunger, through investments in vocational programs, technical assistance for producers, infrastructure like improved storage facilities and rural roads, and more. This implies that **a one-time investment of around $341 billion upfront would be enough to permanently end hunger,** when adjusted for inflation and investment returns.

Give women control over their reproduction and reproductive health

800 mothers↗ die every day from pregnancy-related causes, and 15,000 children↗ die every day (Roser & Ritchie, 2023; Roser et al., 2019), many from bleeding, infections, complications with childbirth, and neonatal health issues.



A major factor in pregnancy-related deaths is that many births are not attended by health staff — more than 30 million women deliver outside of a health facility every year (Guttmacher, 2019). More than ten million women also lack access to the necessary care after major complications during pregnancy, and more still receive an insufficient number of antenatal care visits.

But, as with malnutrition and endemic diseases, these aren't immutable facts of nature. Mothers today are about 4 times↗ more likely to survive pregnancy and childbirth than they were in 1800 (Roser & Ritchie, 2023). Additional investment could speed up this progress by improving hygiene, health care, and family planning.

Concretely, funding could support more antenatal care visits, and the care required after obstetric complications. It could help give pregnant mothers the means to deliver in a health facility or be supported by health staff, and support those health facilities to improve basic hygiene practices, which can help prevent infections.

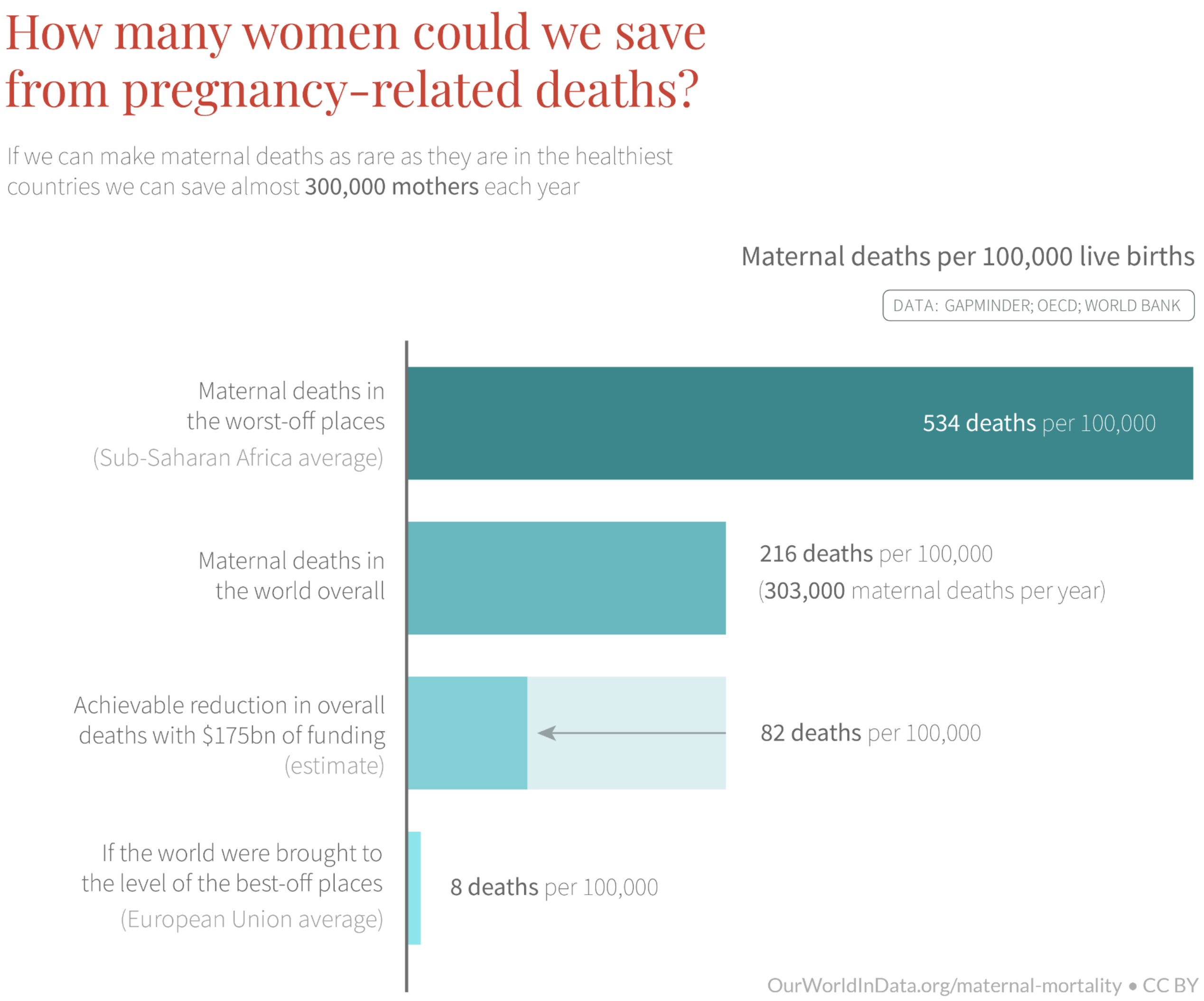
An estimated 8% of maternal deaths are caused by unsafe abortions. Funding could also reduce the number of abortions which are unsafe, such as through providing effective aftercare, especially in the case of complications. Simply providing women adequate access to contraceptives could more than half the number of unsafe abortions in low- and middle-income countries (Guttmacher, 2019).

If all regions were brought to the level of healthcare of the best-off places like the European Union, only 30 mothers would die each day↗ from pregnancy-related causes, compared to the present 800 deaths per day (Roser & Ritchie, 2023). That would save the lives of around 300,000 women per year.

But maternal deaths are only a part of reproductive health and freedom. Comprehensive funding could provide contraception, healthcare for newborn babies and pregnant women, and STI treatments in lower- and middle-income countries.

For instance, the organisation Family Empowerment Media↗ encourages informed family planning and provides information about how to use and find modern contraceptives via radio shows in countries with developing health systems. As well as the obvious value of freedom and awareness about reproductive choices, unintended pregnancies that go the term can disproportionately lead to health and wellbeing burdens, such as from complications from obstructed labour or postpartum depression.

These treatments already save and empower millions of lives in rich countries: we know they work. Applying them worldwide would improve health outcomes and save lives for millions of mothers and their children.



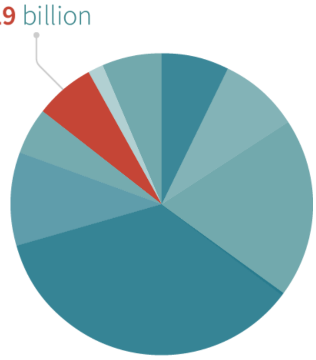
Source for data: Roser and Ritchie (2023).

The Guttmacher Institute (2019) estimates↗ the costs of providing these services. Ideal care would cost $68.8 billion per year, of which $37.6 billion is already funded. This implies that **a one-time investment of around $175 billion[37] could fund a comprehensive plan to provide global pregnancy, contraceptive, and related health services for the next 5 years,** when adjusted for inflation and investment returns.[38] The same report estimates that such investment would prevent more than 60% of newborn and maternal deaths.

[37] This conclusion assumes demand for these services, which may not be universal for cultural reasons. It also assumes sufficient numbers of trained healthcare workers and facilities with capacity to provide the services at scale.
[38] Assuming a 3% p.a. real return on investment.

Massively suppress or eradicate tuberculosis, malaria, and HIV

Tuberculosis↗, HIV↗, and malaria↗ together kill approximately 2.5 million people each year (Ritchie, Spooner & Roser, 2019). In 2021, tuberculosis killed more people than any other infectious disease except COVID-19↗ (WHO, 2022).



Despite claiming the lives of millions each year, we know how to treat and prevent all three of these diseases (WHO, 2022; Feachem, 2019; UNAIDS, 2021). Since the year 2000, we over 74 million lives↗ were saved through tuberculosis testing and treatment (WHO, 2022). Since 2010, health care has halved the number of cases of HIV↗ (UNAIDS, 2021). And since 1900, malaria has been eradicated on half of the earth's surface↗ (Roser & Ritchie, 2022). We are now within striking distance of completely or nearly eliminating TB, HIV, and malaria.

The World Health Organization (2022) estimates that $13 billion over 12 years↗ would reduce tuberculosis deaths by 90%↗ (WHO, 2018; WHO, 2022). Many things need funding: improved case finding and contact tracing, expanded access to treatments to cure TB, and measures to curb infection. But one especially promising approach is to fund the next generation of TB vaccines.

Owing largely to a lack of investment, only one such vaccine↗ has been approved in over a century.

But this could change soon — perhaps in the form of the M72 vaccine, currently undergoing late-stage clinical trials funded by the Bill and Melinda Gates Foundation↗ and the Wellcome Trust.

Meanwhile, the Joint United Nations Programme on HIV and AIDS estimates that we could end HIV as a public health threat for $29 billion↗(UNAIDS, 2021). This would require investments in education, health service accessibility, testing, treatment, prevention, and measures to slow rates of infection.

Image credit: Against Malaria Foundation↗ (@againstmalaria)↗. Insecticide-treated bed nets are distributed to villages in Phalombe District, Malawi

Finally, the Lancet Commission on malaria eradication estimates that eradicating malaria is likely to cost an extra $2 billion per year for 31 years (Feachem et al., 2019).[39] Preventing malaria can be remarkably cost-effective: the charity evaluator GiveWell estimates↗ that nets for stopping mosquitoes, and medication for malaria, both save a life for roughly every $5,000. The Lancet report also recommends↗ new medicines and insecticides, repellants and baits for mosquitos, and better ways to track and diagnose infections. More ambitiously, it also recommends work to develop and distribute new, long-lasting vaccines against malaria↗. Finally, with buy-in from the communities involved, it may be possible to render malaria-carrying species of mosquito either resistant to malaria, or even extinct in the wild, using a technology called CRISPR gene drive↗.

In total, tackling tuberculosis, malaria and HIV would cost around $219 billion upfront, when adjusted for inflation and investment returns.[40]

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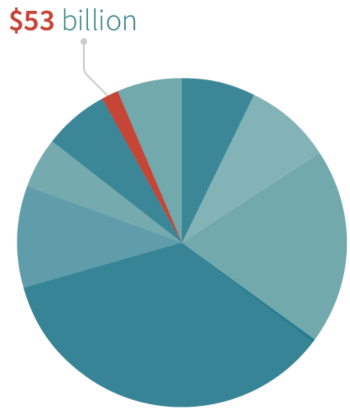
[39] This estimate is highly speculative, and depends on several factors including "managerial efficiency, the efficacy and cost of new tools, and the degree to which interventions can be targeted". At the same time, they note that "the world is at an important decision point. The malaria community can continue current efforts and anticipate gradual reductions in most countries, persistent transmission in some parts of Africa, an ongoing and increasingly difficult struggle against drug and insecticide resistance, and the constant threat of resurgence, or it can commit to eradication by 2050 at the latest and be done with malaria once and for all."

[40] Assuming a 3% p.a. real return on investment.

Massively suppress or eradicate most neglected tropical diseases

Over 1 billion people↗ are affected each year by neglected tropical diseases such as leprosy, guinea-worm, and chagas (WHO, 2023). Twenty neglected tropical diseases pose an enormous health burden, but their treatment is underfunded↗ (WHO, 2023).



Victims of these diseases tend to live in low- and middle-income countries, which contributes to their neglect. But the diseases are preventable and manageable through simple interventions like access to clean water, sanitation, and medications.

In 2015, the World Health Organization estimated that eradicating, eliminating, or controlling most neglected tropical diseases would cost $34 billion↗ over 15 years, excluding donated medicines. This would primarily fund vector control methods, like insecticide spraying and distributing bed nets. *Disease Control Priorities*, 3rd edition, estimates that buying and delivering medicines would add at least $7.3 billion↗ to the true cost (Fitzpatrick et al, 2017).

To give an example of the kind of intervention that could be scaled with more funding: inexpensive medicine (pictured below) can be administered to dramatically reduce rates of parasitic worm infections (schistosomiasis and soil-transmitted helminths) in poor regions. The cost per child dewormed for one exemplary program in Kenya was $0.46[41] (GiveWell, 2022), with evidence for long-term positive effects↗ on that child's development and school attendance.[42] Yet, the World Health Organisation estimates that some 1.5 billion people↗ are infected — nearly a quarter of the world's population.

[41] Or $0.66 per child including in-kind contributions from governments.

[42] Note that the magnitude of these (short- and long-term) effects is uncertain and the evidence base remains partly contested. See this report from GiveWell↗ for a comprehensive review.

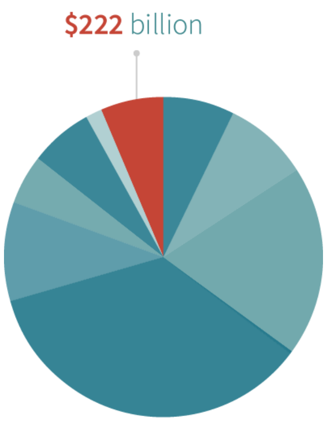
In total, addressing neglected tropical disease in this way would cost around $53 billion upfront, when adjusted for inflation and investment returns.[43]

Image source: Evidence Action / Deworm the World Initiative.

[43] Assuming a 3% p.a. real return on investment.

Halve factory farming by 2050

At least 50 billion chickens↗ will be slaughtered for food this year. That means more chickens will likely be killed in the next two years than all humans who have ever lived↗.



While global estimates are tricky, in the US over 98%↗ of these chickens will be raised in factory farms, confined to cages that are smaller than a standard sheet of paper↗ (Ometer, 2010). Many live in chronic pain↗ from aggressive selective breeding to make them grow unnaturally fast. The ammonia gas from their droppings — often not cleared out for up to a year — causes lung disease, sores, blisters, and sometimes blindness. Hundreds of millions more cows, pigs, and sheep,[44] and likely more than 100 billion fish↗, face similarly unnatural and painful lives before being killed for human food. By biomass, farmed livestock alone outweigh all humans↗, and outweigh all wild mammals by more than 15 to 1.

Image credit: Artem Beliaikin↗ on Unsplash

[44] Again, the large majority↗ of which will be raised in factory farming conditions.

Animal agriculture is also responsible for around 40% of climate warming since the industrial revolution (Tubb and Seba, 2019; CCA Coalition, n.d.), and is a significant risk factor for natural pandemics — the U.S. CDC estimates that↗ 3 out of every 4 new or emerging infectious diseases in people come from animals.

In the UK, animal food products are around ten times more land-intensive↗ per calorie than plant-based food, and meanwhile take up 85% of the land used for agriculture. The same goes for water use, pesticide use, and herbicide use. The amount of freshwater required for farmed animal products is not only relatively higher than crops↗ per calorie, but also vast in absolute terms: animal production uses more than a quarter↗ of humanity's freshwater use.

One approach to reducing the impacts of animal agriculture is to advocate for people to eat fewer animal products. But despite advocacy for reducing animal consumption, there's no clear evidence↗ that the number of self-identifying vegetarians and vegans in the U.S. has risen significantly over the past 15 years↗.

An alternative — and complementary — approach is to harness market forces and food technology to make alternative foods which are competitive with animal products in terms of taste, nutrition, and cost.

Plant-based burger sales increased by over 500% between 2018 and 2020 (ClimateWorks Foundation, 2021). With the right investment, precision fermentation and cellular agriculture could become price competitive with animal proteins in the next decade (ClimateWorks Foundation, 2021; Tubb and Seba, 2019). This would require innovation to improve production techniques, as well as scaled-up production lines to take advantage of economies of scale.[45]

It will likely cost around $222 billion to create alternative proteins that are taste- and cost-competitive with animal protein. The Global Innovation Needs Assessment, supported by the UK Foreign, Commonwealth, and Development Office, estimates that an investment of $10.1 billion per year for 29 years into the development and production of alternative proteins would replace about 50% of animal agriculture (ClimateWorks Foundation, 2021↗).[46] This implies that **a one-time investment of around $222 billion would likely be enough to halve factory farming, when adjusted for inflation and investment returns.[47]**

But once we have achieved healthy, tasty, and cost-competitive alternatives to products of industrial farming, there is no obvious reason why these protein alternatives could not

[45] Cellular agriculture needs to scale to around 220 to 440 million litres of fermentation capacity (ClimateWorks Foundation, 2021; Bellani et al., 2020).

[46] Alternative sources of protein include plant-based; precision-fermented; and cellular agriculture. The report notes that insect-based protein is unlikely to be viable in the West. There may also be ethical reasons↗ to avoid scaling insect farming↗.

[47] Assuming a 3% p.a. real return on investment.

take close to 100% of market share. To end the global harms of industrial animal farming, we would not need to rely on moral arguments urging people to give up foods they enjoy: protein alternatives could simply beat animal products at their own game.

Conclusion

Ambitious giving, combined with strategic philanthropic spending focused on the world's most serious problems, can save hundreds of millions of lives and secure a meaningfully better future.

We're confident that the plan we have just set out is not the *best* way to spend $3.5 trillion. The solutions we have focused on are highly *scalable* giving opportunities that could go a long way towards solving each problem entirely with enough funding. But there are more cost-effective ways of giving for individual donors looking to make as much progress on a problem as possible, without the need for the solution to fully scale. Where relevant, we have highlighted extremely cost-effective giving opportunities for individual donors alongside highly scalable opportunities for global philanthropy.

We're also confident that funding alone will not be enough to solve these problems. Even in the case of the simplest intervention, direct cash transfers, moving this amount of money requires an improved payment and communications infrastructure, and cooperation with local governments. As such, philanthropy always needs to work alongside political processes, and in collaboration with the people who carry out projects on the ground. But governments have clear interests in addressing problems like the basic health of their citizens, or in minimising the threat to their country of a pandemic. And since philanthropic funding also means employment opportunities for those mobilised to put plans into action, funding alone will go a tremendous way towards solving these problems.

We hope we have demonstrated a simple, but oft forgotten fact: ambitious giving, focused on practical solutions for some of the world's most pressing problems, can utterly transform the world. Together, we have the resources and the knowledge to begin revitalising the planet, to improve the lives of hundreds of millions alive today, and to set the world on a safer, more hopeful trajectory for the generations who are to come.

And that's all with funding from just one year. Imagine what we could achieve in year two.

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About the authors

Fin Moorhouse

Fin Moorhouse is a research analyst at Longview Philanthropy. He was previously a Research Scholar at the University of Oxford's Future of Humanity Institute and he hosts the podcast *Hear This Idea.* Fin holds a first-class degree in Philosophy from the University of Cambridge.

Riley Harris

Riley Harris is a research assistant at Longview Philanthropy. He is also a PhD candidate in Philosophy at the University of Oxford and holds Bachelor of Economics and MPhil degrees from the University of Adelaide.

Dr. Tyler John

Dr. Tyler John leads Longview's grantmaking in international policy, priorities research, and academic field building. He holds a PhD in Philosophy from Rutgers University and his work is published in leading journals such as *Ethics.*

Kit Harris

Kit Harris leads grant investigations in artificial intelligence and biosecurity at Longview Philanthropy. He holds a first-class degree in Mathematics from the University of Oxford.

Natalie Cargill

Natalie Cargill is the founder and president of Longview Philanthropy. She previously worked with the United Nations Human Rights Council and completed her studies at the University of Oxford. She is a co-editor of *The Long View: Essays on policy, philanthropy, and the long-term future.*

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W/ longview.org
E/ info@longview.org