Change!

Why we need a radical turnaround

Graeme Maxton

First Edition: 2018, Komplett-Media
Second Edition, 2019

ISBN 978-3-8312-0474-8

LeeMax
Zur Frohen Aussicht 4
8006
Zurich
Switzerland
www.graememaxton.com

Foreword

Is it really so bad?

The headlines, the scientific evidence and the solutions are often confusing. For many people it is yesterday's news, while for others it is a conspiracy.

What is climate change? How big is the problem? And what should societies do?

I am not a typical 'green'. I don't recycle much, I don't always take the train if I can fly and I am not vegetarian. I used to work in banking. But I have also spent the last decade working on the climate problem. I have worked alongside many of the world's top climate scientists, and had the chance to discuss what is happening with business leaders, economists, politicians and activists across the world.

I wrote this book to share what I have learned, to explain what is going on and to help others understand what will happen without change.

To grasp the scale of the challenge is hard, partly because the answers to the climate problem do not lie in the solutions currently proposed. Shifting to electric vehicles, recycling and investing in renewable energy will not achieve very much.

Successfully stopping global warming requires a much more fundamental rethink. Societies will need to overhaul their approach to development and redefine their purpose. Commonly held ideas about happiness, progress and freedom will need to change. To build a better world, societies will need to reform almost everything they consider normal.

Achieving a transition on this scale will take a very long time, of course. It will need a new Enlightenment and that will take many generations.

Unfortunately, given the pace of atmospheric change, that is too long. Not only do societies need to rebuild their foundations, they also need to tear down vast swathes of what has been built so far if they are to avoid a catastrophe.

And they need to do this regardless of the economic, social and human costs.

A tale in four parts

The first part of this book explains the problem. The second part looks at what will happen without change. Perhaps surprisingly, it is possible to predict what will happen in the coming decades with considerable accuracy. The third part focusses on what is needed to address the urgent part of the problem, while the last part explores how humanity might build more sustainable long term economic foundations.

This book is aimed mostly at the rich world as well as China. While the climate problem affects the rest of the world too, and often in more serious ways, it is the rich world and China which have the greatest responsibility for what is happening and the greatest capacity for change. The rest of the world will need to play a vital role too, but a different one.

The transition needed is difficult and complex. Thankfully, many people are already trying to make it happen. I hope this book might nudge you into action too because we will need all the help we can get.

As you read it, please remember three events which celebrated their 50th anniversaries recently: the founding of the Club of Rome, the introduction of the Big Mac and the student riots in Paris during 1968.

The Club of Rome and its book *The Limits to Growth* explained in the early 1970s that radical change was necessary. The Big Mac is a symbol of humanity's unhealthy lifestyle since then. The '68 riots are a reminder of what it sometimes takes to force change.

"Plutôt la Vie!" shouted the students in Paris. "Choose life instead!"

Let's all choose life instead.

Graeme Maxton, April 2019

For MaDrBaTRaXaDaAaX'scaS
and Robin and Alexina

With sincere thanks to Herbert Lenz in Munich for his support and encouragement, and also to Klaus Fabry in Zurich without whom this book would not have been written. Special thanks too for Ian Dunlop in Australia, Nina Sattler-Hovdar in Austria, Mike Jewell in Taiwan and Martin Deron in Canada.

Sections

List of Tables and Charts

Part 1

The problem

> *"An enormous fortress of prejudices, lies, abuses, violences, inequities and darkness stands in this world, with towers of hatred. It must be cast down. This monstrous mass must be made to crumble"*
>
> ***Victor Hugo, Les Misérables (edited)***

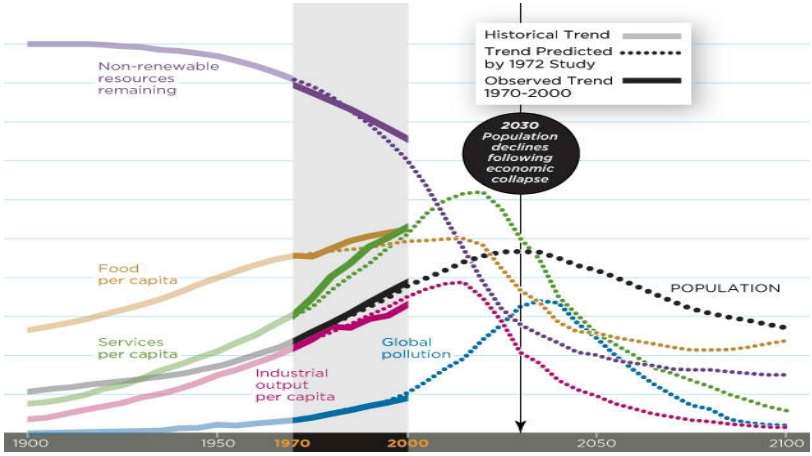
A book for yesterday, today and tomorrow

There are very few books that become more important as they get older. There are almost none that correctly anticipate the future 50 years ahead. This story begins with such a book.

Published in 1972 by a group of scientists at the Massachusetts Institute of Technology (MIT) in Boston, the book explored possible future pathways for humanity. To understand what the future might look like the team selected and analysed five long term trends: the human population; food production; industrial output; the use of non-renewable resources; and pollution.

Having established a base case, which they called the Standard Run, they then analysed the complex inter-relationships between the variables to understand their consequences on human development. The book they wrote based on the results is called *The Limits to Growth*.

Chart 1.0 – The Limits to Growth Standard Run, from World 3 model, with update to 2000



Source: The Limits to Growth, 1972, Graham Turner University of Melbourne[1]

[1] http://www.smithsonianmag.com/science-nature/Looking-Back-on-the-Limits-of-Growth.html A comparison of The Limits to Growth with 30 years of reality, Journal of Global Environmental Change, 2008 (387-411)

Chart 1.0 shows that base case, the Standard Run. It shows the anticipated path of human development if the trends in population, non-renewable resource use, food consumption, and industrial output continued unchanged. It also shows the actual data, from 1970 to 2000 superimposed.

The result of the standard run was startling. Without change, it said, human civilisation would collapse. As the population and industrial output rose, the availability of non-renewable resources would fall while the level of pollution would grow.

The entire system would eventually become unstable because of rising resource costs and higher levels of pollution. Industrial output would then decline and the human population would shrink.

> *Anyone who believes that exponential growth can go on forever in a finite world is either a madman or an economist.*
>
> **Kenneth Boulding,** Economist

More troubling, in almost every scenario the team explored, the same thing happened. When they ran the model assuming that natural resources were unlimited and pollution was controlled, it collapsed too.

This time, the collapse was caused by the limit of farm land. Food production would not be sufficient to meet the needs of a rising population. When the scenario was run with unlimited resources, pollution controls and double the agricultural productivity, the system collapsed too. This time it was caused by a rise in the human population which boosted industrial output too much for the pollution controls. When they ran the model with very little population growth the system collapsed too. It just took a few decades longer. When they assumed unlimited resources, lots of recycling, double the food production and minimal population growth the system collapsed too.

The rise in pollution caused the death rate to rise leading to a crisis. Even with a constant population the system eventually collapsed. The only scenarios which did not lead to collapse were those where everything was stabilised – the population, resource use and industrial output. Only if these were kept at near-1970s levels, would the system remain stable for a long time. Even then, pollution would need to be drastically reduced, products would have to be designed to last longer and food production would need to be reformed.

At a time when the United States had just put a man on the moon and it seemed as if there were no limits to what humanity could achieve, the MIT team warned of a looming crisis.

They said that human development would grind to a halt if societies pushed too hard on the economic and ecological accelerator because they would eventually breach the limits of sustainability. The team also explained how the main variables are closely interlinked and showed that there are complex feedback loops which are often subject to delays and which cannot be changed by technology. A new born child cannot reproduce until it reaches a certain age. Capital and land use cannot be easily transferred to meet fresh demands. It takes a long time before rising pollution has a measurable effect on human health.

Their model also made it clear that a collapse would not happen quickly, at least in human lifetime terms. Societies would not wake up one morning and find that their economies had fallen into disarray overnight. It would not take six months, or even six years, for the system to fall apart. It would take many decades.

In the standard run, the main turning point, when progress stopped and major decline set in, was in the middle of the first half of the 21st century, sometime between 2030 and 2040. But the consequences of the collapse would be clearly visible for decades before then, and decades after.

This is because major shifts in human history do not happen suddenly, despite the dates given in history books. It takes a long time for the pressure for change to build. Societies are driven by long term underlying social trends, as well as lags and complex feedback loops. It can take generations for major change to occur, sometimes longer. Think about some of the big turning points in history such as the collapse of the Roman Empire, the French Revolution, the First World War or the disintegration of the Soviet Union. The storms that created these historical shifts were visible for decades before they happened, while their consequences were felt for many decades after.

Why collapse is hard to see

The comparatively slow pace of change in complex systems makes it very hard for those affected to understand what is happening. The changes seem so gradual, at least in human lifetime terms, that they come to appear normal to those in the midst of them.

This lack of understanding also means that a collapse is very hard to stop or reverse.

Even once a sufficiently large number of people understand what is going on, they find it extremely difficult to grasp the scale of the response needed to stop it. They find it very hard to understand how long it will take for their actions to have any impact, and how long these will need to last. They find it even harder to convince others that change is needed. This is because most people focus on the short term. They have very little understanding or experience of the forces that drive long term changes in complex systems, or how to control them.

Since it was published nearly 50 years ago, the team of scientists has reviewed the Limits to Growth data regularly, as have many other experts. While they have found some flaws in the original approach, it has also become clear that the future anticipated in the standard run was basically correct. The trends in human population, resource use, industrial output, food production and pollution over the last 50 years have been almost *exactly* as anticipated by the MIT team.

The entire system of human development, which societies have crafted so carefully over so many centuries, is collapsing.

While most people are still unaware of it, humanity is in the midst of a major crisis, driven by powerful long term social and environmental forces that are extremely hard to understand and even harder to manage.

The most obvious sign that the collapse is happening is climate change. This is already far more serious – and far less reversible - than most people understand. But there are many other signs that humanity is being engulfed by a major crisis too. The problem of migration is another indicator. People are moving because of structural economic discontinuities and the effects of climate change. Accelerating species loss is another symptom, as is widespread ocean pollution. The rising number of conflicts over access to resources is another signal. The growth of political extremism, as well as the rise in populism, are signs too. So is widening inequality.

As I will explain, all these problems have the same root causes. They are all consequences of humanity pushing too hard on the economic and ecological gas pedal for too long. They are not warning lights, flashing red on the control panel, telling societies that they need to change. They are signs that the system is disintegrating.

That those who are elected to lead human society did not listen to these MIT scientists in 1972 is more than unfortunate. If they had, societies might have been able to avoid a systemic problem which will now engulf them and endure for decades, no matter what people do. If humanity had greatly slowed its rate of development 50 years ago it could have enjoyed centuries of fruitful progress. That is no longer possible.

It is too late for sustainable development

As the collapse is already at a relatively advanced stage, there is nothing anyone can do to avoid many of the nasty consequences that lie ahead. This is especially true when it comes to climate change. No matter what societies now do – even if they all stop emitting greenhouse gases tomorrow - the temperature of the planet will continue to rise and it will take centuries for the concentration of CO2 in the atmosphere to return to its pre-industrial level.

Rather than avoiding the collapse, as was possible in 1972, the challenge humanity faces today is to manage it, and to reduce its long term consequences. Neither is being done. Humanity is instead still accelerating towards a much more serious crisis, one that puts its long term survival into doubt.

Avoiding a more difficult future will not be easy. The problem is so urgent now that the task of responding cannot be left to our children or grandchildren. By then it would be too late. For humanity to survive in anything like its current form depends on what *we* do in the next 20 years. That is all the time left for humanity to change. That is how little time remains for societies to dismantle the destructive elements of their economies, and to begin to reflect on how they might build a more enduring civilisation.

Because societies have misunderstood what has been happening for so long, and as so much time has been lost, they will have to introduce far more radical changes than will be welcome. These will be expensive and will reduce the GDP of the rich world, at least for a while. If societies delay, or if they fail to make the transition that is necessary, the price will be even higher and the majority of people alive today will be consigned to a miserable future they will be unable to change.

This is the problem. In part two I will explain precisely what will happen without change.

Part 2

What happens if societies do not change

> *"Humanity must be stirred up and treated roughly for the benefit of its deliverance. Its eyes must be wounded by the true, light must be hurled at it in terrible handfuls. People must be a little thunderstruck by their own fate; this dazzling awakens them."*
>
> **Victor Hugo, Les Misérables (edited)**

Is anyone out there?

Over the last 60 years, many hundreds of books, articles, learned papers and documentary films have tried to explain the seriousness of humanity's ecological challenge. Some, such as Rachel Carson's *Silent Spring,* The Club of Rome's *The Limits to Growth* and Al Gore's *An Inconvenient Truth*, have captured the public's attention for a while.

But their message has not been understood. If it had, there would have been change. So the ecological problems have got worse and are now so bad that only radical change will work.

There are many reasons why people have not understood what is being said. Sometimes the message has been badly delivered, or the advice has been unclear, and caused confusion. Often it is because people do not want to change, especially when the outcome is uncertain. Or they worry that the change will cost too much and damage the economy. Or they think they that the problem is already being fixed through the UN's Sustainable Development Goals or the Paris Climate Accord. There are many more reasons why people have not understood what is going on, and I will explore them in this book. The main reason however, is because most people do not know about, or properly understand, the slow effect of nature's negative feedback loops.

For most of human history, societies have benefited from *positive* feedback loops, upward spirals of progress where one positive development leads to another. Wonderful inventions in science and technology have reduced infant mortality. Better medical care as well as improvements in agriculture have extended lives. These have increased the population and brought economic growth. This is a positive feedback loop. Another is when business investments create new jobs. These increase the amount of money people have to spend and boosts demand. This leads to more economic growth which stimulates further investment and creates more jobs.

Negative feedback loops work the other way. When inflation is too high, for example, consumer spending falls. Then people lose their jobs and the economy goes into recession. The system spirals downwards. This is a negative feedback loop.

Modern societies have very little experience of nature's negative feedback loops. For centuries, human progress has had very little lasting ecological consequence. Societies have dug, fished, slaughtered, felled, detonated and burned their way to higher levels of development and the effect on the planet has been almost zero. Nothing much has run out, other than some whales and fish. Although some rivers and the atmosphere have been badly polluted for a while they have mostly recovered. Animals like the dodo have disappeared but to little obvious ill effect. Forests have been cut down, but others have been planted to replace them.

Because human activities have been within nature's boundaries, societies have assumed that they can do pretty much what they like. Unfortunately, this has recently changed. Because the human population has increased so rapidly, and in such a short time, the pace and scale of its ecological destruction has greatly accelerated.

The damage over the last 50 years has been on a much larger scale than ever before.

As a result, humanity has set off a very large negative feedback loop and nature's reaction is increasingly visible. The most obvious sign is climate change, though it is also clear in the rising acidity of the oceans and through accelerating species loss. Glaciers and the polar ice caps are melting, and there are more violent storms and prolonged droughts. Sea levels are rising, and the pace is accelerating.

Addressing this problem is difficult because it is happening on such a vast scale that it is very hard for most people to understand. The entire planet is changing but nature's response is also moving at such a slow pace in human lifetime terms that it is very hard for most people to see. The change has actually been happening at lightning speed in planetary time.

For human society however, it may take another generation for the full effects of the change to become blindingly obvious to everyone. The slow rate of change also means that it will take a very long time for any corrective action to work.

For all these reasons, and others, it is very hard for most people to grasp what is going on. Because the changes to the planet are happening so gradually, and because the consequences of climate change are larger than most people can imagine, and they appear to be far into the future, societies have failed to see how quickly they need to act.

The challenge humanity faces is not to stop what is happening. That is impossible in any time frame most people can relate to. The task is instead to manage the negative feedback loop as much as possible – and avoid it getting out of control.

To understand why, it is first necessary to understand the basic facts about what is happening, and what will happen without change. Perhaps surprisingly, it is possible to predict what will happen in the coming decades with considerable accuracy.

Waiting for nature to catch up

As a result of the industrial revolution and the growth in the population in the last 200 years, humanity has been releasing ever-larger quantities of greenhouse gases. These are called greenhouse gases because they trap some of the heat from the sun, like a greenhouse. Rather than ripening tomatoes and strawberries, this greenhouse is warming the planet.

The main gases responsible for the warming are carbon dioxide (CO2), methane (CH4), and nitrous oxide (N2O). Other greenhouse gases include the fluorinated gases which are often substitutes for the ozone depleting gases which governments agreed to phase out in the 1980s. Levels of water vapour in the atmosphere have been rising steadily as well, and they also have a warming effect. But these are a result of climate change, not a cause. Because warm air holds more water vapour than cool air, it increases evaporation from the ocean while drying out the land, leading to more rain and snow. Water vapour amplifies the effect of the other greenhouse gases, and—importantly—will remain in the air until the surface temperature sinks. That process will take a very long time indeed—hundreds of years. The water vapour will still be there long after humanity has stopped emitting greenhouse gases, kept in place by its own warming effect.

Most of the CO2 in the atmosphere comes from the oceans. It is also produced when animals breathe, when plants decay, through volcanic eruptions and in a number of other ways. These are natural sources of CO2. Once it is in the atmosphere, the gas is slowly re-absorbed by forests and plants through photosynthesis, and by the oceans, though all this takes a very long time.

Since the late 18th century, the level of CO2 in the atmosphere has increased by more than 45%, and almost all of this is because of human activity. Before the industrial revolution the concentration of CO2 in the atmosphere was around 280 parts per million (ppm). Today it is around 410 ppm[2] and growing by 2-3 ppm a year. By far the biggest new source of CO2 is from burning coal, oil and natural gas – fossil fuels. Most of the rest comes from agriculture, especially from land clearance and deforestation, as well as from cement production. Because more CO2 is being released than nature can reabsorb, the excess is building up in the air above us[3], trapping some of the heat from the sun and causing a gradual warming of the planet.

As the natural rate of re-absorption of CO2 is extremely slow, the additional CO2 that has been released will remain in the atmosphere for centuries. This is one reason why climate change will remain a problem, even if humanity stops emitting CO2 tomorrow.

After CO2, the next most important greenhouse gas is methane.

[2] https://www.co2.earth/ accessed 12 April 2018

[3] Global Carbon Budget Presentation 2017, slide 44, adjusted

Although methane is present in the atmosphere in much lower concentrations, and only stays there for around ten years, it has about 30 times the warming effect.

Since 1750, methane concentrations in the atmosphere have risen from around 720 parts per billion (ppb) to around 1,850ppb[4] - they are now 2.5x the pre-industrial level and the highest they have been in 800,000 years.

Methane is released naturally during organic decay and through volcanic activity, but it also released through human activities - from landfills, from farmed animals digesting their food and during the production of fossil energy. Today, man-made emissions account for around two-thirds of the methane in the atmosphere.

An additional source of methane has emerged since 2014.[5.]

[4]US National Oceanic and Atmospheric Association https://www.climate.gov/news-features/understanding-climate/after-2000-era-plateau-global-methane-levels-hitting-new-highs

[5]Phys.org, Thawing permafrost produces more methane than expected, March 2018; The Guardian, July 20, 2017: https://www.theguardian.com/environment/2017/jul/20/hell-breaks-loose-tundra-thaws-weatherwatch

Thanks to global warming, and another negative feedback loop, the permafrost in northern Canada and Siberia has begun to melt, releasing the gases which have been trapped in the ice for tens of thousands of years. As well as high levels of methane, large quantities of CO2 have also been released. On Siberia's Yamal Peninsula deadly anthrax spores have been set free too, infecting local reindeer herds.

The third main greenhouse gas, nitrous oxide, or laughing gas, is released during agricultural and industrial activities, as well as through fossil fuel combustion. Its warming effect is around 300x that of CO2 and it stays in the atmosphere for around a century. The concentration of N2O was reasonably steady for 800,000 years, at around 260ppb. In the last hundred years it has risen by more than a third, to around 330ppb today[6].

Have we come all this way just to blow it all now?

Today, the concentrations of all greenhouse gases in the atmosphere are higher than they have been for hundreds of thousands of years.

[6] US Environmental Protection Agency. https:// www.epa.gov/climate-indicators/climate-change-indicators-atmospheric -concentrations-greenhouse-gases

The rise in concentration is also accelerating, with human CO2 emissions increasing by 90% since the 1970s[7]. Most of this is from burning fossil fuels for heating, cooling, electricity, industry and transport. Emissions are currently generated mostly by China, the United States, the EU and India, though historically, over the last 150 years, most have been produced by the United States and Europe, notably the UK.

How the emissions break down, 2014

Emissions by gas

CO2, fossil fuels and industrial processes,	65%
CO2, forestry and other land use	11%
Methane	16%
Nitrous Oxide	6%
Fluorinated gases	2%

Emissions by economic sector:

Electricity and heat production	25%
Agriculture, forestry and other land use	24%
Buildings	6%
Transportation	14%

[7]EPA. https://www.epa.gov/ghgemissions/global-greenhouse-gas-emissions-data

Industry	21%
Other energy[8]	10%

Emissions by country[9]

China	30%
United States	15%
EU-28	9%
India	7%
Russian Federation	5%
Japan	4%
Other	30%

Source: IPCC[10]

Cumulative emissions by country, 1850-2007

US	29%
China	9%
Russian Federation	8%

[8] Fuel extraction, refining, processing, and transportation

[9] Boden, T.A., Marland, G., and Andres, R.J. (2017). National CO2 Emissions from Fossil-Fuel Burning, Cement Manufacture, and Gas Flaring: 1751-2014, Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, U.S. Department of Energy, doi 10.3334/CDIAC/00001_V2017.

[10] Based on global emissions from 2010. Details about the sources included in these estimates can be found in the Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change

Germany	7%
UK	6%
Japan	4%
France	3%
India	2%
Canada	2%
Ukraine	2%
Other countries	18%

Historical emissions per person, 1850-2007

Luxembourg*	1,429 tonnes
UK	1,127 tonnes
US	1,126 tonnes
Belgium	1,026 tonnes
Czech Republic	1,006 tonnes
Germany	987 tonnes
Estonia	877 tonnes
Canada	780 tonnes
Kazakhstan	682 tonnes
Russian Federation	666 tonnes

Source: World Resources Institute[11]

[11]https://www.theguardian.com/environment/2011/apr/21/countries-responsible-climate-change

**The high level of emissions in Luxembourg is mostly due to transport emissions. These are calculated according to the quantity of fuel sold in the country not the amount burned there. Luxembourg is small and many motorists buy fuel as they pass through, which greatly overstates its emissions per head.*

The concentration of these gases in the atmosphere will continue to rise no matter what society now does. Even if humanity stops producing them tomorrow, nitrous oxide will still leak from the fertilisers ploughed into soils, methane will continue to be released from landfills and CO2 will be emitted from the forests that have been cut down. The climatic effects of the gases released in recent decades will also grow, because of lags in the atmospheric system.

So far the additional gases have caused a rise in the average global surface temperature of around 1°C, from an average of 14°C during the 20th century to 15°C today, though this varies by region. In some regions the change has been much greater. The rate of increase has also doubled in the last 50 years. A 1°C rise may not sound much, but it is a very big change indeed. Think of the planet like a human body – another finely tuned biological mechanism. When the average temperature of our bodies rises from 37°C by 1°C it is medically classified as a fever. When it rises by 2°C, to 39°C, our lives are in danger.

The Intergovernmental Panel on Climate Change (IPCC) advises that the total increase in average temperatures should be kept below 1.5°C (compared to pre-industrial times) for fear of the long term consequences. Throughout the scientific community there is a consensus that it must stay below 2°C. This is because a 2°C increase would eventually take the planet back 10 million years in atmospheric time. Most of the ice would melt. If the average temperature is allowed to rise by 4°C, which is the current expectation in 2100 unless there is change, the planet's atmospheric history will be pushed back more than 40 million years, to a time when there were no icecaps and no glaciers at all. But it is important to understand that this melting will be extremely slow. It will take centuries. If the increase in the average temperature reaches 4°C the process will be unstoppable, however.

Unfortunately, given the lags in the system and the fact that greenhouse gases will continue to be emitted for years after humanity stops producing them, it is impossible for the increase in average global temperatures to be kept below 1.5°C any longer[12].

[12] If the world does not change radically by 2020, the 1.5ºC increase in average

Because of lags in the system, the full impact of this change will not be felt until the early to mid 2030s. But then the planet will pass through one of the tipping points which IPCC says humanity should avoid. A consequence is that most of the world's coral reefs will die.

Unless we take radical action soon it will also be impossible to avoid the 2°C increase in average global temperatures which will have much more serious consequences. We know this through two calculations.

Climate scientists have said that if the concentration of carbon in the atmosphere reaches 450ppm then a 2°C increase will become inevitable. The concentration was 410ppm in 2018[13] and rising by 2-3ppm a year exponentially. Simple arithmetic shows that if this continues, the 450ppm level will be breached in the mid-2030s.

That does not mean that average global temperatures will be 2°C above the pre-industrial level in the mid-2030s.

temperatures will become inevitable. It will not be reached until around 15 years later – in the early to mid-2030s. So this statement is based on the assumption that there will not be any meaningful change globally by 2020. See https://www.theguardian.com/environment/2017/jun/28/world-has-three-years-left-to-stop-dangerous-climate-change-warn-experts

[13]Accessed 7 May, 2018, 410.31, see co2.earth

Thanks to the lags in the system this will happen around 15 years later. But it means that, unless there is change, by the mid-2030s the 2°C increase in average global temperatures will be impossible to avoid.

Another way to calculate the risk is in terms of total carbon emitted. From 1850 to 2017 humanity emitted just over 2,140[14] Gt of CO2.

Society currently emits 37 Gt through the burning of fossil fuels each year, with a further 6 Gt due to changes in land use. To avoid 2°C, scientists say that humanity's remaining carbon budget must be restricted to less than 720 Gt of emissions. This is less than 20 years at current rates of production. It leads to the same 2°C threshold year, 2035.

Even then, according to the IPCC, because of uncertainty about the complex feedback loops, there would still only be a 66% chance of meeting the 2°C target[15].

[14] IPCC report 2014. Also https://www.cicero.oslo.no/en/carbonbudget-for-dummies. See also https://www.carbonbrief.org/analysis-only-five-years-left-before-one-point-five-c-budget-is-blown – written in 2015 using NASA data, that show that we have a two-thirds chance of staying below 1.5 degrees if we stop generating CO2 emissions by 2021.

[15] https://www.carbonbrief.org/analysis-four-years-left-one-point-five-carbon-budget See link to google doc calculation.
https://docs.google.com/spreadsheets/d/1GJSvGUtvgQifLYM0CUVJywaaTdSUJQjFq3qr5eC_Dzg/edit#gid=372766592

If humanity is willing to reduce the chance of staying below 2°C to just 50% it has slightly longer: it has until around 2043 (as of 2018) at *current* emission levels. If greenhouse gas emissions rise, there would be less time.

To wait until then would be extremely risky, however. It would take a very big gamble with humanity's future. Would you get on a plane if it had a 50% chance of it reaching its destination?

In summary, unless there is a very large reduction in the level of emissions, the concentration of greenhouse gases in the atmosphere will reach the critical level for a 2°C rise in the average global temperature in the mid-2030s. The chance of staying below 1.5°C, which is what the IPCC and Paris Climate Accord recommend, has effectively gone.

Like a major nuclear war, just different

The 2°C increase is so dangerous because it will cause another tipping point to be crossed, kicking off a much more serious chain reaction. The West Antarctic Ice shelf and most Greenland ice will disappear, as will all Arctic ice, though this too will take a very long time.

With less ice, which reflects heat, the earth will absorb more of the sun's energy. Sea levels, which are currently rising due to thermal expansion[16], will rise much more as the land-based ice melts. The huge Siberian and Canadian permafrosts will also dissolve faster, releasing the huge quantities of methane and CO2 trapped beneath. The rainforests will gradually dry out and die, releasing even more CO2.

Once the 2°C limit has been breached, the effect of these changes mean that rate of warming will continue to accelerate, to almost 4°C by the end of the century and even higher after.
There is then a worry that the great ocean currents, known as the Thermohaline circulation, might breakdown, resulting in even greater temperature shifts.

These changes are so large that it will be almost impossible for human life to continue in anything like its current form. According to the World Bank, a change of 3°C to 4°C is "incompatible with an organised global community".

[16] Sea level rises so far have mostly been the result of thermal expansion. According to the IPCC this occurs when water at higher temperature or under greater pressure (i.e., at greater depth) expands. It is not because of an increase in the volume of water. The main threat in the future is from land ice melting which will add to the volume of water in the oceans.

The Potsdam Institute in Germany says that it would be difficult to sustain a human population of more than 1 billion in such circumstances. This is nearly a 90% reduction in human life. Other estimates suggest that barely 500 million people could survive[17], saying that this sort of temperature increase is "beyond adaptation"[18].

Nor do these projections account for the consequences of the conflicts which will arise as people fight for their survival, as they battle for access to water, food and shelter in the face to rising sea levels and droughts.

Even under the IPCC's most optimistic projections, to keep the increase in the average temperature below 2°C, humanity will need to remove much of the CO2 that has been released into the atmosphere so far.

[17] Kevin Anderson, then Deputy Director, Tyndall Centre for Climate Change Research, 2009

[18] Prof. Anderson considers that "a 4°C future [relative to pre-industrial levels] is incompatible with an organised global community, is likely to be beyond 'adaptation', is devastating to the majority of ecosystems, and has a high probability of not being stable" (Anderson 2011). He says: "If you have got a population of nine billion by 2050 and you hit 4°C, 5°C or 6°C, you might have half a billion people surviving" (Fyall 2009). See Disaster Alley Report, Dunlop and Spratt July 2017

This will require the use of Carbon Capture and Storage (CCS) technology on a vast scale. The International Energy Agency estimates that 3,400 CCS plants will be needed globally by 2050[19].

These will have to run at full power for many decades to reduce the concentration of CO2 in the atmosphere to safe levels. The technology to do this remains in its infancy, however. It is also expensive and there remain questions about who will pay for it and how the gas that is collected can be properly stored so that it will never be re-released.

An alternative way to store the excess CO2 is organically. It can be stored by growing lots of trees. The trouble with this approach is not just the number of trees it would take (the US alone would need nearly 500 billion[20] trees to offset the CO2 it has released) however, and how long it would take for them to grow, but the fact that trees would still be a temporary store. Trees mostly live for decades, or sometimes for centuries, before they die and re-release their carbon.

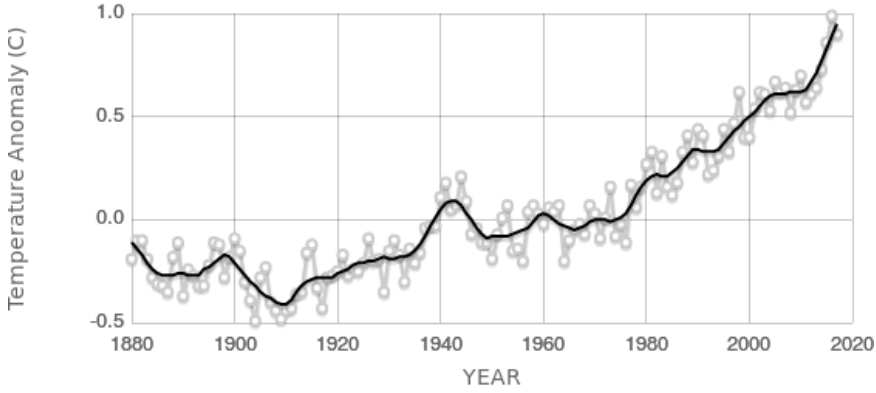
[19] http://www.ccsassociation.org/why-ccs/

[20] https://greenismything.com/2015/06/23/howmanytrees/

Humanity needs to find a CO2 store that can last forever. A further problem is that climate change is making life stressful for many trees, such as those in tropical rainforests or the ancient African baobab, and shortening their lives. Nor do trees solve the problems of ocean acidification or remove the other greenhouse gases from the atmosphere. At best, they are a partial and temporary solution to the problem.

Chart 2

Increase in average global temperature, 1800-2018



Source: climate.nasa.gov

Unless there is radical change during the next 20 years, sea levels will rise by almost a metre by the end of this century and by as much as 70m in the following centuries.

But even a one metre rise will bring very difficult consequences for much of Bangladesh, China's Pearl River Delta, Jakarta, New York, Miami, London, the Netherlands, Shanghai and many other places, with tens of millions of people displaced.

* * *

At this point I suspect that many of you will be feeling a little shocked and asking yourselves how the outlook can be so awful when so much money is being diverted to fix the problem. How can it be so bad when there is so much renewable energy being developed, so many electric cars are being built and there is so much international effort to respond to the challenge?

Unfortunately, all these efforts have achieved almost nothing so far, and they will certainly not achieve anything like enough change in the next 20 years. Despite all the investment in renewables, greenhouse gas emissions are at record levels and still rising. The volume of plastics in the oceans continues to grow, while ever more species are dying. While a great deal of money has been ploughed into renewable energy, humanity still generates more than 80% of its power from coal, oil and gas. With current and planned investments most energy will still be produced from these fuels well beyond 2030.

Electric cars are actually making the problem worse in many places, by *increasing* the volume of CO2 emissions. In China, where most of the electricity they need comes from coal, and even in much of Europe, electric vehicles add to the carbon footprint.

The UN's Sustainable Development Goals are also deeply flawed and inconsistent. The 17 goals and 169 targets promote further economic growth and industrial development, reinforcing the idea that the core of humanity's world view will not need to change. They call for economic growth to eradicate poverty and hunger, but also seek to protect life on earth, which is incompatible.

The SDGs are a good step, but not yet in the right direction. Similarly, the Paris Climate Accord will not avert a climate disaster, even if every country were to stick to its emissions commitments. It would still lead to a 3°C increase in average global temperatures by the end of the century.

Without radical change, the overall picture is one of a brewing catastrophe, a world where the first generation in human history will have a clear idea of what its children will inherit: runaway climate change and conflict.

The fossil fuel business says no

Another reason why the situation is not well understood is that there is still considerable debate about the pace of the emissions reduction needed to avoid the 2°C limit. Some climate experts have argued for cuts of as much as 9% a year.

As emissions and energy are so closely correlated with the size of the economy – they currently rise and fall together – this suggests that societies would need to reduce GDP by around 9% a year too, unless they can substitute dirty industrial sectors for clean ones in roughly equal amounts.

This is because the idea that societies can decouple, and break the link between economic output and energy consumption, has proved impossible to achieve, at least so far.

While it seemed attainable for a while, the world economy has actually re-coupled in recent years. The rise in energy production in China and India has led to greenhouse gas emissions increasing even more quickly than the rate of economic growth. Unless there is decoupling, any serious attempts to cut emissions must come from a reduction in energy use which will reduce the size of the economy, certainly in the short term.

Other climate experts argue for less radical change, with a linear transition starting as soon as possible, so that the world is carbon free by 2050. In practical terms this means that emissions would need to be reduced by a third in the next ten years, another third in the following ten and the final third in the 2040s. Put another way, the level of greenhouse gas emissions will need to fall by 3% or 1.25Gt a year. Again though, this implies something in the magnitude of a 3% reduction in global GDP each year, certainly at the start.

Other goals, notably those set by many governments, as well as the energy industry, are much woollier and less ambitious. They simply promise to be carbon free or even carbon "neutral" by 2050 (suggesting some hope to continue to burn fossil energy but offset it in some way), without providing many details.

Few appear to understand the risk of these fuzzy forecasts.
If humanity continues to emit large volumes of greenhouse gases until 2030, it will run smack against the tipping point where runaway climate change begins. If CO2 emissions continue at the 2017 rate of 43Gt a year – without any increase - the carbon budget remaining in 2030 will be enough for just four years. That is how long would be left for emissions to be reduced to zero, to avoid runaway climate change.

The longer society waits, the more disruptive the transition will be, and the more expensive in terms of lost jobs, stranded assets and social upheaval. If countries get serious by 2020, and cut emissions by 1.25Gt a year[21], the transition period can be stretched to as much as 30 years. If societies only begin to tackle the problem earnestly in 2025, the rate of reduction in emissions will have to be much greater – 1.7Gt per year – 40% more – if the target is to be achieved.

The slow pace of change so far has been greatly hindered by the high cost of renewable energy, though solar is now cheaper than fossil in some parts of the world and wind is becoming more price competitive. Investment in renewable energy has increased hugely since 2004 with another 160 GW commissioned in 2017 at a cost of just under €280bn[22]. Almost half of this was in China. It brought the world's total renewable capacity to 2,200GW[23].

[21] 3% of the 2017 CO2 emissions of 43Gt)

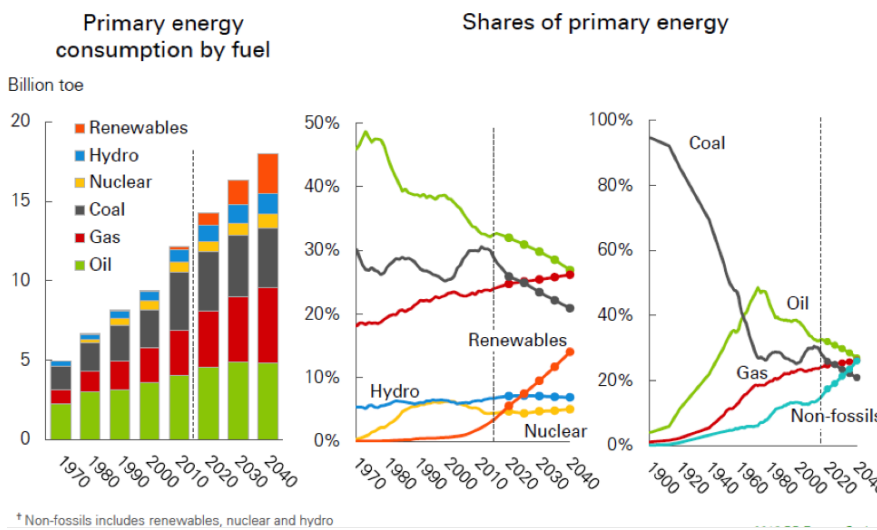
[22] Global Trends in Renewable Energy Investment Report 2018 http://fs-unep-centre.org/publications/global-trends-renewable-energy-investment-report-2018

[23] Renewable Energy Policy Network for the 21st Century (REN21) https://unfccc.int/news/another-record-breaking-year-for-renewable-energy

But the fossil energy sector is still adding capacity too, with another 70GW brought online in 2017[24]. More than half of this, 40 GW, was in the most polluting sort of fossil energy, coal.[25]

Chart 3

BP's forecasts for primary energy consumption and shares by source



Source: BP Energy Outlook, 2018

[24]https://renewablesnow.com/news/world-adds-98-gw-solar-70-gw-fossil-fuel-power-capacity-in-2017-608196/

[25]IEA https://www.iea.org/publications/wei2017/

With investments in fossil energy still growing by more than 2% a year, its total capacity is predicted to reach 5,300GW by 2030. Although there will be more investment in natural gas, which is arguably cleaner than coal, most industry forecasts suggest that CO2 emissions from fossil energy will be higher in 2040 than they were in 2017 based on current trends. BP still expects almost 70% of energy to come from coal, oil and gas in 2040 (see chart). Yet emissions would need to be at least 80% lower by then if society is to stay below the 2ºC limit.

To do what is needed, and replace the world's fossil-derived energy with renewables by 2050, will cost a lot of money - another reason for inaction. Assuming the 2017 cost of renewables is eventually halved, it will cost almost €4trn - 7% of global GDP. While this sounds a lot, spread over several decades it should be easily manageable.

But the transition would still leave trillions of euros in stranded assets, either in unexploited coal, oil and gas reserves or in the fossil energy production plants and refineries that will need to be closed. It would require society to completely upend the plans of one of the biggest and most powerful industrial sectors in the world.

Without radical change, the existing plans of the renewable energy sector will achieve only a tiny fraction of what is needed. To stay below 2ºC requires much more serious action and much sharper and more urgent cuts in fossil energy use. Humanity needs to be a lot more realistic about what is needed.

The climate deniers have also hindered change, of course.
Arguing that what is happening to the climate is part of a normal cycle, citing temperature variations in the past, including the Medieval Warming Period and the Little Ice Age, these people have encouraged others to question the science.

Yet the reasons for these past temperature variations are well understood. What is happening today is completely different. The speed of the change, in the level of emissions and the temperature, as well as its geographic extent, is without any precedent. Scientists know there is more carbon being stored in the trees, oceans, and atmosphere, and that this can only come from burning fossil fuels. They know too that there is less heat escaping into space, because a tiny fraction of the sun's energy is being trapped. Without any other obvious cause, such as a volcanic eruption, the current changes cannot be the result of a natural phenomenon. They must be the result of human activity.

The consequences of this warming effect are also becoming ever more obvious. The number and severity of storms has increased markedly in many parts of the world, and countless temperature records have been broken. Insured losses from natural disasters have increased threefold in the last 30 years, while migration from parts of the Middle East and Africa has increased as droughts and dust storms have spread. These have forced people to move from the land, raising ethnic and social tensions, and spurring many people to seek political or economic asylum in Europe or southern Africa.

Without change, it is the poor world that will suffer most in the next few decades. In areas prone to drought such as Mexico, western South America, southern Europe, China, Australia and South Africa, rainfall will decline markedly. This will cause water shortages and, in many parts, it will not be possible to offset these by using groundwater supplies, many of which are already in distress.

While agricultural yields will increase in northern Europe, Russia and Canada, at least for some crops, and it will be possible to cultivate fruits and vegetables that did not previously grow in these regions, many areas will become too wet to grow much.

Wine growing will no longer be possible in parts of northern Italy and South Africa, because of excess early summer heat or lack of water. The cost of paper pulp will rise as forest fires reduce supplies, with consequences for many basic products – such as tissue and toilet paper.

Many coastal towns and cities will experience more floods and buildings will be washed away. Soft stone cliffs will crumble. Heatwaves will last longer. Many towns and cities, such as Hong Kong and Singapore, will become increasingly unpleasant places to live: too hot and too wet. Countries around the Mediterranean will become too dry and hot to grow much food. The olive tree band [the narrow range of latitudes where the trees can only grow] will move north and south but leave a gap in the middle.
The number of migrants from Africa, central America, the Mediterranean, Bangladesh, much of India and many other countries will increase, providing not just logistical challenges to recipient countries, but moral ones too.

Some countries will be left without power as well as water. The incidence of diseases such as malaria and dengue fever will rise as will the problem of insect infestations. Yields of staple crops will decline while harvests will become less certain.

Human life expectancies will fall in some countries due to more intense heat, less water and less predictable harvests. Thousands of species will die. Thanks to the high concentration CO2 in the seas, which increases acidification, the volume of shell-forming animals will decline sharply too.

Some changes will appear strange. Temperatures will fluctuate wildly at times, with weather phenomena appearing in seasons where they are not usually expected. It will snow in places it has not before and winds will have unprecedented levels of destructive energy. Jellyfish will clog the pipes of nuclear power stations and buildings will be weakened by extremes of wet, dry, hot and cold. The rainforests will gradually dry out, and die. Rather than being carbon sinks they will release their CO2, and add to the problem.

What we consider to be a growing inconvenience today will gradually become a global danger, though the process will happen so

slowly that even this will become the “new normal”. The human lexicon will become dominated by words such as “adaptation” and “resilience”, though few people will understand that what this really means is “delay”.

Humanity will have to find ways to replace ecological services which were previously free, such as water from glaciers, aquifers, or fish protein. Societies will have to rebuild infrastructure destroyed by storms, relocate cities away from coastal areas and move from lands blighted by drought. They will need to use their armed forces to resist immigration and hire people to respond to more frequent emergencies. All this will have the benefit of creating economic growth, just not very useful growth.

Without change, global average temperatures will be almost 4°C higher by the end of the century. For a few decades after they will fall, as large areas of the icecaps and the glaciers melt, cooling the seas and oceans. By the mid-2100s, global temperatures will be rising again, and the warming will continue for many centuries. It will take thousands of years before they return to the levels necessary for human life to prosper.

This is what can be expected without change.

Social and economic stasis for the rich world

What will happen socially and economically? The economic outlook for societies can be predicted pretty accurately too, also by looking at very long term trends.

While the human economy changes much faster than the planet's atmosphere, there are underlying factors that evolve very slowly and over many decades too. Only rarely do these experience sudden shifts, and these are mostly temporary. So what do the long term trends say?

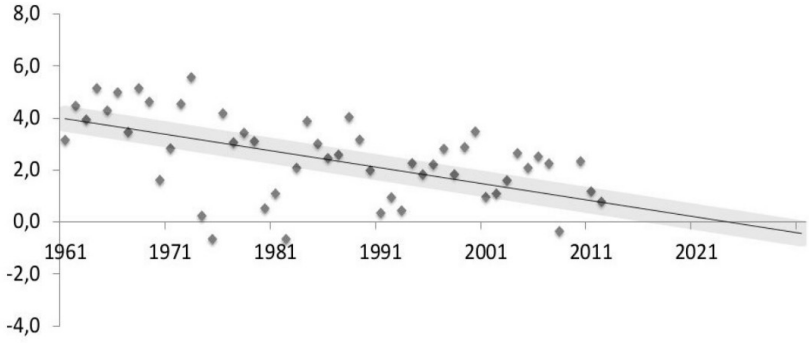
After the Second World War the rich world enjoyed a particularly healthy period of economic growth for more than 50 years. This was greatly stimulated by the need to rebuild, by the baby-boom of the 1950s and 1960s and latterly by globalisation. Since 2008 however, the pace of economic growth has slowed dramatically. This slowdown was the result of changes that are both short term and structural.

The main short term reason for the long slowdown is the enduring effects of the financial crisis, which was particularly serious. Even ten years later, high levels of public and private sector debt are a constraint on the rate of recovery, despite interest rates being kept at record low levels and central banks flooding economies with money through the process known as Quantitative Easing.

There are two long term structural reasons for the prolonged slowdown however, which are generally poorly understood, even by many economists.

The first reason is the steadily declining birth rate in the rich world. Economic growth is greatly dependent on a rising population. When the population shrinks, as is happening in Japan, or grows very slowly as is happening in many parts of Europe, the pace of economic growth naturally slows too.

Chart 4 GDP growth per head, OECD



y-axis is rate of GDP growth in percent

Source: P.A. Victor 2014, World Bank data for high income countries. See also, Victor, P.A. *Managing without Growth. Slower by Design, not Disaster*, second edition, Figure 2.1, Edward Elgar Publishing 2018

Secondly, economic growth has become much harder to achieve in the rich world because of long term changes in the composition of the economy.

Chart 4 shows the rate of economic growth per person has already been slowing in the rich world for a very long time – almost 60 years. As this trend will continue, the rate of economic growth per head in the rich world will soon begin to shrink.

Because of its ageing and declining population, Japan has experienced the consequences of this trend before other rich world economies. Europe has only experienced the early effects of the trend over the last decade or so. The US will not see the consequences for some time, perhaps another decade.

Averaged across the OECD however, the rate of growth per person will turn negative in the early 2020s. Put more simply, the GDP per head will start to decline. In countries with static or falling populations, such as Germany, Italy, Hungary, Greece or Romania, the overall economy will begin to shrink too. This decline will accelerate throughout the 2020s.

Asset prices will also fall – the value of houses, cars, shares and office buildings will drop - just as they have in much of Japan, for the simple reason that there will be more people wanting to sell these items than the number wanting, or able, to buy them.

This gradual transformation is happening because of ageing populations too. But also because of long term changes in the composition of rich world economies.

During the course of the industrial revolution the rich world first shifted from having economies that were mostly based on agriculture to having economies that were mostly based on manufacturing. They then shifted from being mostly based on manufacturing to being mostly based on services. Today they are moving into the fourth stage of economic development, becoming mostly based on personal services and care.

The transition from one stage to the next has been mostly driven by what economists call technological substitution. Farm workers were replaced by machines and so went to work in factories.
Factory workers were subsequently replaced by machines, as well as more recently by computers and robots. Today, it is the service sector, in offices and banks, where workers are mostly being replaced by new technology.

It is this transition that has changed the structure of rich world economies, and their long term growth prospects. Each of the major economic shifts – from farming to factory, from factory to services, and from services to care – has created economic growth. But the rate of growth has declined with each stage because the opportunity for boosting productivity falls. It is much easier to boost output per person when people move from the fields into factories. It is harder when the economy is larger and when the shift is from manufacturing into services. It is harder still when the economy moves from services into care, knowledge and personal services, as is happening today.

Put more simply, it is hard for someone to look after an elderly person faster, and so boost their productivity. It is hard to cut hair faster or to play the violin in a symphony more quickly than the conductor demands. Boosting productivity, which is essential for economic growth, is much harder in the fourth stage of economic development than in the first stage. This means the rate of economic growth is lower.

Since the start of the industrial revolution, rich world economies have gradually mechanised, computerised and robotised almost everything they can. Today, it is people working in accounting, legal research, and much of the finance sector who are being replaced by clever algorithms.

But the number of jobs left to mechanise is declining. Although new business sectors are emerging, such as internet services, these tend to employ fewer people than the major economic sectors of the past. So rich world economies are being left with the jobs which cannot be easily automated. They are being left with the work that require dexterous hands and clever minds in non-repetitive work, or people whose job it is to care for others.

The current wave of robotisation will continue to create economic growth for many years to come, of course. But the rate of growth will continue to slow because there are fewer ways to boost productivity, to become more efficient. Eventually, rich world economies will be built on jobs where increasing mechanisation is almost impossible, or certainly undesirable. A child minder cannot look after a baby in a way that boosts national productivity, in a way that creates faster economic growth.

So the rate of economic growth in the rich world will continue to fall, and eventually decline (so economies will shrink), continuing the trend of the last 60 years. It is for this reason, more than any other, that economic growth in the rich world has been so moribund for the last ten years, and why stimulating it has been so difficult.

Because the economies of the rich world have changed structurally, outdated ideas such as cutting interest rates and printing money have had almost no impact. They have not spurred any growth.

This means that the economies of the rich world will stagnate and then shrink unless they are radically restructured. Putting some figures on it, the average rate of economic growth in the rich world will be just 0.6% a year [26] for the next two decades. Most of this will come from the United States because it has a younger population. From the mid-2020s Europe's economy will actually shrink, following the path of Japan.

The rich world's economy will shrink as a whole after 2035, unless there is change.

[26] Based on Randers 2052 model, CAGR from 2015 to 2035, GDP rising from $37trn in the rich world (OECD) to $41.5trn.

At the same time, these economies will experience another transition, and this will reduce the level of conventional consumption even more. As the pace of climate change accelerates, as cities are forced to respond to more frequent heatwaves, rising sea levels, and the flow of migrants from drought afflicted regions, and as insurance companies stop offering cover to farmers, businesses and households, the state will need to step in.

National and local governments will be forced to respond to problems which the free market cannot fix. To cover the costs of hospitalising those affected by heat, build new sea walls, house migrants and become the insurer of last resort, taxes will have to rise.

Put another way, money will be diverted away from consumption. Rather than buying cars, flat-screen televisions and clothing, people's incomes will be used by the state to provide hospital beds and build stone dykes. So the rich world's economy will gradually undergo another sort of structural change, which will further reduce demand in the traditional sectors of manufacturing, services and retailing that dominate today.

So rich world consumption will come under pressure. It will be squeezed by stabilising populations, and by the impact of these ageing, by the continued shift in the economic structure towards low

growth sectors and by the need to respond to the challenges of climate change. No matter how much money is printed by central banks or how far interest rates are cut, conventional economic growth will be weak or non-existent and the outlook for most traditional business sectors in the rich world will deteriorate. There will be new opportunities, of course, in sea-wall construction, the energy transition, low cost housing, carbon capture and many other areas. In GDP terms, these may even compensate for declines elsewhere. For many traditional businesses though, the economic outlook in the rich world is relatively bleak.

Migration, inequality and anger too

Understanding what will happen to the climate and the economy makes it relatively simple to predict what will happen to society. As the current economic system widens inequality, the poor will continue to get poorer while the rich get richer. As wealth will continue to flow to the rich world, the gap between the rich world and the poor world will widen further too, continuing the trend of the last 200 years.

With lower rates of economic growth in the rich world, jobs will be harder to find. While some highly skilled jobs will be paid very well, most will be increasingly poorly paid and unstable. This is because the pool of available talent will be large and so it will be easier for employers to offer less money and demand more flexibility from their employees so that they can boost profits.

As a consequence, and after 20 years of almost no improvement in living standards, and declining living standards in countries such as the US and UK, the rich world's middle classes will be squeezed further. They will have to pay more taxes because of climate change, as well as to cover the medical costs of their ageing populations, and for higher levels of unemployment. At the same time there will be static or declining incomes, widening inequalities, and less work. People will need to accept that they are unlikely to earn more than their grandparents, in inflation adjusted terms.

Widening income inequality and poor quality employment will also have a damaging effect on people's health and life expectancies. As well as diet related problems, they will suffer more from depression and anger. There will be fear sometimes too, because of climate change.

Many people will become frustrated when they learn that there is no easy fix to the climate problem, and that it will get worse no matter what they do.

This is likely to mean that unrest and political extremism will rise too, fuelled in many countries by the struggle over how to respond to rising migration. The middle classes will begin to shrink, as the momentum which created this social group shifts into reverse.

Without a radical change in economic direction, it is hard to feel optimistic about the prospects for the majority of people in the rich world, socially and democratically in the next 30 years.
Even so, they will remain better off than most of those in the poor world, who will also experience the brunt of the atmospheric changes.

Enlightened jungle capitalism rules, OK?

Another trend which will continue, unless there is a radical change in the economic path, is that social influence and power will drift, as it has done for several decades, from the "will of the people" to the "demands of the corporates", and the finance sector.

Until the 1970s, businesses were constrained by state policies which sought to balance the needs of business and society, and by the rivalry between the western capitalist system, and the Soviet Bloc and China's communism. Since this broke down in the late 1980s, the neoliberal market system has become ever less benevolent.

As a result, the trend for politicians to put the needs of business before the electorate has accelerated. Countries now compete with each other to lower corporate taxes and so boost economic growth. They do this because they have been told that this will create jobs (or stop them being lost) and lead to a trickle-down effect which will reduce the gap between rich and poor. Business leaders across the world, with the help of think tanks and supportive free market economists, have actively encouraged politicians in this false belief, through lobbying, promising them jobs when they step down from political life, making donations and pressurising them in other ways.

The result is a widely held "common sense" idea in business and society that being pro-business is somehow good for everyone when, in reality, it is only good for the corporates, and those who own them, mostly those in the finance sector and their shareholders.

As a consequence, corporate power has become very concentrated with a relatively small number of companies able to wield enormous political and economic influence. Research at the Swiss Federal Institute of Technology in Zurich[27] shows that just 737 of the world's top holding companies control 80% of the largest 43,000 firms, worth 40% of the economic value of all corporations.

Three quarters of the members of this core group are finance firms. Of these, 147 super-entities control half the total. Most are financial institutions, including Barclays Bank, JP Morgan, and Goldman Sachs.

The power of big corporations has become so extreme that, in recent decades, it is hard to know who controls the destiny of society. This confusion has been fuelled by the media and the PR industry which have encouraged people to see businesses as part of the solution to the world's social and environmental challenges, not their cause.

[27] The network of global corporate control, Stefania Vitali James B. Glattfelder and Stefano Battiston
https://arxiv.org/PS_cache/arxiv/pdf/1107/1107.5728v2.pdf

This has led let to all sorts of strange ideas being propagated. An industrial giant such as Unilever is now viewed as an environmentally responsible model for others to follow, despite the fact that it churns out chemicals and industrialised foodstuffs, packaged inside plastics which create all sorts of environmental hazards. Conglomerates such as Starbucks, Apple and Spotify are praised for trying to change how society thinks, by spending money to enhance women's rights and increase the voice of minority groups.

Businesses like GE, which makes aeroplane engines among other things, and car maker BMW, have even been ranked among the world's most socially responsible organisations despite manufacturing some of the most environmentally destructive products.[28][29]

The big corporates have made enormous efforts to be seen as environmentally sustainable, to disguise the fact that they exist only to maximise short term profits.

[28] http://adage.com/article/cmo-strategy/10-companies-social-responsibility-core/143323/

[29]https://www.smartrecruiters.com/blog/top-20-corporate-social-responsibility-initiatives-for-2017/

As the current economic model also promotes smaller government and less regulatory oversight, especially in English speaking countries, the power of business will continue to grow unless there is a radical change in direction, as will the wrong-headed belief that the free market can solve humanity's social and environmental challenges.

Poor poor world

Much of the poor world faces an even harsher future than the rich world. While the rate of growth in the human population has declined, the number of people who live in the poor world has continued to rise quickly.

By 2030 there will be 7.5bn people in the poor world, with most of the increase coming in India, Pakistan and central Africa. This will increase the already heavy burden on the agricultural sector to boost food production and increase pressure on the world's water supplies. The economies of the poor world will also have to find jobs for the 5 billion people of working age who must work to provide care for the young and elderly.

Based on current trends, the poor world's economy will be 90% bigger in 2030 than it was in 2015 (€63trn vs €33trn).

As the gap between rich and poor will continue to grow, because there is nothing being done to reverse this long term trend, most of the new wealth will go to the richest 1%. This means that most of those in the poor world will remain very poor. At best, the majority will see their incomes rise by around 3% a year over the next 15 years. The many hundreds of millions who survive on a few dollars a day will be almost as poor in 2030 as they are now.

As most of the world's economic growth will come from the poor world in the next 20 years, lots of businesses will make investments with high expectations. Yet those hopes of making money will mostly be dashed outside the resource and food industries. Without a change in economic thinking, the number of people in the poor world with the capacity to adopt the spending patterns of the rich world will remain tiny. As the rich world stagnates economically, the poor world will grow, but not as fast as most rich world businesses want, or need.

Demand for basic items like rice, soy and grains will rise along with the population. Much more charcoal will be needed for cooking. Demand for telecoms services will grow too. But the demand for more expensive items such as cars will not, because the huge gap between rich and poor will remain.

This means that global sales of tablet computers, smart devices, Audis and exotic vacations will stall because of weakening demand in the rich world and little uptake in demand from the poor world.

The fundamental problem facing the poor world is the fact that the planet is too small, or more accurately, that humanity has allowed itself to become too big for the planetary resource base. As a consequence, many poor world societies will have to endure something like a nuclear war in the coming decades, just in a different form. The impact of higher temperatures, insecure food availability, migration, rising sea levels as well as water shortages and the increased likelihood of human conflict that will come as a result of all these challenges, will also shorten many lives. The cumulative effects of worsening air quality, water pollution and rising obesity will cut short many more.

Like frogs in a warming pot

For most of the next 30 years, and beyond, people across the world, and most other species, will live like frogs in a slowly warming pot. They will feel the temperature rising. They will be frustrated by the economic stagnation and by the rise in migration. Political discontent will grow.

People will also get angry at the failure of politicians to respond and by the self-seeking demands of corporates and the finance sector.

This is humanity's current fate without change. In part three I will look at how to avoid this future, or at least some of it.

Part 3

Dismantling the modern world

> *"Conflict is sometimes necessary to re-establish social justice, to restore liberty to the people, as well as wise governance to majority, and to ensure the of survival of a people."*
>
> **Victor Hugo, Les Misérables (edited)**

Accept reality or fight for change

For at least the next 20 years humanity has to do something it has never done before, or even attempted. Global society has to reduce its ecological footprint even though this will damage the economy and reduce living standards for many people in the short term. The world has to take a collective step backwards – and make a sacrifice - before it can move ahead.

If societies fail, the outlook is bleak. Nature will progressively fix the climate problem itself and the outcome will be much harder and much less predictable. Most of those alive today will only experience a small taste of the troubles of future generations, but it will still not taste good.

This is the biggest challenge humanity has ever faced, and it is made harder by the fact that very few people are willing to act for the long term and even fewer understand properly what is needed. The transition will require exceptional leadership, unhindered by the past. It will need vision and a single-mindedness to focus on one objective – to reduce the human ecological footprint and bring it back into balance with nature, almost regardless of the cost. It will require strength to resist the temptation of half-way solutions. And it will require different thinking. Humanity cannot behave like the whaling industry of the 19th century, where one ecological limit after another was overcome through the use of more power and technology but the end result was the extinction of the whales and the fishermen too.

Critically, humanity will finally need to accept that there are limits to what it can achieve. That will not be easy. For years, societies have been told that there are no constraints on what can be done. Limits have been viewed as hurdles to overcome, as if humans were the masters of the world. This idea has been reinforced by the apparent immensity of the earth, and its resources, and by the relative smallness of humanity and its activities.[30]

[30] The Limits to Growth Page 150

We are all birds of a feather, and would suffer the fate of endangered species unless we join hands and work together.

Dr. R K Pachauri, past Chair, Intergovernmental Panel on Climate Change (IPCC)

Not only will societies have to accept that there are constraints, they will also need to accept that these have been breached. Those who lead society will need to understand that humanity is in ecological overshoot and help their people embrace the consequences. The task is to reduce the impact of the collapse that is already enveloping the planet, and to stop making it worse. In all this there is also hope.

What societies have to do is within human capabilities. It does not require anyone to invent anything. Humans have all that is physically needed to stop the damage and create a new form of society, which can endure for generations to come. All that is required is for some people to come together and make a series of (albeit very difficult) decisions in the interests of all.

Humanity faces a social and organisational challenge. It is a question of human will, and the application of greater wisdom.

As well as the immediate need to dismantle parts of what has been built economically in the last 50 years, there is a longer term need for reflection. If societies are to find their way to a better future they will need to change what is meant by progress, democracy and power sharing. Humanity's perspective on nature, society's relationship to the climate and intergeneration equality will have to be radically rethought. Public interest will need to take precedence over individual rights, even where this challenges democracy. Freedom and self-interest will need to be redefined. The rich world in particular will need to pare back and adopt a less wasteful lifestyle, and take on the vested interests of multinationals and local elites, including those who see boosting consumption in the poor world as the saviour of their own economies. Scarcity and resource management, redistribution and respect for the world will need to become the watchwords and ideas of tomorrow.

Before I discuss the steps needed to slow the pace of collapse, there is an important caveat to explain. This book does not offer a recipe that will make everything okay.

The challenge humanity faces is too large and complex, and the damage will take so long to fix, that there are too many variables to make it possible to be prescriptive about the way ahead. This book offers a sketch of the changes that are needed and, critically, a measure of the scale of the transition, as well as an estimate of the costs. Until now, proposals to solve humanity's myriad challenges have provided very few practical steps or details about the scale of the change required. As a consequence, many people still believe a painless transition is possible. While electrifying energy systems and vehicles, shifting to renewables, eating less meat, recycling waste, cleaning up the oceans and reducing the rate of population growth might have been enough at one stage, it is too late for these ideas to have sufficient impact now. Humanity needs more radical change and every day it delays the more radical they will need to become.

The book explains the size of the change needed to get humanity out of the mud. The transition proposed will lead to a future that is better than it could be but still worse than now. It does not provide a detailed map to utopia. I wrote it to cajole societies into action and to fuel an essential debate which is currently missing. Most of the world still has its head in the sand and societies need to act, not hide from the challenge.

Not a good place to start

Before looking at the changes needed, there are two additional questions which need to be answered:

1. Why is humanity in this position?
2. Why have societies failed to do anything significant in response so far?

There are two major reasons why societies have reached this difficult place. The first is the rapid growth in the human population in recent decades, which has dramatically increased the ecological footprint. The second is the dominant economic system, the neoliberal capitalist model, which worsens the problem while largely ignoring its consequences.

The number of people in the world has grown very quickly in the last 60 years, although the rate has slowed more recently. In 1960 there were three billion people in the world. Today, there are close to eight billion. Every year the population increases by the number of people in Germany, almost seven million more each month.

There is nothing much that can be done to solve this problem unfortunately, other than improving access to contraception, improving education – especially of women – and increasing urbanisation in the poor world. Women who live in the poor world's cities may not be better off than those who live in the countryside, but they have fewer children.

What can be done in addition is to increase the level of public discussion. Today, the issue of the human population is mostly hidden under the carpet. When it is raised, it often elicits such an emotional response from a small minority that it overshadows the debate. Yet societies need to talk about the issue because it is a big part of the climate problem. Leaving nature to fix the population problem – through climate change, disease or starvation – is likely to prove short sighted. Nature's way will probably be harsher than any process societies manage themselves. The lack of debate on the subject also makes it easy to forget that around two billion people alive today are under the age of 20. Their peak resource use, and capacity to generate atmospheric pollution, still lies in the future. They are an ecological time bomb which risks making the climate problem even worse.

The lack of discussion about the number of people in the world has also led to a common misconception. The population issue is generally thought to be one for the poor world. It is certainly true that there are many more people in the poor world and many more babies are born there. But, ecologically, it is the children in the rich world who are the greatest problem. A child born in Europe or America is up to 30 times more environmentally damaging than a child born in the poor world. It is the children of the rich world who consume the most resources and create the most pollution.

Like smoking, growth kills

When it comes to the second cause, the economic system, it is the desire for endless consumption growth without due concern for the effects on the environment that lies at the root of the damage humanity has done to the planet. To continuously boost economic output has come to seem normal. Yet to achieve this growth requires a steady rise in the throughput of raw materials. To dig up these natural resources, process them, turn them into goods, transport them to shops and sell them requires energy. As most of this comes from burning fossil fuels, the process causes climate change. The drive for economic growth is the direct cause of climate change. That this growth has become viewed as necessary has made it very hard to manage.

The current system of human development views nature as something to be exploited, to create financial value for humanity. The oceans, forests and ice caps have no value beyond the resources they provide. A tree is a piece of timber, a melted ice cap is a shorter shipping route. It is not just that the constant push for economic growth is hugely environmentally destructive. The current economic system is the source of many of humanity's social problems too. It increases long term unemployment and widens inequality. As these problems are more urgent in the short term, and get more media attention, they stop governments from addressing the climate problem.

Businesses are in a constant fight to cut costs and become more efficient. This forces them to mechanise jobs whenever possible, to boost profits. Unless new work is created by other firms – which has not happened fast enough in the last 30 years in the rich world – unemployment rises. This is why unemployment in much of the rich world has increased in the last 30 years, despite it experiencing the fastest economic growth in modern history.

The coming wave of mechanisation and robotisation risks making this unemployment problem worse.

The desire to cut costs has also led to incomes and living standards stagnating or declining in much of the rich world, with millions worse off today than 30 years ago. As business profits have risen, the rich have got richer with the result that the gap between rich and poor is wider today than it was in 1914[31].

The gap between the rich world and the poor world has also widened, as profits have flowed from countries dependent on resource extraction to those with higher added value. It is wider today than in 1820. The trickle-down effect, where the wealth of the rich is meant to gradually flow into the pockets of the poor, is a myth. Under the current system, the opposite happens. The poor and the planet serve the economy which then rewards the rich.

The global footprint and overshoot

Thanks to the push for ever greater output, humanity has been living in ecological overshoot since the mid-1980s. Globally, humanity lives as if it had 1.7 planets today - 70% beyond the sustainable level[32]. Americans live as if they had five. Most of Europe lives as if it had three. It is the poor world that lives within the boundaries of nature, despite having a much higher population.

[31]OECD report on inequality, October 2014, Table 11.4

The poor world has a different problem. For the rest of the world to achieve the same standard of living as exists in the rich world today would require three additional planets. That is what would be needed to provide the additional resources and absorb the additional pollution. It is simply not possible using the current approach to development.

When people understand the overshoot problem, as well as the urgency of the climate challenge, they frequently respond by wanting to "save the planet". That is to misunderstand the problem. No matter what humanity does (well, almost), planet earth will be fine. It will recover from the destruction that has been wrought by human beings, although it could take many millions of years. It is humanity that is completely screwed if it continues on the current path.

[32]The ecological footprint is a measure of how many resources are consumed by societies, and how much pollution is created, compared to what is sustainable. Today, humanity uses 1.7 times the level of resources that can be sustainably replaced, globally. It also creates more pollution than nature can absorb. This is only possible for a short time, perhaps several decades. The Global Footprint Network is the source of this metric. It calculates this by measuring the ecological assets that a given population requires to produce the natural resources it consumes and to absorb its waste, especially carbon emissions.

Of course, the current economic system has also delivered a great deal that is positive, in terms of technology, higher life-expectancies, greater material wealth and more exotic vacations. The focus on economic growth has allowed many hundreds of millions of people to live better. It has served humanity well for a long time. It is just that since the 1980s it has also moved societies far beyond the limits of what is sustainable.

Why then has humanity failed to respond to the challenge it faces? Why have so many IPCC meetings, so many well-meaning NGOs and so many treaties, including the Paris Accord, not had any obvious impact? Why are greenhouse gas emissions at record levels and still rising? Why is species loss still accelerating? Why are the oceans more polluted than ever?

There are several reasons.

For people in the rich world under 40, this is mostly a question for your parents. They are mostly to blame for the place where humanity now finds itself. The post-war generation knew deep down that they were living unsustainably.

They knew that flights for a few euros did not make sense, that so much plastic packaging was not necessary and that throw-away fuelled consumption was needlessly wasteful. They understood that climate change was a serious problem.

They knew and yet most of these people did nothing.

Something similar has happened before, of course. During the Second World War, the Chinese Cultural Revolution and for parts of the Soviet era people looked away while many innocent lives were lost. Today, it is hundreds of millions of people who have chosen to ignore the destruction and injustice that surrounds them. They have turned a blind eye to the death of so many animals, fish and birds, vast plastic islands in the oceans, runaway consumption, rising selfishness, declining liberty, higher temperatures and widening inequality. This time it is not millions of innocent lives that will be lost without change, but billions. It is not a political dictator who is responsible but the managers of the oil companies, cement makers, coal producers, airlines, car manufacturers and all the others who have knowingly caused so much damage to the planet for the short term benefit of a few big investors, knowing that what they were doing was so damaging and unsustainable for all.

The managers and owners of these companies are not like those who work in the tobacco industry, who are able to hide behind the warnings on cigarette packets explaining the serious health risks attached to their products. The car makers carried on selling their products knowing that the long term consequences for many lifeforms would be very serious, and they did so for decades, actively promoting ever larger, heavier and more polluting vehicles.

The airlines pushed down their prices to boost sales, knowing that this increased the level of pollutants in the atmosphere. The fossil fuel industry continued to invest in new capacity, even exploiting the most polluting reserves, the tar sands and the heavy offshore oils. Many government ministries and politicians supported these activities, through subsidies and tax cuts. These are serious and wanton crimes against humanity and nature, or should be.

Like past generations, the majority of people did nothing to respond to the rising tide of environmental destruction because it was easier that way. They did not respond because they listened to the pleadings and denials of the rich and powerful, especially those linked to the fossil energy business. They did not respond for the fear of change and its consequences.

The difference this time is that the threat is global and existential. After so many thousands of years of progress that is more than a catastrophe. What was it all for? Just to bring humanity to this dead end? So far as we can be sure, humans are the only intelligent species in the universe. Have we come all this way to commit collective mass suicide now?

Humanity has also failed to act because it feared the financial cost, even though the wealth at risk is mostly just numbers on machines. The fear of these numbers being reduced, and the effect this would have on the rich, has been a huge disincentive for change.

The financial cost of change will certainly be very high. But it is trivial compared to the cost of doing nothing.

Societies have also failed to respond because the time has not been right. When *The Limits to Growth* was published in 1972, it was too early for a sufficient number of people to understand that the path of human development was unsustainable and that change was needed. That is no longer the case.

While an understanding of the need for radical change remains patchy, and is still only properly grasped by a tiny minority, the time for widespread acceptance appears to be closer. This may be optimistic thinking. But there seems to me to be a growing awareness of the need for a radical change in the path of human progress.

Society has also failed to act for more excusable reasons. The challenge is very hard to understand, and very long term, while the human world focusses mostly on the short term. There is also the slow impact of nature's feedback loops, which make it hard for most people to grasp the urgency. Part of the problem too has been the 'scholarly reticence' of climate scientists, who have feared seeming unscientific or alarmist. Lord Stern, the author of the British government's paper on climate change, said that this reticence is one of the main reasons why humanity has "systematically and grossly underestimated the risks [and costs] of unmanaged climate change"[33].

There are deeper philosophical reasons for humanity's current destiny too.

[33] Lord Stern, 2016, See Dunlop and Spratt Report Disaster Alley 2017, P8

It is the world view that many rich world societies have today, and which is greatly a result of Enlightenment thinking, which has proved so false. It is the belief in economic growth for its own sake, humanity's overwhelming faith in science, in rights to property, individual liberty and democracy that have led societies to where they are now. It is the belief in the free market and free trade, as well as in the idea that technology is always benign, helpful and desirable. It is the sense that there is a human right to more.

Humanity's current thinking has more recent roots too, particularly with the Mont Pelerin Society, which has pushed so hard, in so many ways, and for so long, for the free market economic model to seem normal, as if it were the only way for humans to progress. The thinking has much deeper roots too, of course, in the church and the idea that the world was created for humanity to enjoy.

Mostly though, it is the ideas of the European Enlightenment that need to be rethought, and it is those roots that societies will need to examine if they are to rebuild in the long term, or "fail better"

next time, in the words of Samuel Beckett and philosopher Slavoj Žižek[34]. For now, the urgent need is to dismantle and stop the damage that is being done, not to fix and repair. It is not yet the time to rebuild. Humanity needs to avert catastrophe before it thinks about groping its way to a better world.

Mostly well meaning but falling short

Are there not already ways to address humanity's economic and ecological challenges? Are there not proven environmental ideas such as valuing the world as natural capital, the circular economy, boosting energy efficiency, green economics, degrowth or impact investing? Can these ideas not be scaled up to solve the problem?

Unfortunately not. Such ideas have not had any impact so far and it is not likely that they could bring about change on the scale needed.

The notion of valuing nature, and regarding it as "natural capital" might seem helpful. If societies can put a price on the natural world, they can appreciate what they have in a language they understand[35].

[34] In Defense of Lost Causes, Slavoj Žižek, Verso 2017

[35] If you adopt the language and values of your opponents "you lose because you are reinforcing *their* frame", Lakoff, 1986 and Howell, 2016

According to proponents of the idea, the value of "ecosystem services" to the world economy was roughly €120trn (German billion) in 2011, more than twice global GDP[36]. This is how much societies would have to pay for fresh water, clean air and the pollution absorbing capabilities of the earth, assuming that is, humanity was capable of replacing them.

The problem is that this approach turns nature into a commodity. It makes it easy for businesses to argue that there is more value from destroying a forest and planting palm oil trees, or eradicating the habitat of a species and building a road. The palm oil and the road can easily be shown to generate a higher income than the rainforest or the home of another species.

Natural Capital(ism) offers a market and money-based approach to tackling the world's ecological troubles. It cannot work because it requires the same market and money-based approach that is their cause.

[36]Changes in the global value of ecosystem services, Costanza et al, Global Environmental Change 26 (2014), 152–158

Besides, there is no such thing as natural capital – only nature. The idea that societies should monetise the planet only adds to the problem. It reinforces the idea that humanity has some divine right to decide nature's fate, as long as it is financially justifiable in human terms. It strengthens the idea that societies should put a price on everything (while knowing the value of nothing).

The concept of the circular economy has more merit. The idea that products should be designed to last longer, be reused, recycled and repaired is a good one. Unfortunately, it is too often pitched as a means to boost business profits.

Applied to its logical limits, the circular economy would result in huge swathes of key industries being wiped out. The demand for new cars, light bulbs, mobile phones or washing machines would collapse if they lasted 30 years or more – which is easily possible from a technical point of view. The circular economy runs counter to the demands of the economy for more growth. It would need regulation to become widely adopted. Radically boosting energy efficiency, fivefold or more, has a similar problem. It is technically feasible, simple even. But it also runs counter to the needs of the market. It reduces the sales and profits of energy firms by cutting demand. Fixing the climate problem also needs societies to do much more than cut energy use.

Concepts of degrowth are useful too, but often miss the point, because they tend to focus on reducing monetary GDP rather than cutting the ecological footprint. Deliberately making the economy smaller would certainly help reduce humanity's ecological problems but it is hard for people to understand why this is necessary or how they should go about it.

Similarly, the notion of green growth is helpful only if it reduces the ecological footprint. If a company invests in a new gas-fired power station and shuts a coal-fired power station at the same time, that is good for economic growth *and* it reduces emissions. That is genuine green growth. If however, investing in a gas-fired power station is simply labelled as 'green' because the alternative would be to build a coal-fired power station, this is just greenwashing. It is dressing up a business investment as good because it is better than something worse. The problem with green growth is that it is too often window dressing.

Don't let greed lead

Unfortunately, most "impact investing" is greenwashing too. By tagging investments as "sustainable" the finance sector presents itself as socially beneficial, when its first objective is to maximise

short term financial returns, not solve society's ecological challenges. Only rarely are financiers willing to accept returns that are lower than they would have earned if they had invested in environmentally destructive businesses. That said, there are a great many business opportunities which will need funding during the transition to a more sustainable world and there is certainly a role the finance community can play in service to society. As well as the obvious areas of renewable energy, energy storage, and carbon capture, there are also a wide range of new business opportunities which will emerge in infrastructure development, affordable housing, repair and recycling, remote medical care and sustainable agriculture.

The world of philanthropy can play a useful role in this too, perhaps. Better than leaving the investment decisions to those who have profited so handsomely from the existing system however, would be to tax them more heavily and have their wealth allocated by the state instead. This is because those trying to leave an ecological legacy through their wealth have an unfortunate habit of attaching egotistical agendas to their giving. As Pope Francis puts it, they offer "false philanthropy". Besides, the rich are not, generally speaking, the best people to assume the role of society's angel protectors.

There are lots of other environmentally motivated ideas that have been proposed of course, and some are interesting too, such as building sustainable transition towns or investing in waste products and turning them into something socially beneficial. But these are usually hard to scale up, or suitable only for certain countries, industries or regions.

Unfortunately, none of the ideas put forward by the environmental community are sufficient. None address the main problem directly or boldly enough to have the impact needed. None will cut greenhouse gas emissions fast enough for humanity to avoid runaway climate change. They tinker at the edges.

It is also necessary to debunk the idea that there are technological fixes to humanity's problems. Many people have a touching faith in the power of technology, believing that human invention will offer simple and quick solutions, even when the problems are highly complex and have been getting worse for decades. For these people, the task is to find the scientific solution, like solving a difficult puzzle. When I give talks, the question that I am almost always asked is, "can't we invent something to fix the climate problem?"

The answer is “no” because global warming is a symptom of a bigger problem. The fundamental problem is the human ecological footprint and this is the result of the economic system and the overly rapid rise in the human population. It is the desire for ever greater growth on a finite planet that is at the root of the challenge. Technology can certainly help in cleaning up the oceans and the atmosphere. But thinking that it is going to address the wider economic challenge is mistaken. Such a belief risks diverting humanity from transforming the economic system, from fixing the root cause. The central problem does not have a technological solution.

The challenge is social and organisational. It is about reorganising the human world to stop the environmental destruction. Once society has done that, the task is to identify a better way forward. There is no quick technological fix.

The big goals to aim for

What then should the objective be, and how can societies make the transition? The challenge is to reduce the ecological footprint, to bring it back into balance with nature, and then keep it there.

Practically, this means slowing the pace of climate change as fast as possible and cleaning up the oceans.

Everything else, from responding to rising migration, to reducing inequality, dampening conflict, bolstering human rights or addressing global poverty has to come second. To achieve this, greenhouse gas emissions will have to fall by at least 3% a year if humanity is to avoid runaway climate change. Cumulatively, they will need to fall by 35% over the next ten years, by 80% by 2040 and to zero before 2050. Even this will only give humanity a 66% chance of avoiding the worst. So it would be wiser to be more ambitious.

In broad-brush terms humanity needs to adopt the following goals:

15 steps humanity needs to take

Shut fossil	Cut fossil energy emissions by at least 35% by 2030. This needs to happen even if the energy generated for heating, cooling and industry cannot be supplied by renewable sources, even if it means factories close, people lose their jobs and it greatly reduces the volume of trade and economic output. All investment in the fossil energy business should immediately cease, and most of the industry should be closed by 2030,

	with coal shuttered first. Every new investment made in these sectors makes the problem harder to solve because it locks humanity into a polluting energy system. The goal should be to shut the entire fossil industry by 2040, regardless of the financial consequences. Nuclear energy plants should be maintained until they reach the end of their useful lives not because they are risk free but because they are safer than fossil power. There may be further accidents like Fukushima or Chernobyl but these will only make parts of the planet uninhabitable for many millennia. Continuing to burn fossil energy will make almost all of it uninhabitable.
Skies without planes, roads without cars	Cut fossil-fuel transport emissions by at least 35% by 2030 and by more than 80% by 2040. This means reducing the emissions of conventional cars, trucks, tractors, diesel trains, ships and aircraft by restricting their use through regulation and pricing. For cars and trucks, there will need to be tight restrictions on engine sizes and distances travelled. Given the current investment plans of car makers and the

	cost of new manufacturing capacity in vehicles as well as renewable energy, it will only be possible for electric vehicles to offset a tiny percentage of the current vehicles in use during most of the first decade of the transition. There should be no further investments in airports or motorways.
No more cement	Governments should legislate to reduce the output of the highest energy intensive industries, including oil refining, paper, non-ferrous metals and chemicals. A target should be to aim for a reduction of 50% by 2030. All cement manufacturing as well as most metals plants should close as soon as possible, and within five years, except where the metals can be produced emissions free.
Make plastic pay	Reduce waste and plastic packaging by 50% in the next five years and 90% by 2030. This can be achieved by making manufacturers, not consumers, responsible for waste. Packaging which cannot be recycled by consumers should be returned to retailers. If they cannot recycle it, the packaging should be returned to those who first used it. The disposal

	of any packaging which these companies cannot recycle or reuse should cost enough to make it unattractive for businesses to produce it in the first place; say €10 a kilo for the first 100 kilos of waste and then €1,000 for every kilo thereafter. Attempts to export the waste should be criminalised.
Hug trees	Reduce deforestation and land use change by 50% by 2025 and 95% by 2030. Ban the use of palm oil for any purpose from 2025. Provide a mechanism to give financial support for up to 20 years to the affected countries to ease the transition.
Think local, act local	Radically reform agricultural food production, including fishing, so that it is localised, and on a sustainable scale which does not damage nature, regardless of the economic effect on food manufacturers, food costs and retailers. Develop a welfare support system to help consumers during the transition and ensure that no one starves or suffers clinically as a result. Reduce the use of nitrogen based fertilisers by 50% by 2030 and 100% by 2040.
Cut off the	Phase out the use of all the fluorinated gases

gases	which are adding to the climate change problem by 2025, regardless of the cost to business.
Build better	Increase spending on building insulation, new building design and other energy efficiency measures by 15% a year.
AC DC everywhere	Invest in the electrification of everything that can be electrified, so that new methods of manufacturing and transport can gradually substitute today's fossil-fuel based systems.
Free ride	Invest heavily in the rail infrastructure to provide a more sustainable system of mobility than cars and trucks. Consider free public transport for all
Take and give	Shift all planned future investments in fossil energy over the next 20 years to the renewables sector. Increase planned investments in renewables by 15% a year, with state support. This will allow society to replace the fossil energy sector much faster, and ease the transition to a renewable energy network. Take the many trillions of euros in subsidies[37] currently given to the fossil energy business and

37 https://www.theguardian.com/environment/climate-consensus-97-per-cent/2017/aug/07/fossil-fuel-subsidies-are-a-staggering-5-tn-per-year

	give them to the renewable energy sector. Provide help to consumers who are unable to pay higher energy costs during the transition.
Work together	Establish an international agency to protect the oceans and repair the damage that has been done to them. Prosecute those responsible.
Rethink and recapture	Increase investment in biosequestration, soil carbon storage, reforestation and sustainable urban design. Invest heavily in waste management to ease the burden on the world's rivers, soils and oceans.
The world before weapons	Reduce defence spending to the minimum possible level and divert the funds to climate transition projects.
Make the guilty pay	Invest heavily in carbon capture technology and design, and charge the cost of the investment to the fossil fuel industry, cement makers, deforestation firms and those who have invested as shareholders in these businesses over the last 40 years. The payments from these groups should *exceed* the net present value of their cumulative financial returns from dividends and asset appreciation during this time. Consider

	additional penalties on these groups if there is any shortage of funds. Provide support to the dependants of those whose assets are seized.

A strange but saner world

The social, political and economic implications of these changes are obviously immense. Almost all flights of less than 1,000km would be banned, as would low cost airline tickets. The price of long haul flights would increase drastically while the number of tourists would drop dramatically. Venice would become a city to live in, not just a place for tourists to visit (until sea levels rise too much).

The use of household appliances such as lawnmowers, leaf blowers and snow blowers would be hugely restricted. There would be sharp declines in sales of washing machines to cut waste, energy use and duplication. Each machine would be used communally. Many products would be designed to be upgraded or repaired. They would use less energy and last longer. Energy costs would make it too expensive for computers and TVs to be left on standby. Cities would not light empty streets after midnight. People would no longer be allowed to use computers to burn vast amounts of energy to create ethereal currencies.

Streaming videos, storing files online and emailing would cost more. Free recharges for electric vehicles and mobile devices would end.

Rail would become the major transport mode for passengers and freight. Work locations would become decentralised. The volume of waste would fall. Business schools would train managers to close firms, not grow them.

Plastic would disappear from supermarkets, as would takeaway paper cups from coffee shops. Car parks and fuel stations would close. The price of petrol and diesel would rise to €100 a litre. The use of online conferences and meetings would grow.

The volume of international trade would drop as the cost of transport rose. Farmers would need more staff, to offset higher fuel costs and meet rising local demands for a wider variety of produce. Builders and architects would have to find substitutes for concrete, steel and aluminium. Chemicals firms would shrivel like burning plastic. The people involved in developing new weapons, as well as those responsible for changing toothbrush, lipstick and razor designs every two months, would have to find new jobs.

Vast amounts of investment would flow into new technologies and industries, into renewables, carbon capture and transition services. Academics would work on new models of human progress and improved economic systems. Instead of taxing work, governments would tax resources, emissions and waste. Audit and finance firms would police the transition. Welfare allowances would be overhauled so that the lives of many (but not all) people would be eased during the transition. The PR business would help everyone understand what was going on. It would also have to explain why the climate problem will continue to worsen despite all this change.

That such a radical transition will be difficult to pull off is clear. It is hard even to imagine. So how can societies make the transition? How can those who make the changes protect themselves from those that do not? The key will be organisation and leadership by example.

A Department for Transition

Governments will have to adopt something like a war footing. They will first need to map out the transition, to work out precisely how quickly they can cut emissions, close industries and design new tax and welfare systems. They will need to think through the consequences at all levels of society before they start.

Airmiles 2.0?

To reduce the volume of air traffic, give everyone the right to fly 1,000 km (620 miles) economy class a year. This is a good number because it is roughly what is flown today, globally. There were 7.4bn people in the world in 2016, and they flew a total of 7.2 trillion km (in German, 7.2 billion km) .

This includes the poorest, who never fly, as well as the rich who fly much more. This allowance would be enough to buy one return ticket from Amsterdam to London. To fly from Berlin to Chicago would need the allowances of seven people.

To come back would need another seven. Before buying a ticket, passengers would need to buy air miles from other people. Those flying business class would require four times as many miles as those flying economy. First class ten times as many. Buying miles from the poor world might be cheap because they would have a greater supply and less use for them. Buying them people in the rich world would be more expensive. But not necessarily, as there could be one global online market.

Either way, the hassle and cost of buying sufficient airmiles would encourage people to take fewer flights and promote wealth redistribution. Every year the allowance could be reduced to accelerate the pace of change. Something similar could be applied to airfreight, and indeed sea freight, to discourage their use progressively. The concept could also be used for cars (everyone gets 3,000km a year).

It is an enormous undertaking and will vary from country to country. In every case, the national priority should be the same: to reduce the domestic ecological footprint as fast as possible and provide the greatest possible international support to help humanity avoid runaway climate change.

Other tasks will include establishing international links to other governments, to coordinate activities. Policies will be need to be jointly developed and implemented, and new technologies shared.

Nations will need to work together to share the investment burden, compensate countries losing export markets and to cooperate on reforestation and cleaning up the oceans.

They will need to link together to unwind the fossil energy sector and develop new energy transmission networks, respond to the backlash from the industries facing closure, and ensure that there is a unified message being communicated.

Governments will need to hire staff to track and police progress, and to minimise the consequences of any mistakes. Departments will need to be established to pay subsidies to the renewable energy sector, to distribute welfare payments to those laid off and help them train for working in clean sectors.

New policies will be needed to manage the gradual closure of vast industrial sectors and huge multinational corporations. Decisions will be needed about who should be compensated for the losses they incur, and who should not.

Large-scale state support will be needed in carbon capture, energy storage and the transport infrastructure. Parts of the legal system will need to be overhauled to develop and apply regulations that limit personal mobility, restrict ownership of polluting equipment and assess the value of corporate compensation claims. Local centres for repairing or recycling products will need to be set up.

Government support will also be needed to coordinate innovation, and to support universities, building firms and architects as they identify alternative construction techniques and materials. Departments will also be needed to ensure financial and social stability, and to maintain the support of workers and trades union organisations. A department will also be needed for media affairs and oversight.

These are only a small sample of the tasks which need to be undertaken by governments during the transition.

Another role which will need to be carefully thought through is how to overcome resistance from those who will lose out, especially from those in the most damaging dirty industries as well as their shareholders and the finance sector.

There is likely to be a strong and well-coordinated international backlash, especially from countries with fossil based economies, as well as from nations where appreciation of the climate problem is poor. Responding will require canny PR skills as well as a strategically trained staff and psychologists. Some international bodies such as the IPCC and the UN could be supportive in this, others less so.

Prosecuting the guilty

Given what is at stake, governments should also push for the establishment of an international court to prosecute those responsible for the emissions. That is only fair. Those who have managed and owned the world's fossil energy businesses have known for years that they were responsible for a lethal environmental hazard. They knew that it would become existential decades ago, yet they continued.

Those in the aviation business, the car and truck sector as well as shipping knew too that their vehicles and ships were a large part of the problem. They may not have known how much exactly, but that did not stop some of these falsifying emissions data. Nor did it stop them continuing to sell vehicles and commission ships which they knew to be extremely environmentally damaging.

Those working in the cement industry knew too that they were responsible for huge levels of atmospheric CO2, as did those in other energy intensive industries. Those managing the supporting business sectors, in aircraft engines, automotive fuelling systems and factory manufacturing equipment are equally culpable.

In the fossil energy sector, this process should be relatively simple, as there are only 100 companies to target. The people who run these businesses and their shareholders have been responsible for 71% of global CO2 emissions from the fossil sector over the last 30 years[38].

It is not just obvious companies like Exxon, Shell, BP, Suncor, Petrobras, Total, Eni and all the other oil and gas firms as well as BHP Billiton, Anglo American, Arch Coal, LafargeHolcim, HeidelbergCement, Italcementi and the other coal and cement companies that need to be held accountable for what they have done.

The managers and owners of those businesses who have profited from the burning of fossil fuels should face the consequences of their actions too. Automotive firms such as General Motors, Ford, BMW, Daimler, Volkswagen, Toyota, Renault, Bosch, Continental, MAN, Volvo and the aviation firms - Boeing, Airbus, Rolls Royce, GE - and the airlines – Lufthansa, British Airways and American Airlines, for example. The heads of all these companies should be replaced by managers who are empowered to transform or shut them.

[38]Carbon Majors Database, CDP Carbon Majors Report, 2017

Electric cars are not an easy answer

Can humanity reduce emissions by shifting to electric vehicles (EVs)? The answer depends:
1 – on how the electricity to recharge the batteries is generated, and
2 - how the emissions to make and scrap the EV compare to a fossil-powered vehicle.

Comparing EVs and conventional cars is complex because it depends on the size of the fossil fuel car, its age and how it is used. It also depends on how much the EV is used.

Generally speaking, in countries where electricity is generated mostly by burning fossil fuel (China, India, Australia, South Africa, Indonesia, Turkey, Mexico), electric vehicles tend to **increase** carbon emissions. CO2 emissions can be up to four times higher.

If the electricity is generated from renewable sources, including nuclear, (France, Brazil, Norway, Iceland and Paraguay) then an EV will have **lower** carbon emissions than a conventional car – up to half those of the best electric hybrids.

In countries where electricity is produced using a mix of renewable and fossil energy (UK, Germany, Japan) an EV produces about the same carbon emissions as a small diesel car.

But that does not account for the emissions generated when the car is built. It takes more energy to make an EV. If the batteries are manufactured using a mix of fossil and renewable energy, an average EV costs 17.5 tons of CO2 to produce. That is equal to the emissions produced by an efficient small car in four years. If the batteries are made in a country which mostly uses fossil fuel to generate power, the emissions generated in making the EV could be equal to eight years of emissions from a conventional car.

Another problem is that EVs need lots of rare metals. Extracting these often causes terrible environmental damage, polluting soils and waterways. It also requires vast amounts of energy to extract these materials and these can also cause high emissions. The cobalt and lithium needed also comes mostly from the Democratic Republic of Congo, where there are human rights issues and troubling labour practices.

When they are scrapped, EVs are a major problem too, certainly for now, because there is no recycling and recovery network in most countries.

So while EVs might help humanity reduce carbon emissions long term, it is certainly not obvious that they are doing so today or will do in the near future.

Some nations may baulk at the idea of prosecuting their top business managers, of course. If so, they might consider establishing something like an International Truth and Reconciliation Commission so those who have caused so much ecological destruction for so many decades can explain themselves and publicly make amends.

At the very least, these firms, their managers and their shareholders as well as anyone else who has benefited from their activities should contribute to the costs of the transition.

Reforming welfare will be key

Another important responsibility of governments will be to transform their welfare systems so that those who will lose their jobs during the transition are made as financially and emotionally secure as possible. They will need to be paid an income equal to, or not far short, of what they were paid when they worked, and sometimes for many years. These payments would not apply to everyone. They would probably not be made to those at the most senior levels of the most polluting industries, who carry responsibility for the climate problem.

But those employed at more junior levels by the large fossil fuel businesses, as well as those in aviation, automotive, chemicals, shipping and associated supply chain organisations will need a financial bridge. They will need to be paid by the state and retrained to work in clean industries, or the dismantling sector.

As well as increasing welfare payments, governments should also provide a basic income to the sick and elderly. This will greatly ease the process of change too. The level of payment should be around a third of the national average income and can be introduced progressively, over 20 years or so, to give society time to adapt.

The private sector will need to play a role in the transition too. With so much new investment from government and rising demand for new products and services there will be no shortage of opportunities. Millions of new jobs will be created in clean sectors which will greatly compensate for those lost as dirty businesses close. New businesses will be needed in renewable energy and energy storage, to close and dismantle factories, dispose of equipment efficiently, construct new rail infrastructure, manage repair and recycling centres, build carbon capture plants, offer local transition support services and offer policy advice.

There will also be millions of new job opportunities in farming and local food distribution, in construction, electrification, equipment rental, biosequestration and other sectors too.

Getting others on board

Given the huge scale of the challenge and the likely opposition, the chances of pulling off this sort of transition may appear so remote as to make it almost unthinkable. Why should politicians take on such a mammoth task for few obvious personal benefits? It does not seem worth the hassle. Even if all of Europe were to take the necessary steps to transform its economy, the pace of global climate change would hardly slow at all. To be successful, most of the world will need to embark on the transition.

It is also hard to imagine a transition when societies are still so focussed on short term financial gains. It is much easier to believe that shutting down the fossil fuel industry, greatly reducing car use, banning all low cost flights or radically reforming the agricultural sector will be considered too high a price to pay. It is much easier to think that societies will only do what is profitable to try to slow the pace of global warming, not what is actually necessary to stop polluting the atmosphere.

It is easier to think that governments will not do what it needed if this means that a few thousand people in the rich world lose some of their wealth. It will be easier to invest in new dykes to respond to rising sea levels, or ship water from melting icecaps to countries blighted by drought than to tackle the source of the destruction.

The consequences of such an approach are not hard to predict.
The concentration of greenhouse gases in the atmosphere will continue to rise and the world's climate problems will worsen.
Eventually, when the planet's temperature has risen so much that everyone is in no doubt about what is happening, and it is too late, vast amounts of money will then be pumped into carbon capture in the forlorn hope that this will offer a quick fix. When that does not work, someone will eventually propose geo-engineering. If humanity is silly enough to listen, they will find that seeding the skies with chemicals or dropping nuclear bombs into volcanoes to create a cloud of dust will certainly cool the planet for a while. But it will also make everything even worse long term. It risks killing the oceans, polluting the rivers and destroying what is left of the forests. That is not likely to stop people trying however, if they get desperate enough.

Despite what many of us think is likely, I still hope that enough people will find the courage to build a better future. I know full well that what I have said will most likely fall on deaf ears. I know too that it is the only good way forward that remains.

What then will courageous nations need to do to encourage others to be part of the transition? How can the willing tip the balance in such a way as to bring others on board?

Partly it will require the bold to put up barriers against the weak, to stop them undermining the transition by exporting their dirty goods at lower prices. But there is also a better way, which is to encourage others to climb aboard. It is by leadership through example. The simplest way to have a wider impact is to bring together those nations and organisations which understand the problems best, and find a way to work together constructively, to form a broad alliance to push for change. In many ways, it requires an odd coalition of nations and organisations that have not historically worked closely together.

When it comes to countries, some places are more advanced in their understanding of humanity's challenges than others. As I have said, what is needed is a global response not a national or regional one. But humanity has to start somewhere.

Germany and Austria, as well as much of Scandinavia, the Netherlands and perhaps Scotland stand out as places that understand better what is required. These nations have also shown an historical willingness to make sacrifices for the long term benefit of the majority. Their peoples have a greater sense of cooperation and joint social responsibility. They have a good understanding of the climate challenges and the social injustices that exist globally.

They know better what is at stake and have a sense of the scale of change required. In contrast, the rest of the English speaking world is perhaps the furthest away from understanding what is needed.

The other country that stands out as a possible member of a global coalition is China. While it is the world's largest emitter of greenhouse gases, China is determined to clean its atmosphere, soils and waterways and become a better place to live. The country has a history of thinking long term, and for planning decades into the future.

There is also a need for the country to wean itself off fossil energy to power its economic development. Its stated vision to become an "ecological civilisation" means it has, in some ways, assumed the global lead in environmentally responsible development, despite its record as the world's biggest polluter.

It is China that has invested most heavily in renewable energy. It invested more in solar power in 2017 than nearly all the other countries of the world combined, and 30% more than the year before. The additional renewable energy capacity installed that year was equal to the amount needed to light, heat and cool every German home, all 38 million of them[39]. China now spends three times more on renewable energy each year compared to the world's second largest energy consumer, the US.

Other nations which might conceivably be open to cooperating on change include Brazil and India. While both are major polluters and heavily invested in fossil energy they also have large renewable energy commitments. Both are already blighted by the consequences of water, land and air pollution. Having Indonesia, Bangladesh, Pakistan and Nigeria on board would be immensely valuable too, despite their lack of leadership on change so far.

[39] Quartz Media, For every $1 the US put into adding renewable energy last year, China put in $3, April 9, 2018, https://qz.com/1247527/for-every-1-the-us-put-into-renewable-energy-last-year-china-put-in-3/

Decisions made in Jakarta, Dhaka, Islamabad and Lagos will be more important to the future of the planet than those taken in Washington or Brussels[40].

Many smaller nations, especially those affected by rising sea levels may work on a transition as well. Another possible candidate is Japan, which is investing heavily in renewable energy, has a strong desire to wean itself off fossil fuels and a history of long term thinking and collective action for the benefit of all. Some US states, notably California, may be willing participants too.

Individual politicians from less enlightened countries may want to get involved too, even if the mood in their own nation is unsupportive. Many national politicians, and minority parties with many seats, understand the need for a transition but are unable to gain the support of the majority. Every voice in support can be useful.

As well as nations and regions, there are organisations around the world that also understand the need for change.

[40] See Chandran Nair, The west can't fix the climate crisis. Asia will have to do it, The Guardian, December 2017

They should form part of a coalition too. (There are also many other organisations who claim to understand, as well as many lobbyists, international organisations, NGOs and think tanks which say they are supportive of change but are likely to work against it, or undermine it, because they are wedded to the current system, or funded by its supporters. So there is a need for caution here.)

The most obvious of these are the world's religious organisations which command respect among billions of people.

The Catholic church has been especially outspoken.

Pope Francis' encyclical *Laudato Si* on environmental issues as well as his Apostolic Exhortation, *Evangelii Gaudium*[41] on the church's mission and the crisis of the economic system have been enormously constructive. The Pope has said that the current economic system is a "fundamental terrorism, against all humanity" and called for an end to an economy of exclusion. He has encouraged societies to move "beyond the welfare mentality" and to stop trusting in "the invisible hand of the market" to address problems.

[41] Apostolic Exhortation, EVANGELII GAUDIUM, 2013

Other religious groups have been outspoken about the world's environmental problems too, including the Church of England and Church of Scotland. The Islamic community in the UK and elsewhere has also played a valuable role, as has the Sikh community, the Hindus with their Bhumi Project, the World Council of Churches and the Green Faith movement.

I am sure there are many other religious groups and organisations of which I am unaware, and they too may want to play a role in a coalition for change.

A less obvious place to find allies is the military. Yet, in many countries, and notably the US and Germany, the military understand the risks of climate change very well because it is a major threat to stability and security. So it may be possible to find partners here too.

Today everything comes under the laws of competition and the survival of the fittest, where the powerful feed upon the powerless. As a consequence, masses of people find themselves excluded and marginalized: without work, without possibilities, without any means of escape.

Pope Francis, 2013

Similarly, engaging with educational establishments and particularly with people in their 20s would greatly strengthen a coalition. While many economics departments and business schools are a major source of the problem, there have been strong voices for change in many educational establishments too.

Even now, the vast majority of universities restrict the teaching of economics to the neoliberal capitalist model.

Many students complete their degrees without even being aware of alternative models of economic and social development. Most business schools have also strongly emphasised the goal of profit, and reinforced short-termist thinking. When they run courses of ecology and the environment, few question why economics treats nature as an externality[42].

But there is also a growing movement in much of the academic world to reform the teaching of economics and redefine its purpose.

[42] In economics, an externality is a consequence of an activity that is either unforeseen or deliberately ignored. It can be postitive or negative. A negative externality of burning fossil fuels is that chemicals and particles enter the atmosphere. These cause respiratory problems and are one of the main causes of climate change. Current practice is for businesses to ignore these costs. They are generally ignored by economists too, and are not included in GDP calculations. This is not what Adam Smith, the father of modern economics,

A growing number of universities are trying to widen the scope of economics teaching and countless student organisations are pushing for reform. Some of these groups are focussing on changing the curriculum, to include wider economic thinking. They want to include green economics, environmental economics, feminist economics, Marxist economics, and so on.

Others are fighting for a fundamental rethink about what economics is for.

These student groups are well organised in many countries, and well coordinated. Many have a clear idea about what is wrong with the current system and understand that it is one of the main sources of humanity's ecological challenges. These groups would form a valuable part of the coalition, and help spread the message about the need for radical change to a large and young audience. Those under 30 will experience the consequences of climate change in a much more serious and prolonged way than their parents. They need to be empowered to do what is needed to protect themselves and their children even if that is difficult for their parents.

Another group which would play a valuable role in a coalition is the trades unions. That their support will be needed for the orderly closure of many dirty businesses is obvious. But many trade union groups are also well informed about the flaws of the current economic system and the risks of climate change and would also play a valuable role in helping inform society about the need for change.

The legal system and judiciary will need to play an important role in a coalition too, not just in applying and developing new regulations which will be necessary for the transition, but in helping societies think through jurisprudence issues, to reappraise how humanity regards nature, the rights of other species, the rights of future generations and the prosecution of those who have led humanity astray. There will also be a need to train judges in international environmental affairs so they can better understand cases.

The role of business, finance and the conventional economy in the transition will probably need to be passive rather than active.
As the economic system is a large part of the problem, and businesses and the finance sector are central to the economy, they cannot be a big part of the solution unless there is a radical reform of their purpose, responsibilities and ownership.

Humanity cannot release itself from its ecological challenges through inspired entrepreneurs, impact investors and innovative business practices. Free market mechanisms, and the warped sort of suicidal capitalism that now dominates, cannot be its own salvation. Business people and bankers have no responsibility for choosing the path of society, nor the well being of people. Fixing the climate problem is only of interest to these organisations if there is a profit to be made. This is not because their managers do not care about the destiny of society, or at least not all of them. It is because that is how the system works. Looking to business and the finance community to address humanity's challenges is to look in the wrong direction.

Even if they cannot play a significant role in changing the system, there are still ways that businesses and the finance sector can play a more constructive role than now.

They can get out of sectors which are damaging. They can invest in insulation and energy efficiency. They can preserve water. They can change their reporting cycle from quarterly to annual and seek out shareholders who will take a longer term perspective.

They can join one of the sustainable business coalitions such as the B-Team, the UN's Global Compact and "We Mean Business" to share ideas and best practice. They can design products that last longer, that can be repaired, recycled and reused – and charge a premium for them. And they can ensure that their business practices are as environmentally sustainable as possible, and put pressure on their suppliers and customers to do the same.

Why charity and CSR are BS

What the business and finance sector should avoid however is greenwashing, getting involved in charity and investing in corporate social responsibility (CSR). This is window dressing and it frequently makes the situation worse.

Many businesses have climbed on the environmental bandwagon in recent years to demonstrate that they are socially responsible. Their motives may be worthy but mostly they do this because it is good for sales and profits. If it was not, their shareholders would object. So they claim their packaging is recyclable even when none of it is ever recycled, or they donate money to sustainable NGOs to use their logos and give their businesses an aura of good. Others give to charities which defend newsworthy causes, such as racial diversity or sexual equality.

In such cases, these businesses are not just creating an image to boost sales, they are also muddying the waters for everyone because they make sustainability a marketing tool, not a genuine goal. They (sometimes deliberately) confuse and sow seeds of doubt which makes it hard for consumers or legislators to judge what is truly sustainable.

Similarly, involving charitable organisations should be avoided in a coalition, but for different reasons.

The number of registered charities in the world has mushroomed in recent decades, and few people have bothered to ask why.
In the UK, registered charities received 78% more funds in 2016 than in 2006[43] while in the US, where there are now more than a million public charities and over 100,000 private foundations[44], revenues have grown twice as fast as the overall economy[45].

[43] https://www.gov.uk/government/publications/charity-register-statistics/charity-register-statistics-for-previous-years-charity-commission#to-2008

[44] http://nccs.urban.org/data-statistics/quick-facts-about-nonprofits

[45] http://www.urban.org/research/publication/nonprofit-sector-brief-2015-public-charities-giving-and-volunteering

The problem with most of these charities is that their activities tend to hide the parts of the economic and social system that have failed, rather than leaving them for all to see. They also tend to treat the symptoms, not the root causes, of problems. They are a substitute for good society and, as they grow in number, an ever-larger barrier to the sort of structural change that is needed.

* * * * *

What will the transition cost?

What will all this cost? At the simplest level it really does not matter. The choice is between a transition to a more sustainable future and existential collapse. Almost nothing should stand in the way of humanity taking the better path. Money least of all, as it is just a human construct. It is not real. If necessary, societies should print money to finance the transition. If they can print trillions of euros, dollars, yen and pounds to save the banking sector after the 2008 financial crisis, they can surely print money to ensure humanity's survival. If banks, businesses and countries are left bankrupt by the process, then the challenge will be to manage the fallout and protect the innocent. Bankruptcy is not fatal. Climate change will be.

That said, there is a calculation to be made and it is good to know that the overall financial cost need not be very high, if societies embark on a transition quickly. One study[46] suggests that, if the costs can be stretched over 20 years or more, it should cost 1-2% of global GDP each year, to make the change. That is what it would take to invest heavily in electrification, energy efficiency and insulation, and convert power generation to renewable energy.

That is between €600bn and €1.2trn a year, roughly equal to global defence spending in 2017. Over 20 or 25 years, the total cost would be around €30 trillion, roughly half the world's GDP today.

But that is just the start. The cost of shutting down industrial sectors, providing welfare payments for those losing their jobs and developing substitutes for many of today's building materials is not included. The loss in GDP from closing many big businesses is not included. Nor are the effects of reduced consumption on many small businesses.

[46] Jorgen Randers, 2052, Chelsea Green publishing 2010, P82-89

It does not include the impact of cutting trade with the poor world, of finding a way to do business with far fewer flights, of reforming the agricultural system and drastically reducing waste. Nor does this include the positive benefits that would come from new businesses or the jobs that would be created in recycling, renewable energy, planning, welfare disbursement and industrial transition management.

This estimate does not include the cost of stranded assets either. Most of the money tied up in fossil fuel reserves, conventional power stations, aircraft, ships and motor vehicles, will need to be written off. Nor does it account for the trillions of euros of assets which will be lost because of climate change – the houses washed into the sea or the cities that have to be abandoned - much of which will not be insured. It does not include the costs of adaptation which will be needed to raise highways, build thousands of CCS plants, make building foundations stronger, install additional air-conditioning or pay the military to keep the most desirable parts of the world safe.

These additional costs, and so many others, will increase the bill hugely. They will impact the rich more than the poor, bringing an additional problem.

It increases the risk that those with the most to lose will stand in the way of change. That too will need to be thought about and managed. Of course, if there were no transition the financial cost will be even higher in the long term. It will be the loss of most of the existing economy. If societies delay taking action, the financial cost will rise steeply too.

If they were to wait until 2030, and the transition has to be made much faster, while the scarier and more destructive effects of climate change have begun to kick in, the basic cost would be around 6% of global GDP each year. Other estimates suggest that it could be as much as 10%, if societies wait until it is almost too late. Put another way, they would have to divert 10% of the economy away from consumption to pay for electrification, increased efficiency and renewable energy. All the other costs would rise steeply too. The transition would also be much harder to manage and much more jarring socially.

How can this be financed and structured?

Part of the costs of transition can be funded by the private sector. Once the costs of renewable energy are competitive with those of fossil power, (and here governments can level the playing field

through subsidies) businesses will step in to build the infrastructure needed. Restricting the use of conventional cars, ships and aircraft will encourage innovative entrepreneurs to develop alternatives. With higher energy costs, demand for insulation and improved energy efficiency will rise and with it opportunities for private firms. When avocados are no longer shipped from Chile or flown from Israel, farmers in Europe will do what they can to meet demand. New industrial sectors will appear to reuse and repair products. The service sector will also expand to meet the growing demand for transition advisory services.

Part of the cost of the transition should also be funded by from the assets of dirty industries, their senior managers and shareholders, as I have already said. Most of the change will need to be managed and financed by individual states, though. The shift in agricultural practices will need more than a nudge through taxation and incentives.

Many businesses will also need help in the transition while the assets of others, such as those who control water resources may need to be acquired by the state if they are at risk from climate change, so that they can be run for the benefit of farmers and wider society.

Consumers will pay part of the cost too. They will have to change their consumption patterns and reduce their use of the most damaging goods and services. The price of many goods people use will also rise – notably energy, building materials and transportation.

To make this easier governments can offer people three big incentives. First, they can greatly reduce taxes on work so that people feel they are being compensated for higher prices. By taxing work less, the cost of employing people falls, without any reduction in their real incomes. It should encourage business to employ more people and to retain staff during the transition. Governments can tax resource use, energy, emissions, businesses, the rich and the dead instead.

Second, they can boost the number of mandatory vacation days so that people have more free time. This has a number of benefits. It shares the available work and reduces unemployment during the transition. It redistributes wealth. And it allows people to enjoy their lives more. As long as others are doing the same, it should make people happier.

Third, governments can redefine paid work and so boost the incomes of millions of people. Under the current economic system much essential work is unpaid, while much of exactly the same work is paid. Millions of (mostly) women spend their days looking after children or the elderly at home. They do this unpaid even though they mirror what happens in the rest of the economy, in schools, kindergartens, hospitals and care-homes, where people get paid for doing exactly the same work.

Changing this, and bringing homeworkers into the economy by paying them for their work will boost the size of the workforce, redistribute incomes and increase GDP without any increase in resource use, energy or pollution. It will reduce sexual inequality too and help families during the transition.

Other costs can be financed by selling assets, through issuing government bonds and by printing money. Taxes can be raised in a wide range of new ways too. As I have said, the cost of the transition and how it should be financed are secondary issues.
The main concern should be to work out how to embark on the changes needed, and how they should be implemented to cause the least possible disruption to people and the greatest possible benefit.

The poor world diverges

What about the poor world? I said in the introduction that this is mostly a book for and about the rich world. This is partly to reduce the scope, and write a shorter and more easily digestible book. But it is mostly because the challenges in the poor world are different. It is also because the rich world has the greatest responsibility for the world's historical ecological problems and much of the capacity to solve them.

Even so, decisions made in the poor world will determine the success or failure of any transition globally. It is the poor world where the highest volume of emissions will be generated in the future unless there is change. Addressing the global challenge will need China, India, Africa, South America and the rest of Asia to change too.

But the poor world needs to change in different ways to the rich world. Until now, the approach to development has been the same in the rich world and the poor world but there will need to be a divergence in policy and thinking in the years to come. This is because the needs of the poor world, and the poorest 6.5bn people, are different from the 1bn who live in the rich world today.

In the rich world there is already sufficient work, wealth and income for everyone, and the population is mostly stagnant or expected to fall. In the poor world there are still widespread development problems and the population is still mostly growing. The development policies of the rich world have also served most of the poor world badly over the last 30 years. Poverty remains a huge problem, inequality too. The current economic system has resulted in most of the poor world being plundered of its resources in the name of open markets. It has not created a better world.

The majority of people in the poor world still lack secure access to the basic rights of life: a minimum standard of living that includes a safe and secure food supply, clean water, permanent housing, adequate sanitation and access to energy. Providing these will be almost as important as responding to the global warming challenge.

The poor world is now hugely constrained in what it can achieve because of what has happened economically and ecologically over the last 30 years. The rich world has greatly limited the ability of the poor world to develop.

The poor world cannot boost living standards in a resource intensive way, as the rich world did, as this would make the climate problem as well as so many other ecological problems even worse. So the approach needed in Luanda, Lima or Jakarta has to be different from that previously taken in London or Tokyo. Not only will the capitals of the poor world have to manage rising populations, and the consequent rise in pollution and energy demand, they will have to manage unrealistic expectations of development and consumption. They will have to limit the scope of their economic development so that it is more balanced.

This is likely to cause frustration and anger, and while some of this will be directed at local politicians and regulators, much will (or should) also be directed at the rich world. It is the post war generation of the rich world that is greatly to blame for the poor world's plight.

Even more than in the rich world, the people of the poor world will have to sacrifice their hopes of individual progress out of collective necessity. The focus on developing cities at the expense of the countryside will have to be reversed to a large degree.

That may be as well, as many cities in the poor world will become increasingly unpleasant places to live as temperatures rise. Many are already difficult places to live because of congestion, pollution and poverty. To reduce emissions, the level of motorisation will have to be greatly restricted. This will not only limit mobility in places where getting around is already difficult, it will shatter the dreams of hundreds of millions of people who have long thought of owning a car.

Many of the poor world's farmers will see their rich world export markets evaporate. They will also have to grow food in a much more sustainable way, with fewer chemicals and less machinery. Much money will need to be invested in better irrigation to increase yields of food staples. This will mean higher labour intensity and brings the prospect of forced migration from the cities. Water resources will also present a major problem in some countries, forcing farmers off their lands.

The rich world should help here, not just for moral reasons but also to stave off the effects of climate change. It should pay for and support reforestation projects to sequester carbon and to slow the pace of desertification in many regions. It should transfer the latest technology for farming and energy production and probably pay for most of it too.

Huge investments will be needed in solar and wind energy, as well as in the supply network. It may be possible to export some of this energy to the rich world, an added incentive.

The poor world will also need to find different models of economic progress and in this it will need the freedom to explore alternatives, unrestrained by neoliberal dogma of the rich world.

Poor world governments should not be lectured by western leaders who have no experience in dealing with their challenges. This has one obvious advantage. It offers the chance for the poor world's policy-makers and economists to take the lead in development thinking, and stop being subservient to western ideas about progress[47].

Limit the undesirable

As in the rich world, the governments of the poor world should tax that which is undesirable and not that which is desirable. They should tax resource use, pollution and waste but not employment.

[47] With thanks to my good friend Chandran Nair, The Global Institute for Tomorrow

The difference, however, is that the number of people who pay taxes in many poor countries is very small and so the impact of this change is limited. It is still important as a signal, however. Employing people should not cost more, or at least not much more, than the wages they are paid. Instead, many poor counties should focus on taxing excess wealth, as some of it is very excessive indeed. This will be hard when many poor countries are afflicted by enduring corruption. 'Rolex and relax' is the way some put it, referring to the rewards and lifestyle that the rich extract from a system built on pay-offs. As those in power will not change the system themselves, it falls to the judicial system to enforce change on those with money and power, so that elected representatives become more accountable. Again, the rich world should offer help where it can here, as judicial reform in the poor world would bring a wide range of social dividends, including greater political stability.

Poor countries should examine the idea of expanding the use of cooperatives for their development so that people have a share in progress and are not burdened by debt. Many poor people have been enticed to take out loans from micro-lenders in the last 20 years to invest in businesses. While the loans are usually small, the administrative and interest costs are often high.

This has resulted in millions of people being saddled with mounting debts they cannot repay, forcing them to sell their land or their businesses, while financiers or businesses boost their earnings. Far better to encourage the formation of lending and savings cooperatives, where the rewards and costs stay within communities.

The poor world should also demand that the rich world write off their debts to release them from the burden of interest payments. Past lending means that many poor countries are indentured to the rich world, with a large share of their tax revenues paid as interest. According to the IMF[48], the cost of providing full or partial debt relief to 39 countries would be around $75 billion in 2014 terms – roughly the amount of money that the Federal Reserve printed each *month* that year through Quantitative Easing.

Releasing the poor world from this burden would do a great deal to stimulate development and create jobs. It would be to the rich world's benefit too, as it would reduce migration, much of which is driven by inequality and a lack of work.

[48] Debt Relief under Heavily Indebted Poor Countries (HIPC) Initiative, IMF, April 2016.

By allowing more orderly development, and much greater local investment, it would improve living standards and reduce the rate of population growth too.

The financial transfer from north to south will need to be much greater, however. To aid the transition, the poor world should be paid substantial compensation by the rich world for its plight, which is hugely the result of rich world policies over hundreds of years. Poor countries should be paid to keep their fossil energy un-burnt and un-mined, and their cement factories closed because this is in the interests of everyone. The rich world should cover much of the costs of reforestation efforts, and recompense farmers whose export markets have gone. The push for free trade has meant that many developing countries have become little more than sources of raw-materials and cheap labour, as well as growing markets for the rich world's products. The associated policies have made it almost impossible for poor countries to develop, to become more than sources of whatever can be logged, mined or extracted from their territory. They should be free to rethink trade and their international relationships from the ground up.

A more radical suggestion is for the people of the rich world to provide a basic income to those in the poor world.

This may not be that expensive given that a caramel latte in New York costs the same as feeding several people in the poor world for a day. One way to arrange this transfer would be to give everyone on the planet an equal right to burn a certain amount of carbon each year. Those in the poor world would get the same right as those in the rich world. As they have less need to burn it, the poor could sell their right to the rich, who need to burn much more. This would allow for a redistribution of wealth and also provide a disincentive for those in the rich world to use fossil energy. As carbon consumption declined, the cost of burning carbon could rise to maintain a steady flow of income to the poor world.

As well as taxing work less, the poor world should also set a minimum wage to help people during the transition. Paying people decently boosts morale, improves output and reduces staff turnover. Socially, it boosts well-being and economic activity, because it increases spending. It also brings a level playing field for companies and leads to higher average living standards across society. It will help stop the descent into slavery that risks happening in a world where the supply of labour will greatly outweigh the demand.

When it comes to basic living standards, the provision of power, water and sanitation should be another priority. Building the infrastructure for this will create millions of jobs and make it possible for many millions of people to stop living in the slums that characterize so much of the poor world today. Developing a power and water infrastructure also reduces pollution, as long as the power being used is clean. As I have said, the rich world should also play a role here, in providing the latest technology and by paying for the costs of the installation. It is in everyone's interest.

What does all this mean for me?

When I give talks, one of the hardest questions I am asked is "what can I do?" What can each individual do to make the transition possible and make the world more sustainable? Unfortunately, the answer is not much.

Becoming vegan, recycling bottles and plastics, giving up a car, taking the train instead of flying and saving energy wherever possible are all useful. But they will not make any difference to the current fate of humanity unless there is more radical change on a much larger scale.

The same is true even if every European chose to live as sustainably as possible, or even everyone in the rich world. Every rich world citizen who gives up eating meat is currently offset by hundreds of new carnivores in the poor world. Worldwide meat production has more than tripled over the last four decades and increased by 20% in the last 10 years. The rate of consumption is rising faster than the human population[49]. Similarly, every European who gives up a car in favour of public transport is being offset by hundreds of new car owners in India and China. Car sales are at record levels today too, with China the world's biggest market. For every renewable energy power plant in Europe, several coal plants are built in India.

Individuals can only really have a major impact by acting collectively, as activists, shareholders and voters. They can push for change in the political system and the education system. They can demand that the costs of the transition are shared fairly, so that the rich pay much more than the poor. They can lobby and join organisations pushing for change in the teaching of economics. They can stand for election.

[49] UN Food and Agricultural Organisation, (FAO) database, Article published August 2107. https://ourworldindata.org/meat-and-seafood-production-consumption, see also http://www.worldwatch.org/global-meat-production-and-consumption-continue-rise

They can help their communities migrate to safer places or assist those arriving from uninhabitable ones and need to integrate. They can insulate their homes better so they use less energy. They can help inform others about the need for change to build a stronger collective voice. They can demonstrate against the dirty sectors or political inaction, and run online campaigns to coordinate internationally. They can vote for those politicians promising change.

Of all these proposals, voting has perhaps the least to recommend it because the democratic system itself has become a large part of the problem. Today's politicians think short term and are too often beholden to the demands of big businesses rather than those who vote for them. This may be wrong but it is also understandable. Democracy and the capitalist system are deadly enemies after all.

While those running businesses and banks might outwardly support the democratic system, in reality they are pushing constantly for fewer restrictions, less regulation and lower taxes because these increase short term profits, and help them achieve their goal. To function most efficiently, the market has to emasculate the democratic process.

Voting can have an impact, but only when a sufficiently large number of people agree that they want change. So far, the effect of those demanding some sort of change has led to the rise of the political right in many countries. Ironically, this is greatly because of decades of environmental destruction in the poor world and the failings of the economic system everywhere. Both have led to the rise in migration and the current political mood.

Another important role people can play is to help themselves as well as their friends and families to stay positive. To a great extent, the main challenge individuals will face is mental. It will be hard to maintain a happy outlook in the face of so many difficulties, especially after so many decades of post-war plenty, at least in the rich world. It will be hard for people to feel optimistic when they will have so much to worry about, whether it is access to water, falling living standards or frightening weather. Many millions of people will have to leave their homes, and will lose their hopes and dreams. It will be wearying to know that so much of what has been built needs to be dismantled and that the transition will last so long. So one other vital role that people can play is to help others and not let them fall into despair.

There is one other step people can take as individuals to respond to the challenge.

For this I must give credit to Henrik Nordborg[50] a professor of physics at Rapperswil Institut fuer Energietechnik in Switzerland.

People can fight what Prof Nordborg calls GDP – Global Destruction of the Planet – by going on strike. They can reduce their consumption. They can renew cars or phones less frequently, avoid products with excess packaging, or those containing palm oil, and cut back on flights.

At the most extreme they could cut all their discretionary consumption, everything that is not essential to live, to zero. If Europeans managed to cut their collective consumption by even 10% it would have a big impact on many of the most polluting industries. Many car factories, airlines and other dirty businesses need to run at very high levels of efficiency before they make a profit. Some have to run equipment more than 90% of the time. So a sustained campaign to reduce consumption in a large market such as Germany, or the EU, would quickly force many businesses, investors and politicians to pay attention.

A side effect is that it would also result in the cost of many products rising as businesses tried to compensate for waning profits. But that would reduce long term demand too.

[50] https://nordborg.ch/climate/consumer-strike/

It would shift the economy further in the right direction.

Of course, change in Europe will not be enough by itself, as I have already said. But if a consumer strike in one major region can inspire others to do the same, and make corporates and politicians more aware of the need for a transition, it has the potential to play a vital catalytic role.

Going on strike has many other benefits. It is perfectly legal and it frees up time for something more useful. It also saves money which means that people will need to borrow less, which will quickly get the attention of the banking sector too.

So, if you want to change the world, break the chains that make you a slave to materialism! Go on strike!

To Do List

Who	What they can, could or should do
Individuals	Insulate your home, minimise your fossil energy use. Work collectively as activists, shareholders and voters to demand radical reform of the economic and political systems. Demonstrate

	against fossil energy. Go on consumer strike!
Politicians	Lead! Think not of what the big corporations can do for you, but what you can do for your country. Consider your place in history. Regulate for an economic transition, reach out to other countries, shut dirty industries, tax the undesirable and unsustainable, and help your people understand the need for change.
Investors	Get out of fossil, automotive, aviation, shipping, plastics, cement and all associated dirty industries. Place your accumulated gains from these sectors in a holding account as they will be needed by the state to fund the transition. Invest in clean sectors with the expectation that your returns will be strictly limited by regulation. Think more carefully in the future.
Leaders of dirty industries (fossil, cement, heavy	Hire people to drastically shrink and transform your businesses so they are sustainable or, in the case of the fossil

energy users, automotive, aviation, plastics, chemicals, shipping etc)	energy and cement sector, to shut them. Find a good lawyer. Ask yourself some serious questions about what you have done with your life and why you thought it was okay.
Other business managers	Insulate buildings, save water and energy, lengthen your reporting cycle, seek long term investors, redesign your products to last longer, invest in clean businesses, join one of the sustainable business coalitions to promote change.
Judicial system	Help societies think through the legal aspects of the transition. Train judges and prosecutors to better understand environmental issues. Prosecute those responsible for climate change, species loss and environmental pollution.
Education system, lecturers and teachers	Radically reform the teaching of economics, by scrapping the discipline or redefining its purpose. Help students understand the need for a radical economic transition. Help society reflect on humanity's long term direction and values.

The banking and finance sector	Prepare for breakup. Banks will need to support the economy, not the other way around as they do today. Place any assets that you hold in dirty industries in a holding account as they will be needed by the state during the transition.
Economists and employees of dirty sector businesses	Retrain for another career. What were you thinking?
Environmentalists	Take a course on how to change complex systems.
Military	Refocus. Rather than planning for conflict, concentrate on maintaining international peace and security in the face of climate change, mass migration, drought and water shortages. Work closely with governments to advise them on safe transition options.
Religious groups	Be bold in what you say and do. Help people understand the need for change, help them stay positive, provide them with spiritual and practical support. Help societies rethink their purpose and meaning.

Farmers and food retailers	Localise production to minimise the use of damaging fertilisers, transport systems and packaging.
Trades unions	Help workers understand the need for change. Negotiate with employers and governments to minimise the disruption to clean businesses and protect the innocent. Help academics rethink the role of business and economics.
Journalists and the media	Speak for the good of humanity. Help societies understand the need for change. Establish platforms to encourage debate on a better system of economic and social development.
Global organisations – UN, World Bank etc	Do the right thing: strive to maximise human welfare within the limits of nature. Reform the SDGs so they focus on the development of an equilibrium economy and a greatly reduced ecological footprint.

Part 4

Laying new foundations

The great sweep of history

The current path of human destiny will not stop climate change. It will make it worse. To avoid this future, humanity has to consciously make up its mind to move ahead boldly and with courage. Most people in the rich world are afraid to face the future, afraid to go boldly forward facing the world with their hands and their minds. They are afraid that if they have not got their money and possessions, life will be too difficult. The educated people and most of those in the rich world are afraid to face life on the same conditions as the many poor people who do so with a laugh. Unless the world can believe in a transition and unless humanity can plan for a transition, a transition in which everyone can participate, then eventually the majority are going to sweep up, as they have swept before, and wipe the people and institutions of the rich world out of their way, and bring their own social order, by their own means.

This is where humanity sits.

It is here because rich world societies have created, and been seduced by, an elaborate false world view. Many of the central and most cherished beliefs of this world view are wrong, and have been wrong for many decades. The belief that humanity does not have to respect nature. The belief that there are no limits to the damage that can be inflicted on other species and no constraints on the destruction that can be caused to the oceans and the atmosphere. The belief that endless economic growth would lead somewhere useful.

Although these wrong ideas have been widely accepted, most people still seem to understand the simple fact that it is not possible to live on a finite planet and have infinite growth in the human ecological footprint. It is the desires of a small minority to put their own wealth accumulation ahead of the interests of the majority that has created a crisis for everyone, and almost all other living creatures. Unless they reflect and change, that small minority will find the price for their selfishness to be far higher than they might imagine. More than half of those who live in the rich world should question their decades of exploitation and inaction carefully, especially those over 35 years old.

To move ahead, humanity needs to accept that there are limits to what it can achieve.

More than that it needs to embrace these limits, and celebrate them. Ignorance needs to be converted into enlightenment and intelligence into hope.

Humanity's current plight is not just the result of a failure of thinking. It is a failure of democracy too. The voice of the minority has prevailed because the democratic process has become a side-show for mockery or entertainment in many countries, not the means for the well-informed peoples of the world to guide their own social development.

In most countries, democracy has become a word without any meaning. It is a slogan, a piece of marketing jargon to pacify the masses, to make them believe that there is something more meaningful than consumption. "Yes we can", said President Obama. "Just do it", says Nike.

Democracy has lost purpose because too many of the current generation of politicians have dozed while the wealthy and big business have weakened the influence of government and undermined the democratic system. It is not the majority who have driven social progress for a generation.

It is the wealthy who have established the lobbying organisations to promote their views, made large political donations to influence policy, financed candidates who support their interests, and bought media organisations to spread their views.

The majority have been hoodwinked into thinking that it is economic growth and the free market that promise progress, not the state. Trust the market, because the market operates in the common interest, the people have been told, even when it clearly does not. It is the market that governs society today, not the people. It is this ethereal force, portrayed as a mysterious and unstoppable power of nature, that people need to follow and worship, like God. Governments do not help you, the people are told. They are barriers to progress. Only the unrestrained market can provide freedom. The truth, of course, is that the free market only serves the interests of the rich.

When the people complain about social injustice and ecological destruction - the death of so many species, the melting ice caps and the mountains of plastic waste - they are told that it is they, themselves, that are to blame. It is their desire for low prices that is the cause. It is their desire for shirts that cost less than a pizza, flights that cost less than a bus ride, and the convenience of throwaway plastic packaging.

The market is responding to the people's demands, they are told. It is the market which forces the economic system to hire children to work in the unsafe sweatshops of Asia. It is consumers' demand for low cost flights that causes the air pollution and damages the atmosphere. It is the people's desire for low cost food that forces farmers to use so many fertilisers which cause the nitrate run off that pollutes the rivers.

It is those who buy the products and services who are to blame for the damage, not those who drive down the prices to sell them. It is the consumers who are responsible for the plastic islands that pollute the world's oceans. They need to recycle better. It is not the responsibility of the companies that create the waste. It is people who eat too much who cause their own obesity, not the companies that pack their foods with salt, sugar and fat to sell more.

Societies are being beaten into submission and made to feel guilty by the same argument that is used by America's notorious gun lobby. It is not the people making the products who are responsible for what happens. It is the those who buy them who are to blame.

If plastic packaging chokes sea birds, diesel fumes worsen childhood asthma or ultra-cheap food causes misery, it is the fault of the people who consume the products, even when they have no choice.

Societies need to forbid more

In truth, of course, it is not consumers who are responsible for any of these consequences, just as it is not those using energy who are responsible for climate change. It is the corporates pushing ever-harder to meet the quarterly shareholder demands for ever-rising profits that are the cause. It is the people who own and manage the dirty businesses – the fossil fuel firms, car makers, cement producers and airlines - who turn a blind eye to the damaging effects of what they do. It is the unregulated market that is the problem.

Humanity's ecological and social problems exist because societies have been led to think that government interference and regulation should be avoided whenever possible. If businesses are free, the people are told, the market will meet their needs. Governments are portrayed as incompetent while the private sector is depicted as efficient. No more corporate taxes, says business. Governments cannot be trusted to spend the money properly. Let the market decide.

It is also governments that are left with the responsibility for fixing the social and environmental consequences of too little corporate oversight. It is the state that is left to clean up the pollution on the beaches and the streets. It is the state that has to pay for new sea walls to protect cities from the rising sea levels because of climate change. It is the tax payers who have to cover the welfare costs of those left unemployed when businesses push for higher financial returns. It is governments that need to deal with the migrants seeking a better economic future, because the gap between the rich world and the poor world has become too great. It is governments that are left without the funds needed to do their job.

The result of this mistaken belief system is that governments around the world have not been able to meet their responsibilities - and their duties – to their societies for a long time. It is this wrong world view which has led to the environmental crisis, stagnant standards of living and widening inequality everywhere. It is the lack of tax revenues which has made it hard for the state to respond to these challenges adequately, and increased the widespread sense of despair about the plight of the public sector.

As the voice of the state has faded, the lobbyists representing corporate interests have become enormously powerful, influencing the selection of political candidates, the views of the media and legal processes in ways that the majority of people are not even aware of. As the electoral process has offered so little noticeable benefit for the majority, and because so many politicians have been passive in the face of widening inequality, more migration and greater environmental destruction, there has been a rise in more extreme political parties. These are changing the political landscape and have led to the rise in populism. It was all perfectly predictable.

Leaders need to lead

The people have been left without a voice or means of influencing social progress because human development has been gradually privatised, handed to the market and big business. The views of the people have been diverted instead to online platforms where nothing is heard through the noise, and nothing changes as a result. Even street demonstrations have been neutered, their message ignored because they challenge nothing.

In the poor world it is much the same.

The pressure on poor countries to adopt the same economic system as the rich world under the slogan of "freedom and democracy" has led their politicians to turn them into vast planet-ravaging, debt-driven, consumerist societies too. Scraped clean of any wider social purpose, the rich world's ideas have led to the disintegration of balanced societies, huge levels of private and public debt and widespread environmental destruction.

If humanity is to make the transition to a better and more sustainable world, those who are voted into political office will need to do what they are elected to do. They will need to lead. Governments – the people – will have to take back control if their societies are not to drift further towards a plutocracy, where only the rich have a say. The state will need to find the courage to shut destructive industries. It will need to break up the international monopolies and the finance sector. It will need to protect workers at home and abroad. It will need to ensure that there is genuine competition in the market, not the faux sort that exists today, where vast numbers of brands are controlled by a handful of firms. It will need to ban the lobbyists and properly regulate the media, and its ownership. It will need to reject the self-interested neoliberal ideas of development pumped out by intellectually stunted economists.

Governments will need to forbid more and properly protect the interests of the majority from the greed of the few.

Governments need to understand too that climate change is a real, urgent and existential threat. It is a threat to democracy too, though few mainstream politicians or others seem to have grasped this yet. It is the state that will have to safeguard the welfare of the people, as the effects of higher temperatures grow. To do so, those elected to lead will need to stop boosting economic growth and supporting big corporations. They will need to think about the long term and take decisive action because no one else will do the job, at least not yet.

If today's political leaders are unable to do what is needed, then the options become harder still. Either nothing happens, and climate change becomes unstoppable, ruining the lives of billions, or the existing political leadership will need to be replaced, either through the electoral process or in some less democratic way. One alternative would be for a technocratic government to be appointed to do what is needed, to force an economic transition, and then step down when the job is done. But this assumes that humanity can develop the mechanisms to make such an exceptional change in governance happen, and that it possesses enough people of intellect and courage to manage the transition.

It carries huge risks, though they are still much smaller than the consequences of doing nothing.

Don't let the monopolists decide

Societies will also need to rethink who decides what is important and who matters. It is not just that so many people have become addicted to their mobile phones and social media, with the result that they read less and think less deeply. It is not just that the diet they are fed through web-feeds is frequently manipulated by providers of fake news, or that the sheer volume of information being delivered to people numbs their senses. It is that societies have greatly relinquished the responsibility to decide who matters, and who should be heard, to a handful of private monopolies over which they have no influence.

Microsoft's LinkedIn, as well as Twitter and Facebook, can choose which voices are favoured, and get the most 'likes', in the same way that Google can decide what gets to the top of searches. Neither legislators nor users can be sure if there is a bias in these rankings.

By deleting the videos and posts of radical Muslim groups or taking down images of breast-feeding mothers and nude renaissance paintings while retaining videos showing extreme

violence, these companies have shown that they already censor what they publish, according to their own rules, not those established by society. It is these companies who define what they choose to call fake news and then delete it. In doing so they already give a greater voice to those who express views or publish images with which the managers of these companies agree, and edit or lower the ranking of those who think differently. These firms have the capacity to promote particular products or companies, to manipulate survey results and news feeds, and to restrict the distribution of ideas. Through Google Scholar, the company can influence which academics, and which ideas, get cited and, to an extent, determine future career paths. The use of Google systems in schools raises additional issues about how curricula are being set.

Societies have handed a large part of the responsibility to determine who matters and which people's views are heard to those who run a small number of very large US corporations. When challenged on how they function, these companies typically hide behind their 'proprietary algorithms', as if it is a computer which decides how their systems function, not the people who write the machine code. These firms are motivated by what is most profitable and by their power to influence society to boost consumption.

They have taken great efforts to understand how people think, what motivates them and how they respond to information. Some have links to the US military and the NSA, an added concern.

For those living outside the US, this seems risky from a future social development perspective. So far only Russia and China have made much effort to develop rival systems or seriously limit the access of these firms, in China's case by banning them. Think about it this way: If Google, Facebook, Twitter and Microsoft were Chinese, Iranian or Russian businesses, with the same degree of social influence, would they be subject to greater regulatory oversight than now?

The same is true of other global corporations. Governments have handed power to big business and offered them tax breaks in an effort to attract jobs. This has failed too. It has led to insufficient control and too little oversight of corporate activities. It has allowed businesses to play countries off against each other, to get around environmental or regulatory controls, and reduce taxes, while moving jobs to low cost countries. Free trade regulations have been designed to support these efforts.

The pendulum of social influence has swung too far in favour of business and the economy.

Privately owned companies do not have any responsibility to keep people safe or improve social well being. Their goal is to meet the unitary demand of their shareholders: to maximise short term profits. It is governments that have the responsibility for social progress, whether they are elected or appointed. If humanity is to respond to the climate challenge, the pendulum will need to swing the other way, in favour of wider society.

The environmentalists failed too

As well as breeding better and more courageous politicians, societies will also need to grow better environmentalists, because the sustainability revolution has mostly failed too. If societies are to take the bold steps needed, they should seek a wide range of views about the way ahead, not just those of the greens.

For decades a battle has raged between those fighting for a more sustainable approach to human development, and almost everyone else: those who do not think there is a problem, or do not think the situation is bad enough to require radical change. Despite their efforts, the environmental community has mostly lost this battle. It has failed to convince a sufficient number of people that the ecological threat requires radical change, partly because it has confused societies about what is needed.

Most tree-huggers have believed that the best way to nudge humanity onto a better path has been by offering what they have called a 'positive narrative'. To do this, they have collected evidence of good ecological developments in clean energy, waste disposal and environmentally-friendly businesses and used this to construct a picture of a better world, where humanity can live sustainably. They have decorated these visions with words like regenerative, circular or healing, and told parables about caterpillars becoming graceful butterflies. They have presented a temple on a hill - an escape from today's environmental destruction, climate change and widespread poverty - in the hope that this would stimulate change.

This strategy has failed because it has been impossible for people to properly judge what the environmentalists are proposing. Because they have only emphasised a positive narrative, and not explained reality, people have not been able to understand the consequences of inaction. They have not been able to say how useful, or otherwise, the positive visions are, because they have not properly understood the consequences of doing nothing. Why change?

The confusion has been made worse by the wide range of often conflicting advice many of the environmentalists have given.

Some have promoted market-based changes, putting a monetary value on nature to protect it. Some have said the finance community investing in green technology is the answer. Others have called for more regulation, to tax carbon emissions or subsidise the transition to renewable energy. Some have called for the adoption of a circular economy. Some have even suggested that consumers themselves can tip the balance by choosing "sustainable products", without properly defining what this means. This confusion of ideas has added to the uncertainty about precisely what needs to be done, or how the transition should be achieved. Moreover, none of the solutions proposed by these environmentalists adequately addresses the fundamental problem.

Worse, many environmentalists have given the impression that the shift to a sustainable world will be relatively easy. They have encouraged people to think that the economic system will not need to change very much. Societies will still be able to consume pretty much as they do today. It is mostly business as usual in the new Eden presented by many environmentalists, with the promise of healthy profits during the transition.

In this, these particular environmentalists have also been irresponsible.

They have given false hope and so made the transition harder. Those working for change have to contend with the confusion and scepticism of the public, which has been given so much conflicting information that people now question who and what to believe. These environmentalists have wasted a great deal of valuable time and caused considerable difficulties for everyone by selling the ecological equivalent of snake oil.

In reality, the transition to a sustainable society will not be easy, especially now. It will be extremely difficult and require huge collective effort. It will also come at enormous financial and social cost.

Be agnostic on growth

There are two tasks ahead. One is to dismantle the pillars of a suicidal economic system. The other is to reflect on what comes after. The second stage is less urgent and will take much longer. It requires a new Enlightenment, a period of sustained reflection about what human society is for and what it is trying to achieve. Humanity will have to rethink progress.

To be genuinely sustainable, the society of the future will need to have very long term ambitions. It will need to be constructed so that it can prosper for centuries, perhaps millennia.

That means it must respect the boundaries of nature. In the long sweep of time, the free market economic system has proved particularly transient and destructive. It will endure for barely a century or two, either because it will be dismantled in the coming decades or because it will cause its own, and everyone else's, demise. To last, future societies will need to be more like those of the ancient past. Their ecological condition will need to be stable so that the human footprint does not rise even if the population increases. The needs of future human generations, as well as all other species, will need to be regarded as equal to those that are living.

To do this will require the economy to exist with very little consumption of scarce non-renewable resources. Pollution will have to be limited to what nature can easily absorb. Achieving this may seem impossible, almost frightening, given today's economic system, where societies are built on endlessly boosting economic growth, requiring them to continuously increase the throughput of raw materials, and use ever more energy.

Yet a stable economy does not mean a staid society. Humanity can still develop. Rather than boosting material consumption, it can grow artistically, culturally, intellectually and technologically.

It can focus on improving average well being, life expectancies, health and happiness. Sports and religion can flourish too. It is only the resource flow that needs to be kept in a constant state, so that scarce non-renewable resources are not depleted to any measurable degree and the environmental degradation never breaches natural limits.

Characteristics of a sustainable "equilibrium" economy

- Long term, with the capacity to endure for centuries
- Within the bounds of nature
- Capable of satisfying people's needs fairly, as well as those of other species and future generations
- A fixed maximum human ecological footprint, regardless of the population
- Highly restricted use of scarce resources
- Very low levels of pollution limited to that which can be absorbed quickly and easily
- Progress measured differently from today – growth could not be the goal
- Planned leisure time to offset efficiency gains
- Free and universal access to contraception
- No weapons that could cause lasting pollution or that require non-renewable resources
- No boom and bust, to maintain social stability

- Low levels of inequality
- Restrictions on individual freedom

A stable economy can also enjoy economic growth, if that is thought useful. The GDP can continue to rise or fall, because the value of goods and services produced can still change. A great many industrial sectors will still be needed in an equilibrium economy, to produce food, provide mobility and manufacture equipment, just as today. It will just be done differently – with more localised agriculture, the use of electric propulsion using renewable energy, and by making equipment from recycled metals and other materials. All sorts of new service sectors will be required too, to manage the process of sharing what is produced, for example. The price charged for all these goods and services can still change, meaning that the monetary value of the economy can still grow.

Even so, societies should learn to be agnostic about economic growth, not make it the goal. As well as tracking progress in different ways, future societies might also reflect on the medium of exchange, and its purpose. They should ask whether or not they need money. Much thought will need to be given the role of the finance sector too. Would it be possible, and better, for the societies of the future to function without both?

This is a complex question.

Similarly complex is the question of governance. Is democracy the best way to achieve progress? It is easy to think that it is, to parrot in affirmation because that is the Zeitgeist. It is nonetheless true that the country which has achieved the most in the last 50 years, in terms of improving the well being of its citizens, is China. It is a country that is not democratic, at least in the Western-world sense. It is also true that many of the monarchies and military empires of the past were more stable and longer lasting. Much thought will also need to be devoted to the role and purpose of the nation state.

There are three further conditions which will need to be met if humanity is to flourish sustainably. An enduring economy must meet everyone's requirements for food, safety, purpose, mobility, communications and shelter, and it must do this fairly. This is obviously necessary to sustain life but it is also needed to eradicate injustice, which will greatly reduce the chance of conflict. A vital watchword of the future needs to be dignity. Everyone should also be equal before the law, in reality, not just in name. Second, the right to privacy will need to be reinstated because it is a necessary requirement for freedom.

Being watched and monitored limits people's ability to think and speak freely.

Third, a sustainable world will require leisure time. Technological improvements which increase output will have to be exchanged for greater leisure, so that the sustainable society can avoid excess production and waste. An equilibrium society would still need to develop lots of new technology, to continually reduce waste, improve the rate of recycling, increase energy efficiency and in medical science. A major incentive for people to innovate would be the knowledge that their work had further improved human well being.

A steady state economy would not require equality. People are not all equal. More important would be for it to provide equality of opportunity, to ensure that everyone contributed to social development as much as possible, and according to their abilities. Once the society has met the basic needs of all its citizens, rewards for individual achievement can still be offered, as long as the gap between rich and poor is carefully controlled and as long as any achievements are justly recognised. As well as a guaranteed minimum living standard, there would need to be a maximum standard too.

On the need to reflect on what words mean

As with the last Enlightenment, societies will also need to put a great deal of effort into thinking about what words mean. They will need to carefully redefine what is meant by individual freedom and liberty, and perhaps return to something more like John Stuart Mill originally intended. According to Mill, freedom is defined is the right to say and think openly, to have any opinion, no matter how outrageous, as long as others are not injured by what is said. The state's power over the individual is limited, but it is not removed.

Today, freedom has morphed into the right for people to act as they wish, to behave selfishly, almost completely unhindered by the effect their words and actions have on others, the state, or the earth's destiny. It builds on the false idea that the individual is sovereign. To move beyond, humanity will need to ditch another wrong-headed idea from the 1980s: Margaret Thatcher's notion that there is no society, only individual men and women as well as families. There is a human society, a necessary social connection between peoples and it extends far beyond the mentality of me, myself and I. As well as fearing the tyranny of the majority, healthy societies of the future will need to find a way to embrace its collective wisdom.

Humanity will also need to rethink its relationship with nature. It is not a battle. There is no conflict for humanity to win. Natural limits are not there to be overcome. Modern societies have completely warped Charles Darwin's ideas on nature. When he talked about the "survival of the fittest"2, he did not mean that competition is good and that only the strong survive. He meant that those that survive are those that best "fit" their surroundings. They are best adapted to live in harmony with the world around them. Humanity cannot fight with nature and hope to win. It needs to learn the humility to live in balance with nature, as part of it.

Humanity will also need to redefine happiness, peace and purpose. It will need to redefine leisure, so that does not equal consumption. It will need to encourage cooperation, not competition. It will need to stop wasting huge amounts of energy and time creating products and services of no useful value. It will need to stop dumping costs on nature. It will have to stop making weapons too, no matter how hard that might be to imagine.

Properly thinking through the implications of an equilibrium economy will take a very long time. I do not pretend to suggest that I fully understand what is required for humanity to live sustainably, or what a post transition world might look like.

There will need to be much more analysis and many more contributions from wise people everywhere. There will need to be extensive debate and a coalescence of ideas about what a better world should be like and how societies can construct it. It will require a change in mindset, in human values, not just a change in the economic system and our ideas of progress and well being. Humanity will need to radically rethink almost everything it considers normal. As very few people have given these issues much thought for a very long time, societies will also need to develop the capacity to do that too. One of the biggest barriers to progress in recent decades has been humanity's inability to imagine.

It is not the end-state that should concern societies most now, however. Despite all I have said about the need for long term thinking, it is the short term that must be the focus. Before humanity can think about rebuilding the great edifice that is human civilisation, it must first tear down great swathes of what has been constructed so far, and with grave urgency.

Humanity will need to work hard before it can rebuild.