Matthew Pye

The essential science of climate change.

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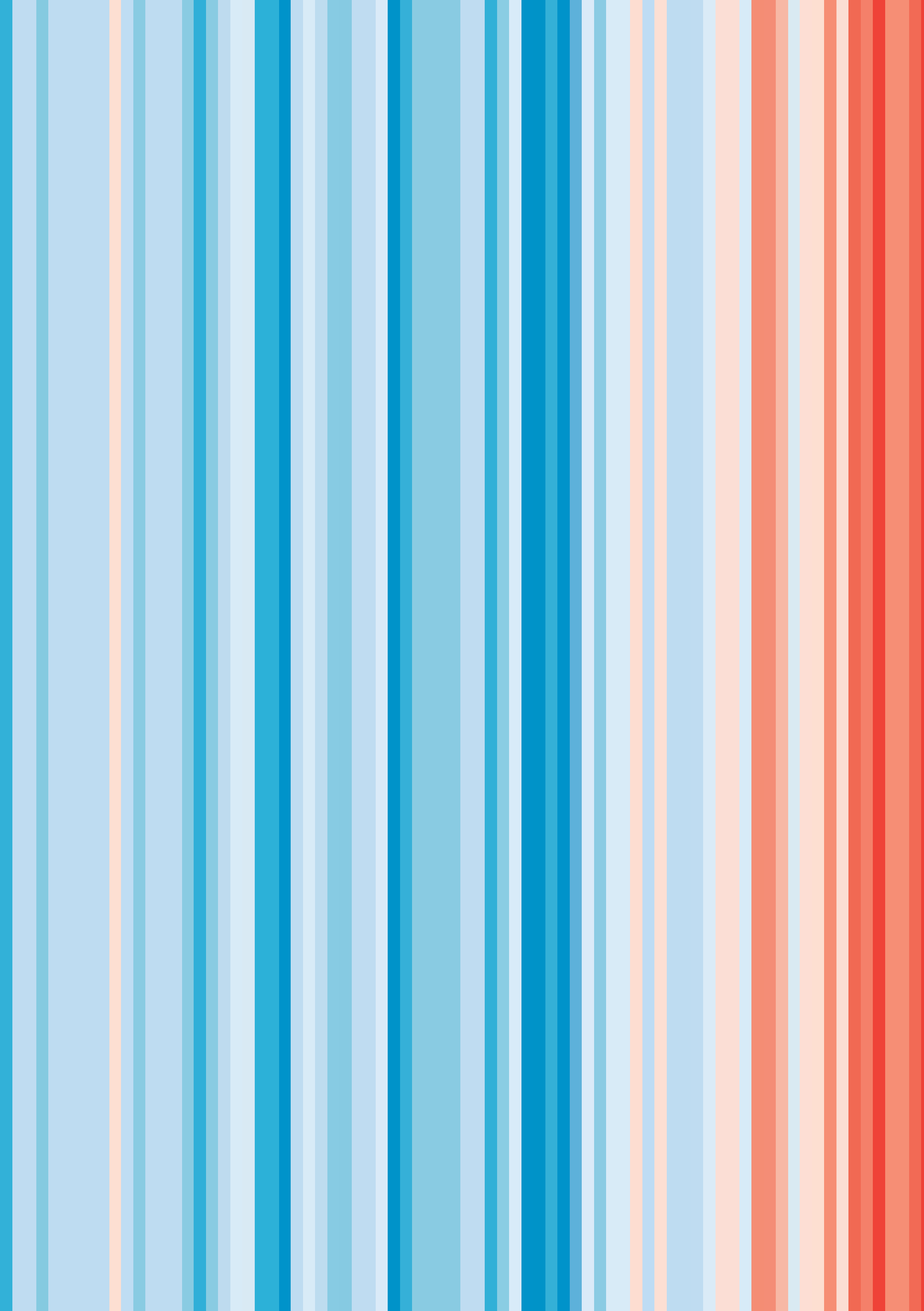
No Common Sense



Colophon

'Plato tackles climate change.'
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Chapters Eight & Nine from

Plato ~~courage~~ tackles climate change.

Matthew Pye

science

Chapter Eight

The Science of Climate Change

Introduction

There is little point mobilising different philosophers to examine climate change if the basic scientific facts are not right. Getting the evidence straight is critical, any book on climate change must be written on a firm scientific base.

Due diligence with the empirical data and the latest conclusions of mainstream science avoids two dangers: It prevents us from being too casual about the severity of the crisis we are in, and it prevents us from undue alarmism.

This chapter summarises the key points of climate science in a step by step way. All the analysis is rooted in the latest research and data, and without compromising that, it hopefully breaks everything down into language and metaphors that can be readily understood.

This is how our boom can go bust, according to climate science.

The size of this bust is important.

What is at stake in our climate crisis is monumentally big. It is neither the kind of bust that might happen in an economic cycle, or even during a global recession, nor is this a bust equivalent to the Bronze Age Collapse or the Fall of the Roman Empire. The type of collapse that could happen will dwarf such events. This is because we have a global population that now stands at over 7.8 billion, and it is because our societies are so interconnected at every level. Moreover, it is not just human societies that may collapse, but entire ecosystems; it will not only affect humans, but all other species too and it is irreversible on human timescales.

It is a bust of massive proportions.

The strength of the science is important.

For anyone who has not yet had the key scientific conclusions explained to them in a clear way, all of this strong language will seem somewhat overcooked. Foreseeing the possible collapse of human civilisation as we know it would normally commit a book to the science-fiction section of bookstores and libraries. Yet, regrettably, we are currently on a pathway towards around 4°C by the end of the century and the conclusions of mainstream science are emphatic. We are moving deeper into a minefield of formidably dangerous trigger points, and the range of disruption and suffering that this will cause to human beings will be unacceptable.

However, it is still possible to avoid this crash, there remains a narrow pathway out of the crisis. Moreover, if we could use our common sense to make the right choices, right now, then we would not only dodge the wrecking ball, but we would also surely gain a much richer life. The status quo is reducing the biosphere's astonishing, diverse beauty down to a world of cattle and cats, cornflakes and coke. It will be hard to save our social body from muscle atrophy as our senses feed off the vividness of a digital screen. Yet, there is so much to win by resetting our priorities and recovering our common sense.

We need to understand the science to do this; literally, we need to understand. We need the humility to accept that there are laws of physics and chemistry that govern us. This humility will serve us well in how we go about the imperative changes to our systems and lifestyles. If we manage to dramatically reduce our emissions, then it could also mean that we will be living in a healthier, more just society too.

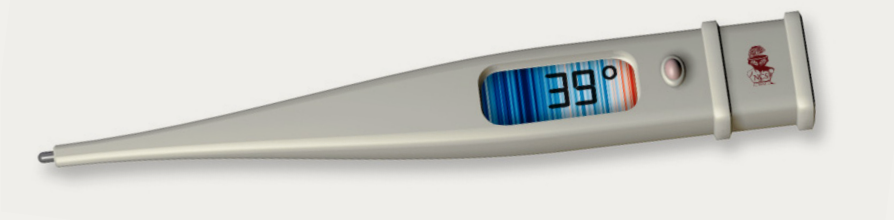
This chapter is about understanding the key aspects of that science.

The Absolute Basics

Global Heating

A rise of 2°C average global temperature might not sound like a big deal, but anyone who has had a fever for a few days at 39°C will know how lethargic and grumpy it can make human beings feel. Moreover, doctors inform us that if an elevated temperature is not treated for several weeks, then vital organs can start to break down. A 4°C rise for humans is a medical emergency; vital organ damage occurs and death will follow if the temperature is not lowered. It is called hyperpyrexia.

All life has similar difficulties with movements in temperature outside of their tolerance zone. The parallel between ecological systems and the human body is only a metaphor, given that different organisms experience heat stress differently. However, it gives a good approximation of the deadly consequences that await human civilisation that we are on track to lock-in by the end of this century.



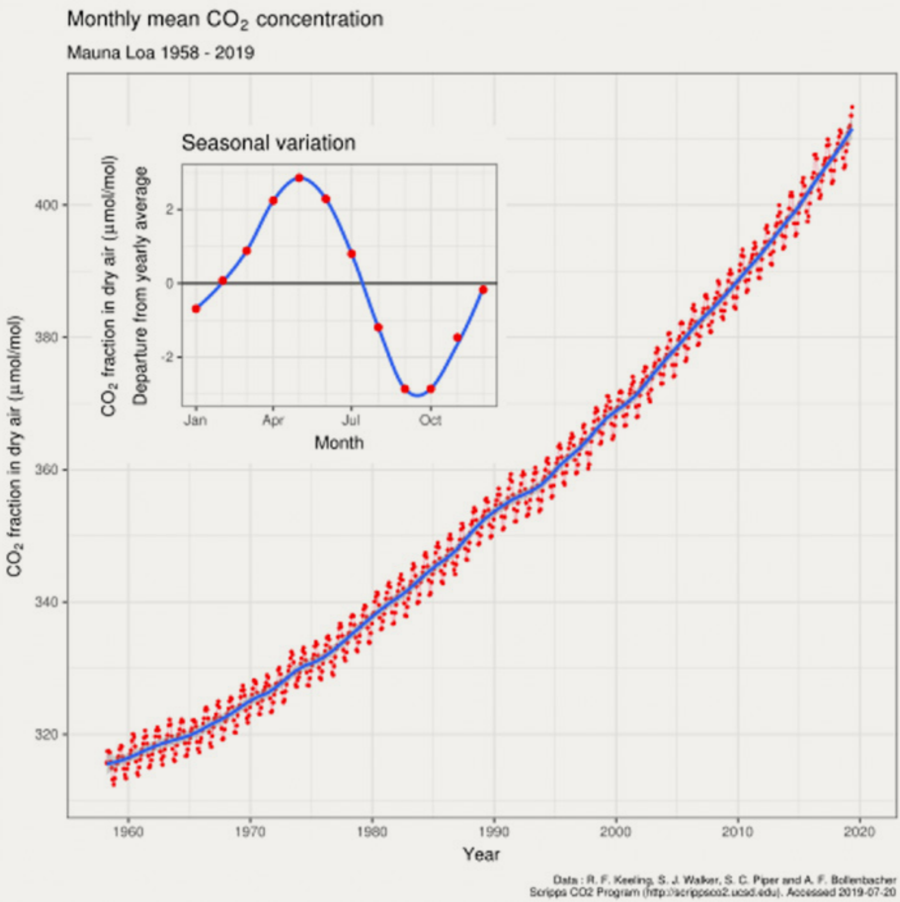
It is crucial to not underestimate the dangers of escalating levels of greenhouse gases in the atmosphere. In 2019, global average temperature was 1.1°C higher than the pre-industrial level; this is consistent with a warming trend of 0.2 °C per decade. Since 1980, each decade has been warmer than any preceding one since 1850.[1] The six warmest years on record have all been in the past six years. It is possible that 2020 has set a new record with 54.4°C (!) being recorded in the USA.[2] Indeed, rising temperature is one marker of climate change, there are many others: rising sea-levels, melting ice, extreme weather events (heat waves, floods, droughts, storms) and wildfires. These markers lead to decreased food security and water availability, increased migration, dramatic changes in ecosystem, decreased biodiversity, health hazards and reductions of economic growth (especially in low developed countries).[3]

Greenhouse Gases

Science has known of the greenhouse gas effect since 1824, through the work of French physicist Joseph Fourier. In 1856, Eunice Foote provided the first key chemical details of this effect when she established that H_2O and CO_2 trap heat.[4]

Modern science can measure, in a remarkably precise manner, which particles make up the atmosphere above our heads. Since 1958, the Mauna Loa Observatory in Hawaii has been measuring the concentration of atmospheric molecules, expressed as parts per million (ppm) or billion (ppb)[5] (the number of molecules of a gas per million/billion molecules of dry air).

1 World Meteorological Organization: *Statement on the state of the global climate in 2019.*
2 National Ocean and Atmospheric Administration: *State of the Climate* (August 2020)).
3 World Meteorological Organization: Statement on the state of the global climate in 2019.
4 Foote E., "*Circumstances affecting the Heat of the Sun's Rays*". Read before the American Association, August 23d, 1856. It is common to credit John Tyndall for this discovery, but his lecture to the Royal Society lecture was delivered 3 years later on June 10th, 1859.
5 The number of molecules of a gas per million/billion molecules of dry air.



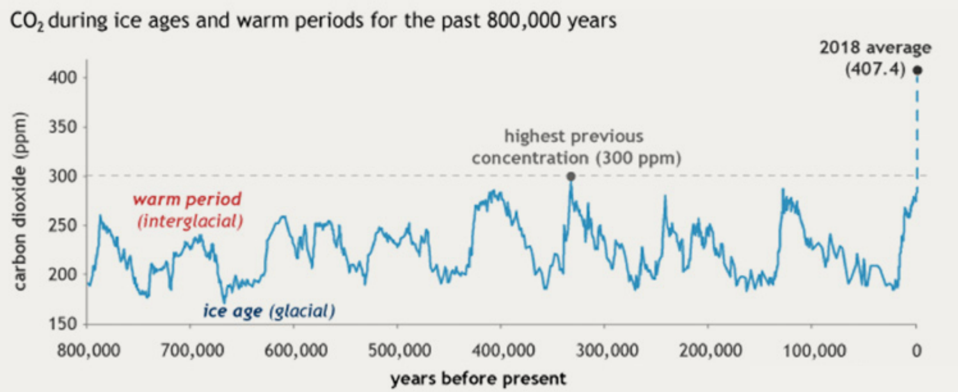
This data has been plotted onto a graph known as 'The Keeling Curve', so named after the scientist Charles David Keeling, who set it up. The Mauna Loa reading at the time of writing signalled that there were 414 particles of CO_2 in every million (414ppm).[6] Nitrogen (N) makes up over three-quarters of the rest with 780,900ppm, alongside Oxygen (O) that occupies 209,500 ppm.

6 Monthly average July 2020, 1.5 ppm higher than July 2019.
Source: https://www.esrl.noaa.gov/gmd/ccgg/trends/monthly.html

Although 414 parts per million[7] does not sound like a lot, a carbon reading of 414 ppm informs us that we have bumped up the level of CO_2 by 46% since the start of the Industrial age.[8]

This is a concentration of CO_2 that is unprecedented in around 4 million years and when geologists look back in time to previous epochs that had the same levels of CO_2 they do not see a world which is compatible with human civilisation as it is now: "Current levels of CO_2 correspond to an equilibrium climate last observed 3-5 million years ago, a climate that was 2-3°C warmer than today, and sea levels that were 10-20 m higher than those today."[9]

It will take us into an utterly alien world for our species. This is a kind of situation that is very hard for us homo sapiens to wrap our heads around.



NDAA Climate.gov Data: NCEI

7 To be exact, the global average for 2019 was 410ppm. The 414ppm that was measured in Mauna Loa is a reading taken at a particular moment in the annual zig-zag of concentrations caused by the four seasons.

8 These figures do not include the other greenhouse gases like methane (CH4), nitrous oxide (N20) and halogens.

9 *World Meteorological Organization Greenhouse Gas bulletin 2017.*

The climate has been so temperate and accommodating in the past. It is hard to imagine that it could switch so dramatically to become such a dangerous enemy. Indeed, human beings have just experienced an unusually balanced climatic period known as the 'Holocene' that lasted from 11,700 BCE until the modern day. This calm interglacial pocket of time provided the favourable conditions that helped Neolithic homo-sapiens to grow up, and it served as the background for our more immediate ancestors' development in the Bronze and Iron Ages.

Looking over the shoulder of the people in the Holocene, and observing the climate for those hominoids who lived in the last 800,000 years of the Palaeolithic Age, we can see that things appear to be more turbulent. With this wider zoom we can see the effects of planet Earth's slowly drifting patterns of orbits, spins and wobbles (more eloquently known as the Milankovitch cycles). Yet, even when these huge rhythmic pulses are examined throughout this age, the level of CO_2 was entrenched in a stable range of between ~180ppm and ~280ppm[10]. Therefore, a reading of over 410ppm is not a historic level; it is a profoundly prehistoric level.

Throwing our whole ecological system out of its long-entrenched equilibrium is unimaginably foolish. The entire biosphere that we are part of has evolved over millions of years into forms of life that are perfectly adapted to this current environment. Anthropogenic climate change is happening at breath-taking speed, 0.2°C per decade, and it is accelerating.[11] This is about 20 times faster than the average rate of ice-age recovery warming.[12] Many species' ability to adapt will be vastly outpaced by climate change.

10 *World Meteorological Organization Greenhouse Gas bulletin 2017.*

11 Intergovernmental Panel on Climate Change, Global Warming of 1.5°C (2018) Executive Summary

12 Nasa Earth Observatory: "As the Earth moved out of ice ages over the past million years, the global temperature rose a total of 4 to 7 degrees Celsius over about 5,000 years." That is about 0.008 to 0.014°C per decade; in other words, current climate change is 14 to 25 (average 20) times faster than the average rate of ice-recovery warming.

The graphs are vertiginous. It is like suddenly doubling the voltage on the power supply to your laptop on which you have all your work, family photos, bank account details and personal files stored. Why would you wilfully do that, especially when there is no back up?

Image 1. - Michael Wadleigh speaking at the European School Brussels II

No Common Sense

Why is such a fundamentally important reality so far from our common sense?

Millions of people have an awareness of climate change, but far fewer are aware of how radically dangerous it is at a systemic level. This lack of understanding makes it possible for people to think and act as if more recycling, eating less meat, reduced flying and a reduction of single use plastics are anywhere close to the level of change that is required.

1. Christmas Turkey Syndrome

Spare a thought for the Christmas turkey.

He has been fed so regularly and diligently all year by the farmer; he cannot imagine when he hears the shake of the grain bucket on December 24th that things are going to turn out so badly after breakfast.

Likewise, it is truly difficult for us humans to imagine a different set of coastal maps from the ones that we have all grown up with. It is hard to imagine a whole city going under water because it all seems so concrete. Surely geologists deserve more screen time; it used to be cool to be a geologist in the 19th century, now we tend to think of them in the same kind of category as the fossils that they study and collect. Geologists should garner the respect and the attention that they deserve to make it clear to us that planet Earth can look radically different from what it looks like today.

It was only 'yesterday', in geological terms (c16,000BC), that Doggerland was the one of the busiest hunting grounds in Europe, with grazing mammoth, herds of deer and the odd prowling lion. Today, it is under about 30 meters of water, and it is only really of interest to fishermen who tune into BBC Radio 4 for the Shipping Forecast. Geologists can describe landscapes and climates that are unimaginably alien to us if we really spin the dial of time back on the globe.

We have been pumping these greenhouse gases into the atmosphere for over 200 years and the effects of doing so seem to have only invaded our awareness with intermittent extreme weather events. It would be easy to think, especially in the technologically advanced Western world, that the problem was not so serious. Rather like the COVID-19 virus, the problems of climate change will express themselves with the most damage rather later than the moment at which the problem was established.

To casually imagine that nature will remain essentially favourable to human life is deeply negligent, both of the geological past and of those who have an interest in its future.

2. The difference between a tree and a forest

Climate change is a truth that is essentially non-sensory. The climate can only be seen in scientific graphs. By contrast, we sense the weather because it blows in our face, chills or warms our bodies and gets our clothes wet. The weather happens to us. The distinction between the weather and the climate is very important. It can be made clear by simply thinking about the difference between a tree and a forest.

When you are in the middle of a forest you can only see the trees around you; each tree is like a weather event. By contrast, the whole forest remains out of sight. Not only can you not see the trees hundreds of miles away, but the forest has been around for hundreds, thousands or perhaps millions of years. The forest, in this fullest aspect, is like the climate. One dead tree does not signify anything about the forest, you need to be able to look at the bigger picture. One flood or storm, one cold or warm winter, does not signify anything about the climate. You need to have much deeper and wider data to be able speak scientifically.

Fudging the difference between the climate and the weather is a common tactic used by sceptics to undermine the climate science. It is also true that whilst extreme weather events are typical of what climate change looks like, those who are committed to stopping climate change can make an error by asserting a certain link between a weather event and a climate trend without qualification.

In this rather abstract way, climate change is mostly beyond our common sense.

3. Motion Blindness

By extension, another challenge to our common sense about climate change stems from our inability to experience change. For obvious reasons, the human mind is set up to see the world in the present tense; we just get to see our lives moment by moment, and so observing long term change[13] is generally elusive to us. We are shocked to see an old passport image of ourselves from a decade ago and we are shocked to see relatives after a long break. The imperceptible change, cell by cell, of our faces is not something that we can see in the conventional sense of the verb.

The late Physics Professor Al Bartlett famously gave a lecture about the human inability to grasp change. Starting in 1969, for 36 years he gave his (unchanged) talk about change a total of 1,742 times.[14] He always opened with the same arresting claim: "The greatest shortcoming of the human race is our inability to understand the exponential function." By just playing around with simple arithmetic, he demonstrates the real-world consequences of steady growth rates.

13 The word "change" is used modestly here, out of respect to the deep thoughts of Zeno. This is because as soon as an object changes, it is no longer the same object. So, in the very moment of change the notion of change simultaneously becomes irrelevant, because change implies continuity and as soon as change happens there are two different and clearly distinct objects that have only a tenuous link to each other, arguably they have no link at all.

14 This is an average of 1 lecture every 7.5 days.

For example, he calculated that if the 1999's population growth of 1.3% per year continued, it would lead to a population density of 1 person per square meter on the dry land surface of the earth in 790 years. That is not enough room for anyone to swing a kitten in.

Yet we would have to farm this square meter for all our food, park our car in it, whilst also squeezing our share of all the houses, hospitals, schools, factories and shops into it too.

Similarly, the headlines for climate change sound diminutive; our Greenhouse Gas (GHG) emissions grew on average 1.6% per year since the 1970s. However, what that actually means is that they doubled by 2013[15] - and at this rate they will triple by 2040 and quadruple by 2060.

Thinking about environmental issues in percentages and rates is clearly a necessity for some types of analysis, but it does not always help us to get a common sense of what is actually going on. There would be intense media attention and debate about population growth if it were to become an annual event. Having 81 million[16] extra people disembarking off a giant spaceship every New Year's Day would cause the current residents of Earth to ask some critical questions about how they might be fed and located. Given the current stress marks that can already be seen on the planet's resources, the fact that we are adding the equivalent of the entire population of a country like Germany to a closed mass system every year is one of the most remarkable silences in our current political thinking. This political silence about population growth is equally bewildering when the negative implications for climate change of having to factor an extra 81 million people every year into the carbon emissions calculations are considered.

15 Emissions Database for Global Atmospheric Research (EDGAR), EDGAR 5.0 FT2018 (EC-JRC/PBL, 2019)

16 We are currently adding about 81 million people a year (a growth rate of 1.1%). United Nations World Population Prospects, the 2019 revision, medium estimate.

Bartlett's point is not that we would ever reach a point of one person per square meter in 790 years, because the stress would snap civilisation and the planet much earlier. His point is that humans have to concentrate to be able to see the real action that is actually occurring inside a steady, long-term trend. This lack of awareness makes humans very prone to making disastrously passive responses to critical issues.

In Munich, a 43-year-old female patient was admitted to hospital in October 1978. Suffering from a lesion in section V5 of her brain; patient 'LM' complained of extreme headaches and vertigo, but more puzzlingly, she could now only see the world in snapshot images. Her disorder is known to medical history now as Gross Akinetopsia.[17] It is more commonly known as 'Motion Blindness'. Patients suffering from Akinetopsia, with their strobe-like vision, find it very challenging to pour a glass of water and cross a road. They have also reported difficulties in following a conversation as the fluent soundtrack does not match the stuttering images of the lips that they see. LM is the only extensively documented case of severe Motion Blindness.

Yet, perhaps we are all suffering from that condition in a sense. We can see the evidence for climate change, but we really struggle to perceive the massive wrecking ball that is coming our way for various cognitive reasons.

17 Zihl J; von Cramon N Mai (1983). "*Selective disturbance of movement vision after bilateral brain damage*". Brain. 106: 313–340. doi:10.1093/brain/106.2.313.

The Essential Science in 6 Graphs

Science can freeze frame reality. It can pull the past, present and future together into one place, so that we can get a good look at it. The following 6 graphs illustrate the most fundamental facts about climate change. They are made from the baseline data that human civilisation is dependent upon.

Graph One – The cause of Climate Change

These are the long-lived greenhouse gases in the atmosphere. They are the cause of climate change. The graph shows that greenhouse gas concentrations have been increasing and are continuing to rise relentlessly.

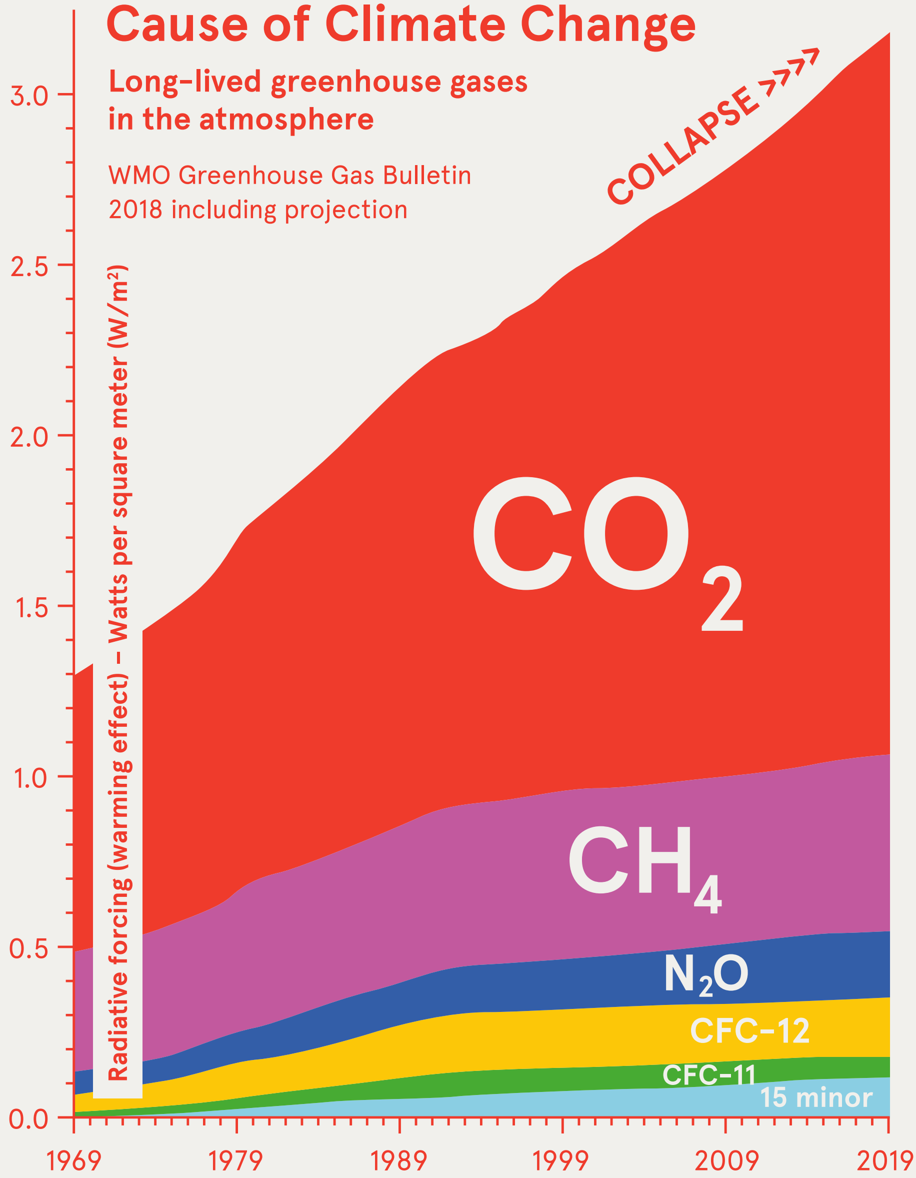
Stating the obvious, we are not controlling our emissions. The line on the graph is going up, and new records are being set every year.[18],[19] In the last 30 years, radiative forcing (the technical label for the 'warming effect') has risen 49%. The overall average increase was 0.03 w/m2 per year, but the last 5-year average was 0.04 w/m2 per year.[20] These blunt facts mean that we are not decreasing greenhouse gases in the atmosphere. Conversely, we are accelerating their increase.

A rise from 2.1 to 3.1 W/m2 radiative forcing might not sound like a lot, but when the 1 Watt per square meter increase is cashed out into a different set of units, the reality of it all is rather amazing. A 1W per m2 increase across the entire earth's surface amounts to a 510 trillion-Watt force.

18 *UNEP The Emissions Gap Report 2019,* United Nations Environment Programme (2019).

19 *PBL Tabellen mondiale CO_2 en broeikasgasemissions 1990-2018*, PBL Netherlands Environmental Assessment Agency (2019).

20 National Oceanic and Atmospheric Administration Earth System Research Laboratory, *The NOAA Annual Greenhouse Gas Index* (1979-2018).



WORLD
METEOROLOGICAL
ORGANIZATION

Graph 1: Courtesy of Homo Sapiens Foundation, Our Future Uncompromised, adapted from World Meteorological Organisation Greenhouse Gas Bulletin Figure 1 (2019).

This upturn is the equivalent of 600,000 Hiroshima nuclear bomb explosions per day.[21]

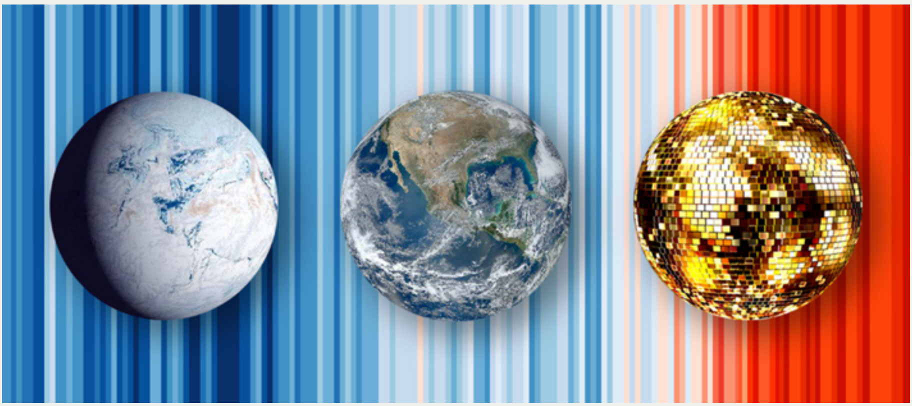
When geologists create images of the planet for how it must have looked in the deep past, as a snowball earth or a greenhouse earth, it is hard to imagine the forces that must have been at work over millions of years to make such transformations possible. When we look at our earth from satellite imagery today and see a giant disco ball, we might simply be reminded of the streetlights at home.

Yet these lights represent another awesome power. They are just a fragment of the energy that human beings are affecting the planet with, on every spin. Seen as a disco ball, those glitzy lights offer a startling reminder of our invasive colonisation of the planet.

Such is our impact on the planet, geologists have proposed that a new section of geological history can be asserted: the Anthropocene (after the Greek for human, ἄνθρωπος, '*anthropos*').

A 'Disco Ball Earth' could be a very apt symbol for the Anthropocene.

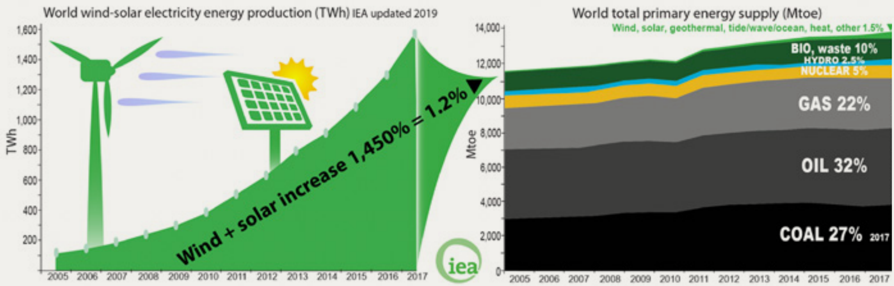
Image 2. - Disco Ball Earth



21 Increase of 1 W = 1 J / s, earth surface 510.1 trillion m2, thus increase 1 W/m2 equals 510 TJ / s for total earth surface. Energy content of Hiroshima bomb 'Little Boy' is estimated to be equivalent to 63 TJ. Increase of 1 W/m2 is the equivalent of 510 / 63 = 7.6 'little boys' per second or about 600,000 Hiroshima nuclear bombs per day for earth.

Graph 2 – Energy Sources

Our emissions are increasing due to the fact that we are still meeting the large majority of our energy demands with fossil fuels. The chart on the right shows that 81% of all our energy is produced by either coal, oil or gas. These statistics are taken from the latest data of the International Energy Agency. It shows that wind and solar power has dramatically increased from around 110 Twh to over 1,580 Twh since 2005, a whopping 1,450% increase.



Graph 2: Courtesy of Homo Sapiens Foundation, OurFutureUncompromised.org

However, increasing the size of an apple pip by 1,450% does not change much if it is in competition with slowly inflating Beach Ball or Hopper Ball that had a sizeable head start. In fact, although the use of fossil fuels increased by a much smaller percentage, it outstripped green energy growth by 11 times in absolute terms.

In COP21 in Paris, President Obama proudly underlined the "ambitious investments" [sic] that the USA had made in tackling climate change by talking about the size of his 'apple pip': "Over the last seven years, we've made ambitious investments in clean energy, and ambitious reductions in our carbon emissions. We've multiplied wind power threefold, and solar power more than twentyfold."

Globally, wind, solar, hydro and all other renewable non-emittive energy sources still only account for 4% of humanity's energy supply. Nuclear Power, for all of its other complications, is at least carbon friendly, so we get to 9% with this included. Biomass (which is emittive and has great unsustainability issues) is about 10%.

The impression that we might have, from casually observing solar panels on people's roofs or wind turbines in the open fields by motorways, is that green energies are significantly replacing fossil fuels. Politicians may frequently cite their commitments to huge-percentage increases in green energy supplies.

However, the data that matters shows very clearly that we are not making any inroads into curtailing our reliance on fossil fuel. The word "transition" for the energy sector is a real misnomer: It has never happened. The whole industry is stuck in stasis.[22],[23]

In fact, all of the recent policy commitments to new investments in green energy are not even sufficient to deal with the increased demand for energy that will come in the years ahead from factors such as consumption and population growth. Therefore, fossil fuel use and emissions will continue to increase until 2030 and beyond.[24],[25],[26]

22 T.C.J.Dangerman & A. Grossler, "*No way out? - Analysing policy options to alleviate or derail Success-to-the-Successful in the energy system*". (2013) https://hdl.handle.net/2066/91359

23 Wainstein, M; Dangerman, J; Dangerman, S, *Energy business transformation & Earth system resilience: A metabolic approach, Journal of Cleaner Production*, 2019, 215 pp. 854 - 869

24 United Nations Framework Convention on Climate Change (UNFCCC) *Updated synthesis report on the aggregate effect of the Intended Nationally Determined Contributions* (INDCs) May 2016.

25 PBL Netherlands Environmental Assessment Agency, Climate Pledge NDC Tool, Global emissions, http://themasites.pbl.nl/climate-ndc-policies-tool.

26 United Nations Emissions Gap Report, 2019, figure ES4.

Graph 3 – Rising Emissions

On 4th June 1992, the United Nations Framework Convention on Climate Change (UNFCCC) opened its doors for the Earth Summit in Rio. By 1994, the UNFCCC entered into force with near universal membership (196 parties).[27] It had become very clear that humanity was stepping into very dangerous territory with global warming. The UN understood that the politicians needed regular updates on the science and regular reviews of the progress made in achieving the Convention's objective. The convention's ultimate decision-making body is the Conference of the Parties (COP) and, as part of their plan, they established annual COP meetings in which these reviews would take place. The first COP meeting took place in Berlin on March 28th, 1995.

The UNFCCC has a singular objective: "To stabilise greenhouse gas concentrations in the atmosphere at a level which would prevent dangerous anthropogenic interference with the climate system".

There have been a long list of negotiated outcomes that often carry the name of the location in which they were agreed upon, and state various purposeful slogans. However, despite all of the signatures, the troubling fact is that not a single COP meeting has made progress in achieving its declared objective. The reason for gathering hundreds of politicians, diplomats and scientists together every year is to achieve the goal that the UNFCCC was set up for, which is "to stabilise emissions".

A list of the meetings is presented on the next page.

27 United Nations Framework Convention on Climate Change timeline.

UNFCCC Conference	Year	Location	Negotiated Outcome	Emission Outcome CO_2 parts per million[28]	Emission Outcome Gigatonnes of CO_2 per year[29]	Emission Outcome Limit for 1.50C Gt of CO_2[30]
COP 1	1995	Berlin	Berlin Mandate	360.0	27.8	1,091
COP 2	1996	Geneva	Geneva Ministerial Declaration Noted	361.8	28.3	1,063
COP 3	1997	Kyoto	Kyoto Protocol	362.9	30.4	1,033
COP 4	1998	Buenos Aires	Buenos Aires Plan of Action	365.5	28.4	1,004
COP 5	1999	Bonn	Bonn Agreement	367.6	2[illegible].3	976
COP 6	2000	The Hague	Bonn Agreement Consensus	368.8	29.3	947
COP 7	2001	Marrakesh	Marrakesh Ministerial Declaration Adopted	370.4	29.4	917
COP 8	2002	Delhi	Declaration on Climate Change & Sust. Development	372.4	30.4	887
COP 9	2003	Milan	Climate Change Fund & Least Dev. Countries Fund	375.0	32.0	855
COP 10	2004	Buenos Aires	Complete Marrakesh Accords	376.8	33.1	822
COP 11	2005	Montreal	Global Environmental Facility Guidelines	378.8	33.8	788
COP 12	2006	Nairobi	Nairobi Framework We[illegible]	381.0	35.0	753
COP 13	2007	Bali	Bali Roadmap	382.7	35.0	718
COP 14	2008	Poznan	Adaptation Fund	384.8	36.2	682
COP 15	2009	Copenhagen	Copenhagen Accord	386.3	37.4	644
COP 16	2010	Cancun	Cancun Agreements	388.6	38.5	606
COP 17	2011	Durban	Durban Platform for Enhanced Action	390.5	39.6	566
COP 18	2012	Doha	Doha Amendments to the Kyoto Protocol	392.5	40.5	526
COP 19	2013	Warsaw	Warsaw Outcomes	395.2	40.9	485
COP 20	2014	Lima	Lima Call for Climate Action	397.1	41.1	444
COP 21	2015	Paris	Paris Agreement	399.4	41.6	402
COP 22	2016	Marrakech	Marrakech Action Proclamation	402.9	40.8	361
COP 23	2017	Bonn	Fiji Momentum for Implementation	405.0	41.2	320
COP 24	2018	Katowice	Paris Rulebook not finalised	407.4	42.1	278
COP 25	2019	Chile Madrid	Paris Rulebook not finalised	409.9	43.1	235
COP 26	2020	Postponed				

Long-lived-greenhouse Gases

Graph 3 Courtesy Homo Sapiens Foundation – Our Future Uncompromised, adapted

28 Ed Dlugokencky and Pieter Tans, NOAA/GML (www.esrl.noaa.gov/gmd/ccgg/trends.

29 Friedlingstein P. et al, *Global Carbon Budget 2019, Global Budget v1.0.*

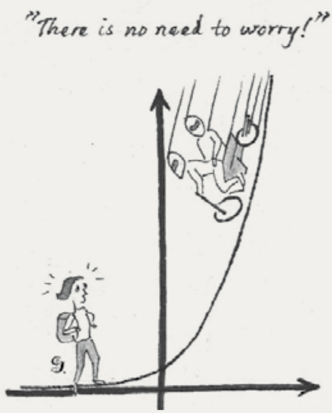
30 Cumulative CO_2 emissions until 2100, < 1.5°C, > 67% probability, IPCC (2018) Global Warming of 1.5°C, table 2.2. Limit by the end of the mentioned year.

The red line, which cuts across the years and the places is going up.[31] We have gone from 360ppm of CO_2 to 410ppm, because we have continued to add excessive amounts of CO_2 into the atmosphere. In 1995, the year of the first COP meeting, we added an extra 27.8 gigatonnes of CO_2. This number continued to climb through the nineties and we now emit over 40 extra gigatons of carbon in a year. This is a very basic observation, but it has to be stated repeatedly.

The UNFCCC has many sub-groups, from Climate Finance to Climate Technology, from Deforestation to Gender, but it has one singular overriding objective. It has to keep anthropogenic interference in the atmosphere to a safe level. All of the other targets and outcomes only have any value in how they relate to this central aim.

The UNFCCC is not doing its job.

In Paris at COP21, Obama announced positive news about the bike that we are all travelling on at an impossibly fast speed: "... the good news is this is not an American trend alone. Last year, the global economy grew while global carbon emissions from burning fossil fuels stayed flat. And what this means can't be overstated." When the scientific reality is put squarely against his use of the word "s tabilisation", Obama's statement does actually sound like a major overstatement.



In the graph above, it can be seen that there have been some years during which the rate of increase started to flatten out, but this is hardly a comforting fact. If you were to be a child as a passenger on your dad's

31 This much hyped 'lull' in energy related CO_2 emissions in 2015-2016 was short-lived. Energy CO_2 emissions grew at 1.5% in 2017, 1.8% in 2018, and so on. The 2020 decrease in emissions because of the global economic slow-down as a result of the COVID measures, is expected to be short-lived. Of course, to stop climate change emissions have to be zero.

bike, and because of his enthusiasm and energy the bike had accelerated at an exponential rate, it would be little comfort if he shouted the message: "There is no need to worry" through the wind-noise.

Slowing down the rate of increase is not enough. Even if your bike stopped increasing in speed and stabilised at 100kmh, it is still going way too fast. Moreover, this is not a flat track, and there are major obstacles and bumps ahead.

What is urgently needed is a firm and sensible application of the brakes to actually slow down the bike to a speed that is compatible with your survival[32].

UNFCCC – A School Report

In the European School system, where my students study, the pass mark is 5 out of 10. A failure to meet this average mark means that they must repeat a year of schooling.[33] Throughout the year, the students are presented with their grades in tests and homework across all of their subjects with marks out of 10. Their continual assessment is provided so that they can know if they are on target, and it helps students, teachers and parents make the right interventions in adequate time. A student with homework scores of 3/10 in Maths and French, a 7/10 in Art, but with 4/10 in all the other subjects will clearly be in danger of having to repeat the year.

It is a clear method of assessment.

32 In fact, to achieve 1.5°C or lower we need to go in reverse, but first we have to slow right down and eventually stop.

33 There are some qualifications to this rule.

Going back to Obama's speech at COP21 Paris, this level of clarity is absent: "For our part, America is on track to reach the emissions targets that I set six years ago in Copenhagen. We will reduce our carbon emissions in the range of 17 percent below 2005 levels by 2020. And that's why last year I set a new target: America will reduce our emissions 26 to 28 percent below 2005 levels within 10 years from now." No, there is not a problem with the microphone, there was no problem with the autocue. That is how Obama presented his emission goals.

What is the concrete reality behind these confusing numbers? Do these commitments bring us closer to the UNFCCC's objective or not? If they do, how much closer? Why do the media and the public tolerate being given their information in such a jumbled way, especially for something so fundamentally important to every society?

The USA was not alone in making things cloudy in Paris. Obama was simply following what has become the standard way in which the vital statistics for climate emissions data are released and published. Climate targets continue to be framed like this. For example, in 2020, the EU established the European Green Deal that affirmed its intention to reduce emissions by at least 50% (and towards 55%) by 2030 based on the level of 1990.[34] Japan is committed to reducing its emissions by 26% by 2030 based on the level of 2013, and so on.

By contrast, Economics would not tolerate such numerical ambiguity.

34 Proposal for a Regulation of the European parliament and the Council establishing the framework for achieving climate neutrality and amending regulation, European Climate Law (2020/0036 (COD)).

It is informative to make a comparison with another institution. For example, The Bank of England has a clear mandate, much like the UNFCCC. It must keep the UK's inflation (CPI) "as close as possible to 2%". The Bank must write an open letter of explanation to the Chancellor of the Exchequer if the CPI index roams more than one percentage point away from this target in either direction. In the letter, it has to explain how long it expects the inflation rate to remain off target, and the bank must also explain the policy actions it is taking to rectify the problem.

On the homepage of the Bank of England's website, the target inflation rate (2%), the current inflation rate (0.6%, as of July 2020) and two other key statistics (the lending rate and QE) are clearly shown. This is just common sense. In a democratic society, government institutions are accountable to the public and whether they succeed or fail in their goals, everyone has the right to know what is happening. This is especially true with something as fundamentally important to the economy as interest rates and inflation.

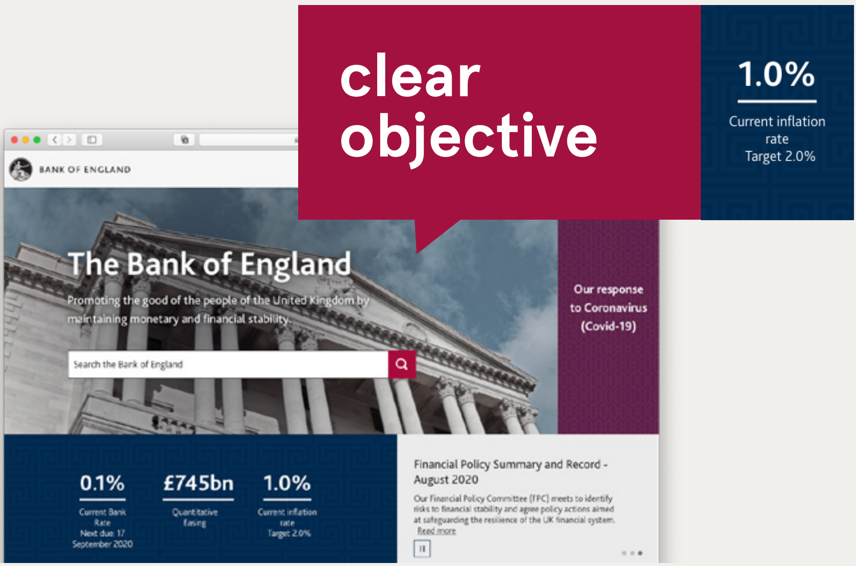


Image 3. - Bank of England Homepage

A visit to the UNFCCC website is very different. Anyone (whose interests include treasure hunts and wasting valuable time) could spend several days clicking around the website looking for the key information. There are interesting articles about beating plastic pollution, how people in the Sahel are developing solar energy and so much more. It is a busy webpage with many layers and hundreds of articles that are related to climate change. All of which creates the impression that something is being done.

However, the fundamental question about climate change remains unstated and unanswered.

The essential target for humans is buried far away from the home page, and the essential data that demonstrates our progress towards that target is missing. It is a systemic problem that extends from the webpage to the podium. It is a systemic problem that is also mirrored in the way the media reports on the UNFCCC. For the media, a motivation to get to the roots of a story has been undermined by the commercial imperative to appear interesting and attract clicks.

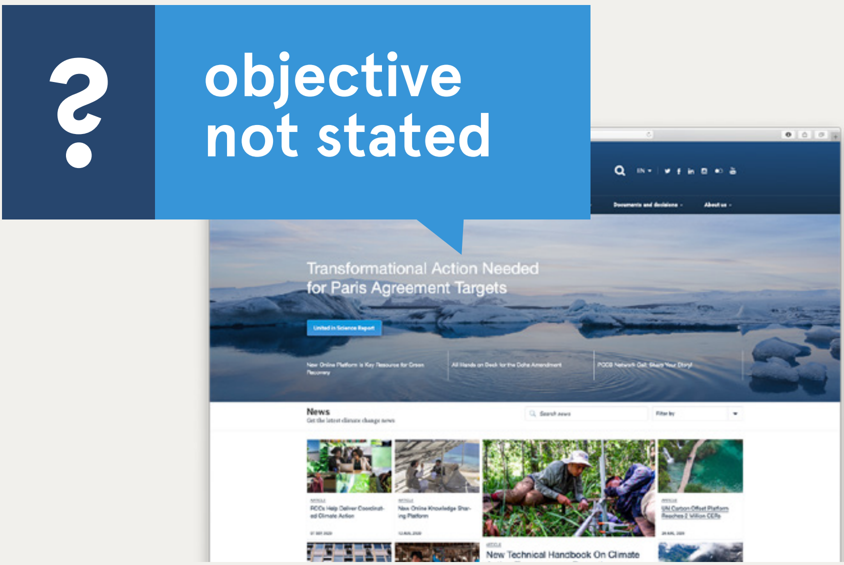


Image 4. - UNFCCC Homepage

Back to School

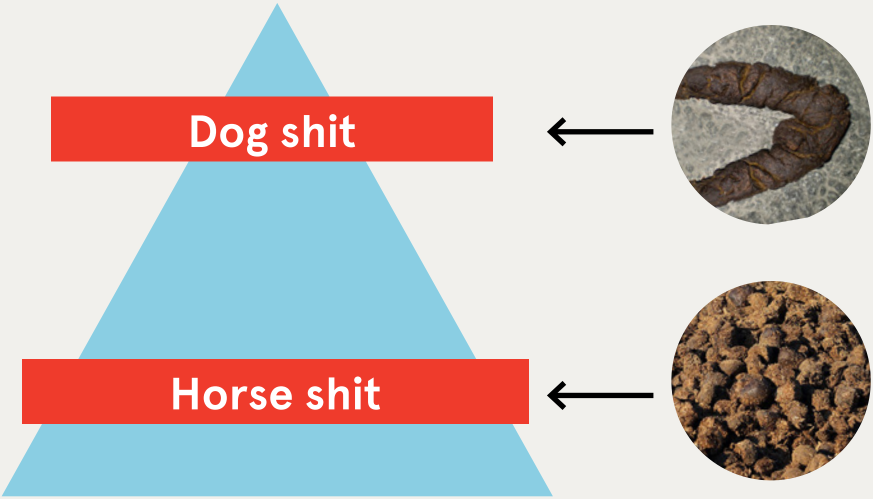
There are two school-related issues here.

Firstly, returning to the problem of reporting emissions targets as percentages: imagine that as a parent you receive a report for your child which reads like this: "In History, we expect Madeline to achieve a 26-28% improvement in her grade by 2025 based on the results she attained in 2005" and "In Geography, we expect Madeline to increase her mark by 40% by 2040 based on the level of 1990". Given such a foggy and muddled format, you would rightly insist that the school provide another document. It would be reasonable to ask for the overview to be given in grades like 7/10 and 8/10. It is a notation system that is transparent, and it enables the reader to draw the main conclusions easily. They show where improvements have been made, and where more effort or interventions are needed.

Every child in a class has the right to know how well they are performing, for better or worse. Every citizen has the right to clear information about the atmosphere.

Secondly, many students who fail an exam or an assessment do so because they do not answer the question. When appropriate, my Philosophy students' essays are assessed on a 'shit' scale. At the bottom of this scale is horseshit. These responses are characterised by various features: they cover a large area, they have little shape but a large volume, they don't really smell of anything because their content is rather bland, and they are not very memorable. Although it is a very unpleasant thought, at the top of the scale is dogshit. These are outstanding essays, characterised by a very meaty content, a compact size and a strong impression that is difficult to forget. Most importantly, dogshit essays point somewhere.

If I invited my students to assess any of the speeches made in all of the COP meetings, or indeed any political comments about climate change, they would be graded as horseshit. They simply do not answer the question that they have set out to answer. Although teachers can monotonously repeat the same message about focus, and although many students struggle to see why this is so fundamentally important in an assessment, the dull fact is that not answering the question posed makes all of the knowledge and understanding they might have used irrelevant.



Whilst it might seem tedious, the press must continually hold their politicians accountable to their own mission of "stabilising greenhouse gas concentrations in the atmosphere at a level which would prevent dangerous anthropogenic interference with the climate system".

In order to keep this properly in focus, there are two very simple questions that must be posed: "How many more gigatonnes of carbon can be released before we commit ourselves to a 2°C rise, or 1.5°C?" and "When are we currently projected to exceed that carbon limit?"

The truth is, these are not actually boring questions. In an odd way, they are the most striking questions, because nobody is asking them. It is weirdly mesmerising that every year thousands of delegates, with thousands of scientists, accompanied by thousands of staff, tracked by thousands of reporters, all assemble in one town for 2 weeks – and the main reason for them all being there is not directly addressed or openly discussed.

Graph 4 – The Gigaclock

Here is the answer to the first of those questions:

"How many more gigatonnes of carbon can be emitted before we commit ourselves to a 1.5°C or 2°C rise?"[35]

Researchers are constantly refining their modelling of how the biosphere would respond to heightened CO_2 levels. They have to consider so many variables when making these calculations. These limits come from the 2018 IPCC Report Global Warming of 1.5°C.

The simple point of this graph is to show that there is a limit to what can be put up into the atmosphere. It also shows the accelerating speed with which we go through the budget by the rapidly increasing sizes of subsequent 20-year slices. At 2019 emissions, we are due to spend the 1.5°C budget by 2025, the 2.0°C budget by 2043.

It is a number that should be clearly displayed on the UNFCCC website, as it rolls down to 0.

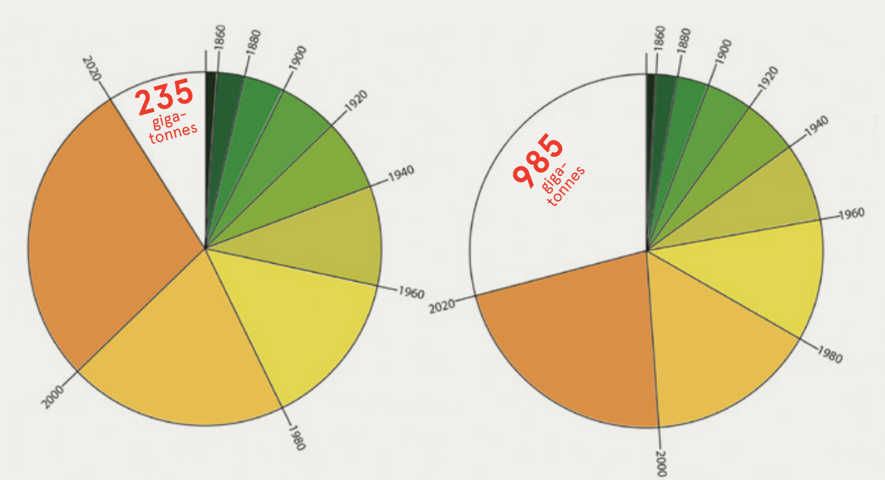
If we take the Paris Agreement at face value, and assume that all of the nations of the world actually want to limit climate change to well below 2°C, then this carbon budget would be the starting point and the end point of the commitments and the negotiations that follow. The fact that this simple budget does not define either the political or public debate about tackling climate change indicates that we are not yet really serious about the crisis.

We remain lost in a fog of meaningless targets that have been fixed without any reference to this budget.

35 There are some important qualifications to this graph. Firstly, these are for a 67% probability to limit warming to 1.5°C or 2°C since pre-industrial average. It relies on a rapid reduction of other greenhouse gas emissions and accounts for earth feedback systems. It does not include any negative emissions or temperature overshoot (then cooling).

Remaining limit for 1.5°C
5 years of 2019 emissions

Remaining limit for 2°C
23 years of 2019 emissions



Temperature increase since 1850–1900	Limit 1840–2100	Emitted by 31 Dec. 2019	Remaining by 1 Jan. 2020
~1.5°C	2,635	2,400	235
~2°C	3,385	2,400	985

Graph 4: Courtesy of Homo Sapiens Foundation, OurFutureUncompromised.org

Graph 5 – the state we are in

Where are we now?

The safest interference with the atmosphere would be as close to a 0°C rise as possible. However, the World Meteorological Organization confirmed in 2019 that we have already achieved a 1.1°C increase.[36] Having already overstepped a 1°C rise, human society has passed a threshold that scientists warned us that we should not cross decades ago.

Given that anything over this line carries significant risk, the boundary for a global warming rise was set at COP21 in Paris in 2015. According to the Paris agreement, nearly every nation of the world committed "**...to limit global warming to well below 2°C, preferably 1.5°C**".

However, here is a strange fact. The level of CO_2 that is in the atmosphere now basically guarantees that a rise to 1.5°C will happen in the near future.[37] This is because of what scientists call 'lock in' – certain CO_2 levels 'lock in' temperature rises, even if it takes years to materialise. There is a time-lag between the CO_2 going up into the air and the thermal effects taking place. It is like setting an oven to a certain temperature; we know that it does not get to that temperature immediately, it takes some time.

To avoid a 1.5°C rise, truly gigantic amounts of CO_2 will have to be removed from the atmosphere - something we do not know how to do. There are many other aspects to this issue, that would take too long to open up here, but underneath all of the debates about what is 'plausible' and how they should pin the parameters of stating an 'average' temperature, the bald truth is that unless something close to miraculous happens, 1.5°C is effectively going to happen.

36 https://public.wmo.int/en/media/press-release/2019-concludes-decade-of-exceptional-global-heat-and-high-impact-weather.

37 Rogelj, J. et al. *Energy system transformations for limiting end of century warming to below 1.5 °C*. Nat. Clim. Change 5, 519–527 (2015).

This mechanical detail about the climate system is well understood by science, but this has not been evident at COP meetings. Neither the highest-ranking politicians, nor the media seemed to be aware of the implausibility of even negotiating anything relating to a 1.5°C rise. It was almost surreal to follow the coverage of the COP21 (Paris) back in 2015, given that this most basic fact about the situation was simply not on the table. For example, the BBC's Science Correspondent, Matt McGrath, published an article just before the conference in which he reported that 15 leading Buddhists, including the Dalai Lama, called for the Paris Agreement to limit warming to 1.5°C. However, no comment was made about this ambition being a very improbable goal.[38] A BBC Sport correspondent would not ask a football manager what result he might be hoping for in a match in a post-match interview. He should have watched the game and questioned the manager about the performance and the result.

With 1°C already here, and with 1.5°C coming, the scientists have insisted that the temperature rise caused by current and projected emissions will invite an unmanageable amount of damage and risk for human civilisation. In fewer than 20 years, with Paris fully implemented, GHG in the atmosphere will likely cause dangerous 2°C, the upper limit of the COP21 agreement. Despite this, many major industrialised nations are not even on track to fulfil their Paris commitments.

What are we heading into?

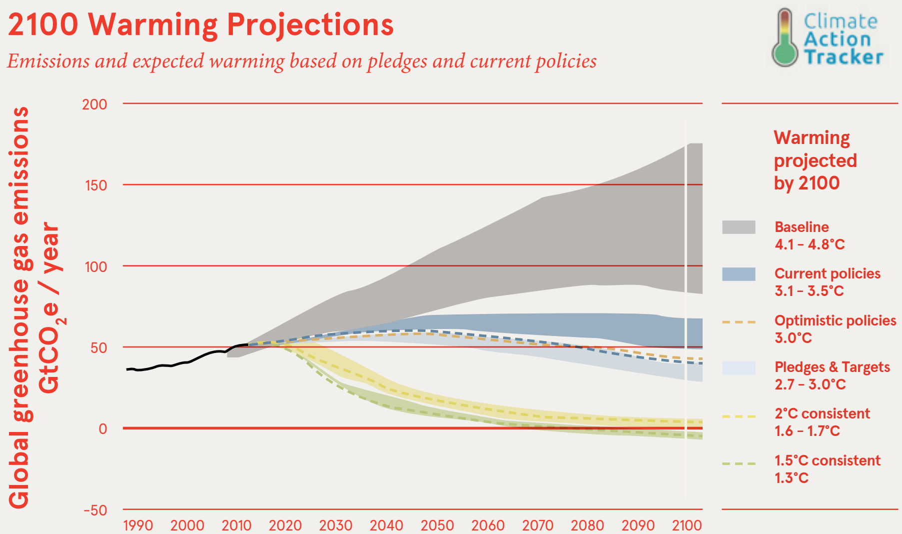
There is a great deal of difference between where we are now, and the policies and action that are required to get "well below 2°C". This gap is known as 'The Emissions Gap'.[39] All nations of the world agreed to put forward their Nationally Determined Contribution (NDC) towards stabilising GHG in the atmosphere. 190 nations made an intended

38 https://www.bbc.com/news/science-environment-34658207.

39 UNEP (2019) *The Emissions Gap Report 2019, United Nations Environment Programme* (UNEP) Nairobi, figure 3.1.

commitment and 173 proceeded to submit their national commitments. Interestingly, Nicaragua neither offered an NDC, nor did it sign the Paris Agreement. This was not because of some delusional leader, but, rather nobly, it was because they simply wanted to point out the size of the emissions gap and they wanted to protest about the lack of serious action.

Indeed, even when all of the NDCs are added up, and assuming that every nation will follow through on its commitments (and most major industrialised nations are failing to meet their pledges[40]), humanity is still heading for a climate that is projected to be an intolerable 3-4°C warmer. This is shown by the two blue sections on the graph; the upper dark blue



Graph 5: Courtesy of Climate Action Tracker

area represents the current policy commitments, and the lower lighter blue represents the pathway if current targets are met. It might be the case that nations enter into a positive feedback loop with policy making once public opinion swings firmly behind climate action, but it is also true that nations can emphatically swing the opposite direction, such as with the USA and Brazil recently.

40 Victor, D.J. et al. *Prove Paris was more than paper promises.* Nature 548, 25–27 (2017)

That is bad news.

However, this graph is highly misleading.

There is worse news...

Negative Emissions

The climate scenarios that the media use rarely disclose that calculations include 'negative emissions'. Working out negative emissions involves counting the total greenhouse gases that are drawn out of the atmosphere. Trees and plants do this all the time, and so rewilding our landscapes would help boost our negative emissions. However, what the graphs and calculations in the public domain do not admit to is the sheer scale of how much negative emissions capacity is assumed in the numbers – it far exceeds what is currently available. They imagine that we are able to suck CO_2 out of the atmosphere on a truly massive industrial level with technology that does yet exist.[41]

It seems to be neither correct, nor transparent, to have such reductions in greenhouse gases included in the graphs, yet they almost always are. The 2100 Warming Projections graph (previous page) from Climate Action Tracker is no different[42]. It is, therefore, very misleading.

There are two important statements to be made then in conclusion for Graph 5.

41 Even if it were to exist, such projects would suffer from the usual objections of NIMBY.

42 The UN also produced a similar graph, with a little more detail, in their "*Emissions Gap Report 2019*". They also include unproven and misleading levels of negative emissions in their calculations.

Firstly, we are essentially committed to overstepping a 1.5°C rise.[43] This is because without dabbling in the scientifically and ethically dubious potentials of geoengineering, and with carbon capture still a far distant reality for the scale required[44], there is simply no path from the present that can pull us to that safety point from here once the negative emissions have been properly accounted for.

Secondly, if the media reporting was more transparent about the current path that we are on, then the projections would show that we are actually heading for a rise of around 4°C by 2100.

Another way of stating the facts is to acknowledge that the current NDCs only add up to a commitment that is one sixth of what is required.[45],[46]

Graph 6 – Who is responsible?

Most media coverage of climate change points to China as the world's worst emitter of CO_2. The figures require some adjustment to get an exact picture of who is causing the emissions. Given that the atmosphere is shared by every human being, the statistics should show the figures divided on a *per capita* basis. Everyone has an equal right to the earth's resources and, therefore, to an equal share of the atmosphere.

For example, China has 1.42 billion people, 18.5 % of the world's population, and accounts for 28 % of global CO_2 emissions. In comparison, the USA has only 0.3 billion people (4.2 % of the world's population) and accounts for 15% of emissions. In other words, Americans' emissions are 17 tons of

43 Rogelj J., et al. Paris Agreement climate proposals need a boost to keep warming well below 2 °C. Nature 534, 631-639 (2016)

44 Anderson, K. & Peters, G., "The trouble with negative emissions." Science. 354, 3609, p. 182-183 2 p (2016)

45 United Nations Environment programme, Emission Gap Report 2018

46 These figures were all correct at the time of going to press. As different editions of the book are published, these figures will be updated. For updates, see OurFutureUncompromised.org.

CO_2 per person, and Chinese are 7 ton/person per year.[47] This is true for 'territorial' emissions. This calculation of emissions measures the volume of CO_2 that are emitted from within each national boundary of the globe. Indeed, that seems like the common sense way of counting emissions. Portugal and Peru, Bulgaria and Brunei should all be held accountable for what they produce within their territory.

However, the map of emissions looks quite different if the emissions are calculated as 'consumption emissions'. This means that if a European buys a product that was made in China, then the emissions that occur because of their consumption are counted as European, not Chinese. This way of calculating emissions accounts for the major industrial powers 'outsourcing' of the external costs of their lifestyle and is, therefore, fair and representative.

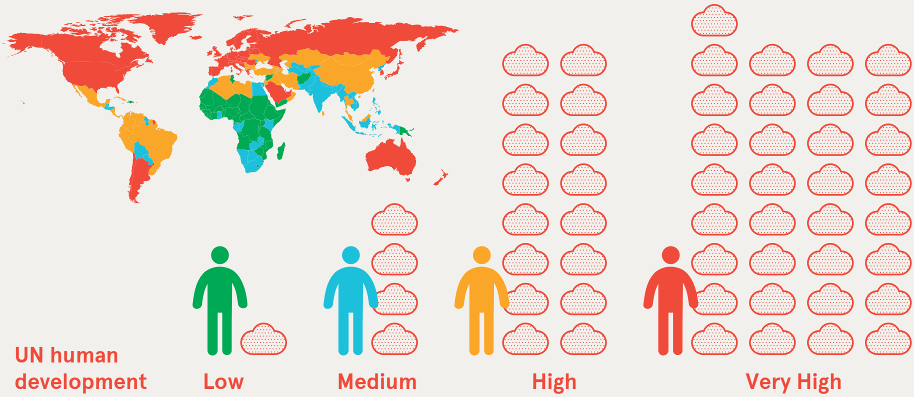
If emissions are only calculated 'territorially', then China has 30% of the volume of CO_2 emissions and Europe has 10%. If emissions are calculated based on consumption, then China only bears 24% responsibility for the CO_2, and the EU (28) bears 12% of the responsibility.By lining up the data in this more realistic way, Luxembourg comes out as the worst country with 41 tons CO_2/*capita* and Rwanda as the least culpable with 0.1 ton CO_2/*capita* per year.[48]

Once all of this has been taken into account, a clearer map emerges of the distribution of CO_2 emissions. Therefore, throughout this book the emissions will be counted both as 'consumptive' and '*per capita*'.

47 Friedlingstein P. et al, Global Carbon Budget 2019, National Emissions v1. Population data: United Nations World Population Prospects 2019 revision. *Per capita* data, Homo Sapiens Foundation.

48 Ibid.

Responsibility for objective failure



Graph 6: Courtesy of Homo Sapiens Foundation, OurFutureUncompromised.org adapted.

Overall, the nations which the United Nations classifies as “Very High Developed” (USA, EU) cause 33 times more emissions *per capita* than those nations classified as “Low” (Nigeria and other African nations), 8 times more than “Medium” (India), and twice the amount of those classified as “High” (China)[49].

Apart from the basic inequity of these proportions, it is also instructive to remember that those countries that contribute the least to the problem also have the fewest resources to stop it from happening.

The final consideration that is required to get the most accurate image of climate change responsibility is ‘historical emissions’. Most of the countries classified as “Very High Developed” have a strong economic position because they were the first nations to industrialise their economies. This historical fact means that they had a large head start in filling the atmosphere with CO_2.

49 Calculations OurFutureUncompromised, data United Nations World Population Prospects 2017 Revision (medium estimate) (2017), United Nations Development Programme Human Development Index (2018), Le Quéré C et al. Global Carbon Project, Carbon Budget and Trends (2018).

When this is recognised, the figures show that the "Very High Developed" nations cause 70 times more *per capita* than "Low" Developed nations, they cause 21 times more than "Medium" and 5 times more than "High".[50]

The example of Nicaragua

In an interview covered by Democracy Now![51] during COP21, Paul Oquist, the chief UNFCCC negotiator for Nicaragua expressed his dismay at the progress in Paris: "...3 degrees Celsius is not acceptable. Three degrees Celsius is a disaster. It is catastrophic. So, we think that we have to get out of this spin and back to where the problem can be solved".

During the interview Oquist makes very pertinent points that helps us wrap up this section of key data. He explained that Nicaragua had not signed the Paris Accord[52] for three reasons:

- It was non-binding;
- It was insufficient;
- It was unfair.

50 Calculations OurFutureUncompromised.org, data Boden T. A. & Andres R. J. Carbon Dioxide Information Analysis Center (CDIAC) National Fossil Fuels CO_2 emissions 1751-2014 (2017); Global Carbon Project (2019) National Emissions V1, United Nations Development Programme, Human Development Index (2019), United Nations World Population Prospects 2019 revision

51 https://www.democracynow.org/2015/12/4/we_do_not_want_to_be

52 Nicaragua did eventually accede to the Paris Agreement in October 2017.

11%

Chapter Nine

System Change; Cut11Percent

Science-based laws

All of the principles and explanations from those 6 graphs can now be brought together. They can be embodied into one number. This number indicates what each individual nation of the world needs to do for us all to have a genuinely safe and prosperous future. This singular number for each nation of the world specifies how fast they must reduce their emissions each year, if we really are all committed to staying well below 2°C.

These numbers are needed to inform binding climate laws at a national level. Climate change is a systemic issue, so it requires a systemic response. Laws are the abstract structure to all of our lives and are the only effective way to affect change at a rapid, robust and systemic level. These numbers should, therefore, be used in every nation by those on the streets and by those in the media. They should be used as the standard measure for anyone writing casually or professionally about the climate crisis. These numbers will indicate if we are succeeding or failing to preserve the awesome beauty of this remarkable planet.

This section concerns the most basic level of our solutions to climate change. If we get this solution in place around the world, it will trigger all of the other innovations, improvements and restorations that we would love to see around the globe.

Whether via the courts or via parliaments, these national numbers are essential for judging our progress away from a system collapse and towards a happier world.

They should also be used in climate negotiations in future COP negotiations, but the likelihood of a weak and fragmented structure, such as the current United Nations, making any significant progress is remote. Of course, the objective should be upheld at all times, but the slow crawl of establishing sufficient emission reductions by voluntary consent has failed to achieve any meaningful progress so far and the strong tides of nationalism, protectionism and defensive foreign policy in 2020 do not seem likely to diminish soon.

In any event, the strongest psychological, legal, media and social forces operate at a national level. For example, we are easily triggered by national news events that are reported in the media with a sensitivity to the particular history and characteristics of our nations. National legal systems are also far more developed than those that are emerging in international law. Fighting for climate justice will best happen at this level.

The Numbers

These numbers assume some very basic things:

- There is only one atmosphere;
- Greenhouse gases disperse equally in the atmosphere;
- The atmosphere should be shared equally by all humans. [53]

53 See the 'One Atmosphere Equal Rights' initiative, administered by Homo Sapiens Foundation, supported by many eminent scientists from every nation and discipline, including Nobel Prize winners (OurFutureUncompromised.org).

The numbers are based on the latest data and the conclusions of the best science available in 2020.

Each national number is calculated in the following way:

• It takes the total remaining carbon budget
that limits the warming to 1.5°C or 2°C;
• These budgets do not include unproven reductions of negative emissions achieved by technology that does not yet exist;
• They do not include the possibility of overshooting the targets and then dragging the concentrations back to a safe level at a later date;
• The numbers do include the latest updates to how we understand Earth System sensitivity to greenhouse gas emissions;
• This budget is then divided *per capita*;
• Each nation is then apportioned their fair share
of the reductions, based on emissions generated by the consumption of goods and services by that country;
• The reductions are calculated on a percentage
eduction from the current level of emissions;
• This percentage is to be achieved in the year
starting from now and repeated each year.

After these steps, a few significant numbers are established. At the time of writing (August 2020) the global average reduction in emissions required every year (from now) to keep global warming below 2°C stands at 4.1%. The average for the EU is 7.4%. For the 1.5°C target the numbers are improbably large, with 16.1% annual reductions for the global average and 30.4% annual cuts for the EU 27[54].

A full set of numbers for almost every nation of the world can be found in the appendix and at www.Cut11Percent.org.

54 For annually updated data and references, see OurFutureUncompromised.org

The numbers stand in opposition to the way climate targets are set and discussed at the moment. In other words, all of the problems outlined in the previous section have been squeezed out. The figures provided here in this final section are unashamedly different from the whole public and political debate about climate targets. For any policy maker or voter who is reading this, these numbers cannot be related to the current climate targets. They are fundamentally different, and rightly so. The entire game of climate negotiations so far has been profoundly misleading and ineffective. The whole game of % reduction targets for a future date, based on a previous date, with all sorts of hidden assumptions loaded inside has to be bravely called out for what it is by those in power and those on the streets. It is a game that we have all grown up with and become used to, but this accepted norm needs to be urgently replaced by a far simpler, fairer, more honest format of reporting.

Why 11%?

Why 11?

Eleven percent represents the average reduction of greenhouse gas emissions that all Very High Developed (VHD) nations together need to achieve per year, every year, starting from the moment when our initiative started.[55] It is, therefore, a symbolic number that will remain fixed as a statement about the new approach that is needed for climate change debate and policy making.

The numbers for each individual nation in this group are different. The numbers for each nation will either rise with inaction, or fall with strong action. The reason for citing this number as the symbol for the project

55 To limit global warming to 2˚C with >66% probability accounting for earth system feedbacks, rapid reduction of non-CO_2 forces, and international and intergenerational equity, global carbon emissions from fossil fuels and industry (not including land-use emissions) must be limited to 905 $GtCO_2$ from 1/1/2019 onwards, *IPCC SR1.5 2018, Global Carbon Project 2019.*

is that the VHD nations are the healthiest, wealthiest and best educated nations on the planet, and set the example of 'human development' - a standard of living that all nations want to achieve. The VHD make up 20% of the population, and yet we are responsible for 50% of consumption emissions and for 68% of historic or cumulative emissions (the cause of climate change). They are the ones with the prime responsibility and the capacity to make the change. Once the VHD nations take the lead, the other nations will find it much easier to follow.

Why one percentage number?

The 'Cut11Percent' project provides a base line that is realistic and fair.

Embedded in "Cut11Percent" are the key principles for effective and transparent climate action. Each singular number for each nation then shows the responsibility for exiting the crisis at a national level.

We are in the end game with climate change. It is critical to know as precisely and as clearly as possible where we are up to. In the recent flood of strikes and demonstrations across the globe, there were thousands of poignant and funny banners – but in the end, it all comes down to one core question: "Are we reducing our emissions fast enough?", and there should be an easy way to answer this. It is a basic democratic issue of the 'Right to Know'.

It comes down to one vital statistic, which in 2019 for the VHD was 11%.

If 'midnight' on the Gigaclock represents the moment at which we have emitted enough greenhouse gases to lock in an average rise of 2°C, then we have to be very attentive to how fast the hand is moving towards that position. The following percentage figures can be understood as indicators of how hard we need to press on the brakes to avoid moving past 0 on the Gigaclock. The higher the number, the harder we have to press on the brakes.

We have not yet exhausted the carbon budget to avoid trespassing over the 2°C line, but the following section will explain the measures necessary to do so.

The Extractions and Emissions Table.

The table, which is presented at the start of the tables, graphs and charts section, details what each nation of the world has to do in order to restrict global warming to either a 1.5°C or 2°C rise. It starts with the Very High Developed (VHD) nations; it unpacks the responsibility of each of the VHD nations into fair portions – according to the principles of basic social justice and the mainstream science explained earlier. The table then shows what responsibility all of the other nations have in the crisis.

The VHD nations

Within this group, there are some heavy hitters and these have been colour coded as the Ultra High Developed. The colossal states of Australia (-14%) Canada (-15%) and the USA (-16%) and the diminutively sized Luxembourg (-40%) have the heaviest carbon footprints because of their highly consumptive lifestyles. Of these big players, France (-6.3%) has a lower number because of its nuclear power capacity. By contrast, Portugal (-5.6%) benefits from a Mediterranean climate, a well-developed green energy supply and a more modest level of consumption than most of its EU neighbours.

Despite the general sense in public debates that the EU is a world leader in sustainability, the figures simply do not bear out this claim. Moreover, despite all of the talk about progress with the climate crisis, as we have noted previously, the trends for emissions since 1992 are still upwards. It is still the case that every one of the VHD countries has carbon footprints that far exceed safe levels.

The cause of the elevated emissions is rooted in the resource consumption figures. This first column indicates how many tonnes of resources a VHD lifestyle requires each year. The average American (32 tonnes) and average Singaporean (78 tonnes), the average Brit (23 tonnes) and average Luxembourger (104 tonnes) are ripping up the Earth's crust at a rate that is totally unsustainable. "Earth is a Closed Mass System, energy comes in (sunlight), but no matter (natural resources).[56]"

Just like a spaceship floating in outer-space (but much bigger), our Closed Mass System has a finite supply of stuff that we need to build our cars, ships, trains and planes; to assemble the laptops, phones and lawnmowers; and to construct the bridges, houses, power stations, offices and shops. When it's gone, it's gone[57].

"The alarming evidence is that the destruction of nature by global extraction of natural resources has nearly quadrupled in the last 50 years. Astonishingly, the next 35 years of natural resource extractions and fossil fuel emissions are projected to rise the last 300,000 years (the entire time our species has walked on the Earth)"[58].

Without a radical change to our priorities, we are setting up acute problems for the generations that will follow on after us.

The bottom line with sustainable development and climate change is not just that there are many of us, the issue is that the VHD countries are consuming far too many things, and we set the example for everyone else to follow. Both climate change and excessive resource extraction can cause a collapse of our civilisation. Indeed, the scientific authority on natural resources (The United Nations International Resource Panel) has concluded that for sustainable development, the average person can consume seven tonnes of the Earth's resources per year by 2050[59] –

56 Homo Sapiens Foundation, ClosedMass.org

57 Every single element of Planet Earth came from the guts of a supernova.

58 Source: Homo Sapiens Foundation, ClosedMass.org, for references and data.

59 *International Resource Panel, Managing and conserving the natural resource base for sustained economic and social development* (2014).

a sobering conclusion for all those nations who understand themselves as highly developed.

Finally, attentive readers will note that the average emissions reductions required by the VHD since the start of the project have now dipped slightly to 10.3% per year (*per capita*, starting 2020). This is because new countries – with lower consumption levels still – have joined the group of VHD. It is likely that the COVID crisis of 2020 will reduce emissions. However, the short-term drop in consumption should not be allowed to mask the systemic changes that are needed when exiting the COVID pandemic.

The HD, MD and LD nations

In the next group, there are the High Developed (HD) nations who need to make average annual cuts of 4.2% per year from 2020. Ranked 85th in the United Nations Human Development Index, HD China is the biggest emitter of greenhouse gases in the world, with 1.4 billion people. However, its consumption emissions are 6.2 tonnes CO_2 per person, about half that of the VHD average. Whilst they are a world leading investor in green technology, they are still heavily reliant on coal to meet their energy demands.

The Medium Developed (MD) countries need to make annual reductions of -0.9% overall. India (-1.2%) with almost 1.4 billion inhabitants, is the most significant nation in this group. The modest lifestyles of India's huge population means that their per-capita emissions are low, at 1.7 tonnes CO_2 *per capita*. However, if India would follow the same path as the VHD nations into a very high consumptive, fossil fuel-powered economy then it will shunt global emissions into truly dangerous territory.

Finally, the Low Developed (LD) countries could actually accelerate their emissions by 1.9% per year on average until 2100 and it would still be consistent with their 2°C budget because their emissions are so very little per person. On March 15th 2019, the monstrous typhoon Idai slammed into Mozambique (0.6 tonne CO_2 *per capita*, +1.0%). It caused a 4-metre storm surge in Beira and an 'inland ocean' of over 3,000sq kilometres. The extent of the suffering and the damage vividly illustrated the global imbalance in play with climate change. Climate change fits closely to the entrenched plot line of the North-South divide that is so familiar to Human Geographers. There is a stark contrast between the wealth, infrastructure and emissions of the VHD nations and the vulnerability of those nations that have barely contributed to the greenhouse gases that are in the atmosphere. There was also some very heavy-hearted cost counting in the neighbouring countries of Zimbabwe (+0.4%) and Malawi (+2.8%).

Overall, we need to cut our greenhouse gas emissions by an average of 4.1% per year starting from today as a global population.

Visualising the 11%

This chapter's central goal, concerning the science, is to establish the vital statistics for our future on this remarkable planet. These key figures do lead the mind to wonder what such a level of emissions reductions would look like on the ground.

To help visualise what this 11% per year might look like, it could be useful to take the example of Finland. This is because the national emission cuts they need to enact are almost exactly the average for the VHD nations. Finland needs to reduce its emissions by 11% per year starting from now.

Suppose, for the sake of the thought experiment, that the transport industry in Finland makes up about 11% of their overall emissions[60] (this is a fairly standard figure for transport in VHD countries). In order to make an 11% cut, Finland would then require the entire transport sector to be genuinely carbon neutral within one year. Hypothetically, the next

60 The example of transport is just illustrative. It is not that far off being correct, but the percentage for each sector of the economy will be very different for each nation. The details do not really matter – but the process illustrates how deep and purposeful the actions we have to take are.

Image 5. - Flag of Finland

year would require the food industry to be carbon neutral for a further 11% reduction. The next three years would need a massive investment in renewable green energy, followed by intensive tree planting, kelp growing, mangrove planting[61], peat preservation… and so on.[62] A plan should be put in place for everything so that the country could be carbon neutral in time to stay within a 2°C rise.

Once a plan to reduce GHGs for every greenhouse gas emitting sector of the economy is put in place, there would then be a huge argument about which one goes first. Why should the transport sector have to be the first one to act in 2019? Why should the food industry have to achieve all of its reductions in 2020? The role of a competent government would be to take all of those transformations and line them up in a proper sequence, evenly and strategically distributed. Each sector can then fulfil its responsibility for their national economy to complete its role in keeping the global temperature rise under 2°C.

This is not the place to work through the complexities of how this might be done, let alone for each individual economy. Instead, it aims to serve as a taste of the kinds of system thinking that is required; the energy sector would certainly have to move first, because this part of the economy fuels all of the sectors and, therefore, all of the subsequent infrastructure and industry transformations could be achieved with low carbon emissions. Secondly, there are a lot of cross-sector targets that could be done too, such as increasing efficiency and reducing waste. Most importantly, reducing emissions sufficiently will not be possible without drastically reducing energy use and consumption. Indeed, there are thousands of books and academic papers that provide insights and guidance for such challenges.

61 Mangrove forests capture 40 times more CO_2 than a tropical rain forest.

62 A monumental effort must also be made in the background to work out the science of engineered carbon capturing. For the moment, although the price has fallen to around $100 a tonne, the amount of energy required to build these machines, and the rate at which they can sink carbon is far off the progress required.

However, this is not the point to get distracted, given that these types of publications do not provide their advice within a coherent plan that is based squarely on an absolute target provided by science. This short section is just a thought experiment – and this type of writing is frequently used in Philosophy. Thought experiments are not designed as an actual plan; they are deployed to get a clearer picture of the way things are behind the clutter of details. This scenario with 11% emission cuts lined up in a row has been constructed to illustrate the sheer pace of the reforms required and to understand what a genuine effort to deal with climate change would look like.

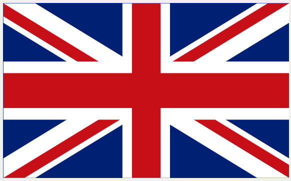


Image 6. - Union Flag

The UK could be used as a more precise example of how it might actually all work out. Within the VHD group, the UK needs to reduce its emissions by 6.9%. The government is advised to 'reduce beef and lamb' consumption by 50%, which will reduce greenhouse gas emissions by 3%. Stopping food waste will reduce emissions by 0.7%. Many people target air-flights, these are about 7% of GHG emissions in the UK, so halving them would achieve a 3.5% reduction. These 3 actions together would meet UK's 6.9% reduction for 2019. Then the UK would have to plan for the next 6.9% for 2021, then 2022, until the UK is near zero carbon.[63]

In the end, it is a task for each nation state to complete these targets as democratically as possible. In theory, each nation should then come to the global table with their commitments that are rooted in the science and principles above, and then combine their efforts with the same basic logic. Again, now is not the time to delve into the complexities of diplomatic negotiations. The role of Philosophy here is to point out the type of system thinking needed, and to show what is lacking amongst all of the images

63 Theresa May announced her government's commitment to be carbon neutral by 2050. A welcome move forwards, but this commitment allows the government to push back real action to after 2030 after which the sums would simply be utterly unmanageable. It is certainly not a figure that has been worked out from a proper empirical base. The notion that the UK is a world leader in climate action remains an aspiration, not a fact.

of solar panels and grand speeches given at COP meetings, behind all the hugely important (but disparate) ambitions of different NGOs and action groups.

There simply has to be an accountable, realistic, science-based plan that stops the Gigaclock before it ticks down to zero.

The importance of the numbers

This chapter is dedicated to the science and simply points out the very weird truth that although humanity is faced with a total collapse of its civilisation, we still do not have a measurable handle on the situation. This is the case for governments, institutions, the media and throughout society. The data is there if we wanted to look at it, we could frame all of our policies and actions by the realities of science, but for a range of reasons discussed throughout this book, we do not do it.

Of course, it is possible that we might decide that it is all too much effort once we have seen the scope of the changes required. Perhaps it is simply too late to pull public opinion, democratic processes and corporate interests around to a full acknowledgement of the cuts in emissions that are required. If this is so, then we should at least be honest and tell our children that.

However, if we are actually trying to "stabilise greenhouse gas concentrations in the atmosphere at a level which would prevent dangerous anthropogenic interference with the climate system" (UNFCCC Article 2) then we have to do it in an accountable and transparent way. We have to have a scoreboard, upon which we can add up all emission reduction proposals and then measure if we are squeezing the brakes hard enough to stop the Gigaclock ticking past zero. We cannot just wave different initiatives at the problem and hope that they work, like some sort of primitive tribal dance. They are basically meaningless if they do not measure themselves against any non-absolute target

Professor Kevin Anderson,
is a world authority in climate science, especially in the field of carbon budgets. After meeting with the Climate Academy and examining the details of the thinking he endorsed the value of 'Cut11Percent', "it is really good to see this level of scientific understanding and political integrity brought together to produce this very challenging but robust target that we all need to be using to inform our policies for the future."

Image 7. - Prof. Kevin Anderson

Individual change

It is not without some reluctance that a short attention will be given to the individual. The reason for the hesitancy is that this is overwhelmingly the centre of gravity for our thinking about the problem. Until we throw ourselves without qualification into the struggle for legally binding laws that will provoke system change, any attention given to individual action rapidly siphons away the energy required for the bigger challenges.

Such a hesitancy is not because all of the individual actions are not part of the whole; it is simply a question of remaining consistent. The pull towards the individual and small ecological gestures is so formidably strong in our culture that it seems appropriate to stand in stubborn opposition to it.

There are thousands of books out there about '100 ways to be Green', '50 ways to save the Planet', and so on. There are very few that create a proper perspective on the bigger picture. This book is unashamedly about trying to provide that. It is so easy to get lost in all of the details about climate change and to miss the central points of understanding, and the key points for action. The situation is too urgent for people to still be lost in the details.

I did lose three hours of my life once while in a meeting about the ecological value (or not) of a compost heap in school. The discussion ended without a conclusion and everyone felt deflated. Again, it is not that these small things are not part of the big picture, otherwise I would have happily spent that time eating imported beef from Argentina with a nice bottle of red from Australia. However, there is simply no time left for individuals to work everything out from the bottom upwards. The big carbon footprints in our lives are obvious, and we can deal with them with a few simple choices.

So briefly, with all of those qualifications stated, here is a short analysis of what the 11% reductions in emissions might look like at a private level.

Visualising 11% for the citizens?

An individual with the ambition to live a more sustainable life could think about their lives through a similar process to the example given for Finland. They could do a survey of their household activities and consumption, line them up, and then chop them up into manageable steps. However, there are two problems for households. Firstly, it is very difficult to make realistic plans other than what common sense provides without an easy way to work out how many percent any one person is over budget with their emissions.

Indeed, our lack of awareness about our specific carbon footprint is a significant gap in our democracies. For example, we know precisely how much fat, sugar and carbohydrates are in a packet of crisps; we also know if they have been anywhere near some nuts, but we do not know the size of each snack's carbon footprint. We have a 'Fitbit' that can provide a generally reliable idea about how many steps we took in a day, but we do not have one for the carbon footprint for each of the items we purchase. With the technology available, it would be possible to quantify the embedded emissions that we consume and that would greatly enhance our understanding of the carbon-cost of our lifestyles.

Secondly, and more importantly, our individual emissions are deeply entrenched in the system of our economies. We cannot choose the type of fuel that the bin lorry uses and we cannot decide how our clothes are made, food is produced, buildings, transport, offices, streetlights, data banks, hospitals, factories etc. are powered. Individually, we cannot change the infrastructure of our society: this determines the lion's share of our emissions. We do not directly control the big cogs in the machinery of the state, and those who do control them have proven very reluctant to move forward decisively.

In a recent study, in 'Frontiers in Psychology' the lead author Patrick Sörqvist exposes how poor much of our thinking is when we are trying to act ecologically. He comments: "Some groups have found that people intuitively think the environmental burden of a hamburger and an organic apple in combination is lower than the environmental burden of the hamburger alone".

Image 8. - A Burger and an organic Apple.

We have spent 30 years trying to handle climate change with an individual empowerment approach, where 'every little bit helps'. The problem is that all of the little bits do not add up to achieve the enormous change required. Under 'action fatigue', many people will feel satisfied that 'they have done their bit'. All this is not to undervalue the power of the electorate: we can all be determined to reduce our carbon footprint as much as possible.

Being a citizen, not just a consumer

What we need to do now is throw everything we can at holding each of our country's governments to account about the major issues. We need to put ourselves into the public space as citizens, not just consumers. The big wheels of policy need to start turning to direct the huge investments necessary into effective actions.

Our democracies must be properly informed about the bigger picture.

Again, it is rather odd that this basic set of statistics was not first published decades ago. It is absurd that our democratic societies think that we can function in the face of catastrophic climate change and yet do not show any concern for a reliable update about what is actually required – in hard numbers.

It should be admitted that our understanding of the whole climate system has improved markedly over the last couple of decades – calculating the carbon budget for a 2°C rise is enormously complex. However, there is a more obvious explanation for the absence of this data in the public domain – it clearly suits the big Very High Developed emitters to keep the public debate as foggy as possible. Any clear detail about who is responsible for the greenhouse gases in the atmosphere immediately makes the case for a fair and rapid reduction in emissions.

Banners like "No Planet B!" and the call for "Climate Action!" are all statements of anger and frustration. The sea of commitment and engagement that has poured onto the streets of towns and cities all over the world show the world's leaders just how many millions of people desperately want change. However, until these slogans are accompanied by a precise and informed demand for imperative legal action, they will easily be affirmed and then brushed off by those people who need to make the decisions. For those with a vested interest in the status quo, any open slogans or wide ambitions are fine – it is very easy to appear green in such circumstances. You can put an eco-shampoo bottle in the hotel bathroom, put out a press release about how your company is collecting bottle tops, or have your political party make some vague noises about investing in solar energy.

Making a clear demand

The suffragists had a clear goal – a woman's right to vote. The Civil Rights Movement also had a clear goal – full racial equality before the law. The slogans and speeches of the climate marches are powerful and moving – but until they consolidate around a demand for laws that are based on the reality of the chemistry and physics of the atmosphere, those in power will find it easy to agree with the problemand carry on doing nothing.

Image 9. - Irish Women's Suffrage lapel pin

A medical emergency

A fit and healthy baby that enters the world kicking and crying can score nine or a maximum 10 in the 'AGPAR Test' which is measured by doctors at birth. It was much too quiet when my son was born, he scored only a one. He was taken to an intensive care unit where the doctors and nurses rapidly hooked him up to multi-coloured tubes and wires that fed him and continually measured and monitored all of his body's key indicators 24 hours a day.

The ward was busy with general checks and moments of paperwork, close family visitors were ushered in during the afternoons, sometimes behind portable green curtains, key surgery was carried out. But in the reverential atmosphere of the unit, one thing was always familiar - the background chimes of the monitors that kept watch over every baby's vital statistics. If the oxygen level in their blood dropped below a certain level, the digital numbers would turn blue, a small light would flash, and the tone of a slow ticking chime would start to accelerate and rise in pitch. Someone in a medical uniform would then swiftly appear to make the right adjustments.

Thibault pulled through. On the day of his discharge from the hospital, I took a moment with a coffee in the bar downstairs and thumbed through a copy of '*The Economist*'. After skim-reading the articles on '*Orban versus the intellectuals*' and '*Zuma versus his people*', I absentmindedly reached the back pages. Here, all of the vital statistics of the global economy were presented (perhaps tellingly, just before the Obituaries on the very last page).

The data on these '*Economic and Financial Indicator*' pages show all the key signals from around the world, from the Greek GDP to the Columbian CPI, and from the rates of Belgian Bonds to the value of the Russian Ruble. The Nikkei 225 and the CAC 40 are monitored alongside the movements in the dollar price of Gold and West Texas Intermediate Oil. These indices can control the social and political weather - a drop in the price of oil had given a boost to the profit margins of the Pirelli in Italy, but it was causing social unrest in Venezuela. The long-term unemployment data in France and the UK had swollen the numbers of voters on the political edge, especially towards the Right.

However, Thibault was born into a world in which there was no fundamental index to measure our progress with climate change. This remains true today. In the pages of '*The Economist*' there was no tracker of how many gigatonnes of carbon we could safely emit before our whole economic system is placed into a situation in which all economic activity will be critically undermined. There was no clear index of the good, the bad and the ugly for emissions and resource consumption.

For all of those millions of people who are deeply concerned about the climate crisis, where do they go to get a reliable update about the state we are in? We all want to hold our governments to account for their inaction, but how can that possibly be measured if there are no established norms for emissions? How do we defend human equality before the law if the law has no international and scientifically informed standard to plug into? How do we uphold universal human rights if we do not make our calculations of emissions on a *per capita* basis? How can we claim to fight for climate justice if we do not use the common sense principles that are embedded in the Cut11Percent figures?

Millions of people ask the following question: “What can I do for climate change?”

The answer has to be that we need to take the protests and actions to a new level – a level with real grip that takes us beyond slogans and sentiments. We must be unified in a demand for clear, systemic change. These numbers embody the most basic principles of fairness and realism. They must be made known and they have to be respected at every level of our home nations. Without this focus, the climate protests will simply become cultural wallpaper.

This chapter is available for free to enable all of this to happen as quickly as possible, and of course, the latest updates are available at www.Cut11Percent.org.

Thank you for using and building upon our common sense.

vital

statistics

The Vital Statistics

Here are the vital statistics for human civilisation on the planet. These simple numbers are what you get when the latest scientific data and basic principles of common sense are put together.

These numbers are the work of OurFutureUncompromised.org and have been approved at the highest level of the scientific world.

	Resource Consumption			CO_2 Emissions from Consumption			
						Reduction required for	
	Per capita 2018	Trend 1993-2018	**Reduc-tion for SD**	***Per capita* 2017**	Trends 1992-2017	**1.5°**	**2°**
	Tonnes CO_2	% / yr	**% / yr**	**Tonnes CO_2**	% / yr	**% / yr**	**% / yr**
ULTRA HIGH	**29**	1.4%	-5%	**13**	0.3%	-52%	-12%
VERY HIGH	**17**	1.8%	-3%	**8.9**	0.8%	-33%	-8%
HIGH	**16**	4.6%	-2%	**4.8**	4.1%	-17%	-4%
HUMANITY	**12**	2.9%	-1%	**4.8**	1.9%	-16%	-4%
MEDIUM	**4.5**	3.6%	+2%	**1.5**	4.9%	-5%	-1%
LOW	**2.3**	3.0%	+6%	**0.4**	4.6%	-0.7%	+2%
1 **NORWAY**	**38**	2.5%	-4.9%	**9.6**	1.1%	-34%	-8.2%
2 **SWITZERLAND**	**32**	2.8%	-4.6%	**15**	1.6%	-62%	-14%
3 **IRELAND**	**22**	2.8%	-3.2%	**9.1**	0.2%	-31%	-7.6%
4 **GERMANY**	**23**	0.5%	-4.1%	**11**	-0.8%	-41%	-9.7%
4 **HONG KONG**	-	-	-	**17**	1,2%	-73%	-16%
6 **AUSTRALIA**	**43**	2.0%	-5.2%	**16**	1.9%	-62%	-14%
6 **ICELAND** *	**35**	2.3%	-5.0%	**11**	1.6%	-43%	-10%
8 **SWEDEN**	**32**	2.6%	-4.7%	**7.4**	-0.4%	-25%	-6.3%
9 **SINGAPORE**	**78**	5.5%	-7.5%	**21**	1.7%	-94%	-19%
10 **NETHERLANDS**	**28**	1.9%	-4.6%	**9.4**	-1.3%	-33%	-8.0%
11 **DENMARK**	**25**	1.9%	-3.9%	**9.5**	-0.5%	-34%	-8.3%
12 **FINLAND**	**37**	1.5%	-5.5%	**12**	-0.2%	-46%	-11%
13 **CANADA**	**35**	1.2%	-4.6%	**17**	0.8%	-68%	-15%
14 **NEW ZEALAND**	**25**	2.2%	-3.7%	**8.8**	1.4%	-32%	-7.8%
15 **UK**	**23**	1.5%	-3.6%	**8.5**	-0.7%	-28%	-6.9%
15 **USA**	**32**	1.5%	-4.5%	**18**	0.4%	-77%	-16%
17 **BELGIUM**	**24**	1.2%	-4.0%	**16**	0.7%	-66%	-14%
18 **LIECHTENSTEIN** *	-	-	-	**4.1**	-1.4%	-13%	-3.2%
19 **JAPAN**	**26**	0.5%	-5.0%	**11**	0.1%	-41%	-9.6%
20 **AUSTRIA**	**33**	1.8%	-5.1%	**11**	0.6%	-42%	-9.8%
21 **LUXEMBOURG**	**104**	3.5%	-7.9%	**41**	1.7%	>-100%	-40%
22 **ISRAEL**	**24**	2.7%	-2.8%	**10**	1.7%	-35%	-8.3%
22 **KOREA**	**29**	2.6%	-5.1%	**13**	2.5%	-57%	-13%
24 **SLOVENIA**	**24**	2.7%	-4.3%	**9.2**	0.6%	-34%	-8.1%

	Resource Consumption			CO_2 Emissions from Consumption			
	Per capita 2018	Trend 1993-2018	**Reduc-tion for SD**	***Per capita* 2017**	Trends 1992-2017	**Reduction required for**	
						1.5°	**2°**
	Tonnes CO_2	% / yr	**% / yr**	**Tonnes CO_2**	% / yr	**% / yr**	**% / yr**
EU 27	**24**	1.4%	**-4.3%**	**8.5**	-0.5%	**-30%**	**-7.4%**
25 **SPAIN**	**24**	1.8%	**-4.4%**	**6.6**	0.4	**-23%**	**-5.7%**
26 **CZECHIA**	**23**	2.6%	**-4.1%**	**10**	-1.2%	**-38%**	**-9.1%**
26 **FRANCE**	**23**	0.9%	**-3.8%**	**7.2**	-0.4%	**-25%**	**-6.3%**
28 **MALTA**	**26**	1.2%	**-4.5%**	**12**	2.2%	**-38%**	**-9.0%**
29 **ITALY**	**22**	0.6%	**-4.2%**	**7.9**	-0.6%	**-27%**	**-6.7%**
30 **ESTONIA**	**30**	2.4%	**-5.2%**	**14**	-0.5%	**-59%**	**-13%**
31 **CYPRUS**	**28**	2.7%	**-4.2%**	**7.1**	1.4%	**-23%**	**-5.8%**
32 **GREECE**	**27**	0.8%	**-4.9%**	**6.4**	-1.5%	**-20%**	**-5.0%**
32 **POLAND**	**25**	3.6%	**-4.7%**	**8.3**	-0.4%	**-30%**	**-7.3%**
34 **LITHUANIA**	**38**	3.6%	**-6.5%**	**8.3**	-1.6%	**-33%**	**-7.9%**
35 **UAE**	**50**	7.9%	**-6.3%**	**25**	5.4%	**>-100%**	**-23%**
36 **ANDORRA ***	**-**	-	**-**	**6.3**	0.6%	**-22%**	**-5.5%**
36 **SAUDI ARABIA**	**12**	-0.8%	**-1.1%**	**19**	4.2%	**-91%**	**-19%**
36 **SLOVAKIA**	**36**	1.3%	**-5.7%**	**9.1**	-0.2%	**-35%**	**-8.4%**
39 **LATVIA**	**24**	4.7%	**-5.0%**	**6.8**	-0.9%	**-25%**	**-6.2%**
40 **PORTUGAL**	**19**	0.7%	**-3.7%**	**6.0**	0.1%	**-22%**	**-5.6%**
41 **QATAR**	**13**	3.9%	**-1.1%**	**31**	5.6%	**>-100%**	**-33%**
42 **CHILE**	**17**	2.9%	**-2.8%**	**5.0**	4.5%	**-17%**	**-4.3%**
43 **BRUNEI DAR.**	**20**	1.7%	**-3.2%**	**19**	3.9%	**-88%**	**-18%**
43 **HUNGARY**	**15**	1.0	**-3.0%**	**7.0**	-0.5%	**-26%**	**-6.4%**
45 **BAHRAIN**	**14**	0.4%	**-1.2%**	**13**	2.3%	**-53%**	**-12%**
46 **CROATIA**	**16**	2.5%	**-3.6%**	**5.4**	1.3%	**-19%**	**-4.8%**
47 **OMAN**	**10**	2.6%	**-0.3%**	**14**	6.8%	**-51%**	**-12%**
48 **ARGENTINA**	**15**	2.0%	**-2.0%**	**4.7**	2.2	**-16%**	**-4.2%**
49 **RUSSIAN FED.**	**10**	0.0%	**-1.6%**	**9.7**	-0.9%	**-35%**	**-8.3%**
50 **BELARUS**	**0.4**	2.5%	**+9.1%**	**7.5**	2.6%	**-27%**	**-6.7%**
50 **KAZAKHSTAN**	**18**	-0.8%	**-2.4%**	**13**	1.6%	**-63%**	**-14%**
52 **BULGARIA**	**13**	1.7%	**-3.2%**	**5.9**	-0.4%	**-20%**	**-5.0%**
52 **MONTENEGRO ***	**28**	7.0%	**-4.9%**	**3.3**	1.8%	**-11%**	**-2.7%**

	Resource Consumption			CO_2 Emissions from Consumption			
	Per capita 2018	Trend 1993-2018	**Reduc-tion for SD**	***Per capita* 2017**	Trends 1992-2017	**Reduction required for**	
						1.5°	**2°**
	Tonnes CO_2	% / yr	**% / yr**	**Tonnes CO_2**	% / yr	**% / yr**	**% / yr**
52 **ROMANIA**	**17**	2.9%	**-3.7%**	**3.9**	-2.1%	**-12%**	**-3.1%**
55 **PALAU ***	-	-	-	**13**	0.7%	**-56%**	**-13%**
56 **BARBADOS ***	**11**	-2.3%	**-1.6%**	**4.6**	0.6%	**-15%**	**-3.8%**
57 **KUWAIT**	**48**	4.2%	**-5.5%**	**22**	4.2%	**>-100%**	**-21%**
57 **URUGUAY**	**39**	5.6%	**-5.6%**	**3.6**	2.8%	**-11%**	**-2.9%**
59 **TURKEY**	**16**	4.4%	**-2.4%**	**5.9**	3.2%	**-22%**	**-5.6%**
60 **BAHAMAS***	**21**	-0.8%	**-2.9%**	**4.8**	0.1%	**-14%**	**-3.4%**
61 **MALAYSIA**	**25**	3.7%	**-3.5%**	**36**	4.9%	**-32%**	**-7.8%**
62 **SEYCHELLES ***	**22**	1.9%	**-3.6%**	**6.9**	5.2%	**-32%**	**-8.0%**
63 **SERBIA ***	**17**	2.5%	**-3.9%**	**5.3**	0.7%	**-19%**	**-4.7%**
63 **TRINIDAD & TOBAG**	**5.6**	1.8%	**0.5%**	**28**	3.8%	**>-100%**	**-38%**
65 **IRAN**	**14**	2.4%	**-1.7%**	**7.7**	4.7%	**-28%**	**-6.9%**
66 **MAURITIUS**	**21**	1.4%	**-3.9%**	**4.9**	2.8%	**-18%**	**-4.6%**
67 **PANAMA**	**8.1**	2.0%	**+0.4%**	**5.5**	7.9%	**-17%**	**-4.3%**
68 **COSTA RICA**	**8.3**	3.4%	**-0.2%**	**2.6**	3.3%	**-8.0%**	**-1.8%**
69 **ALBANIA**	**12**	4.0%	**-2.5%**	**2.0**	2.8%	**-6.4%**	**-1.2%**
70 **GEORGIA**	**9.1**	-1.9%	**-1.5%**	**2.9**	0.7%	**-10%**	**-2.6%**
71 **SRI LANKA**	**4.2**	5.8%	**+1.7%**	**1.7**	6.4%	**-6.5%**	**-1.3%**
72 **CUBA ***	**7.7**	-1.7%	**-0.6%**	**2.6**	1.5%	**-8.7%**	**-2.0%**
73 **ST KITTS & NEVIS ***	-	-	-	**4.7**	3.1%	**-17%**	**-4.2%**
74 **ANTIGUA & BARB ***	**13**	-1.0%	**-1.7%**	**6.0**	3.0%	**-21%**	**-5.4%**
75 **BOSNIA & HERZE ***	**11**	0.4%	**-2.5%**	**6.7**	2.2%	**-24%**	**-6.0%**
76 **MEXICO**	**10**	1.9%	**0.7%**	**4.3**	1.7%	**-14%**	**-3.5%**
77 **THAILAND**	**15**	3.4%	**-2.9%**	**4.2**	3.3%	**-15%**	**-3.7%**
78 **GRENADA ***	-	-	-	**2.5**	3.3%	**-7.8%**	**-1.7%**
79 **BRAZIL**	**18**	3.8%	**-3.0%**	**2.5**	3.0%	**-8.2%**	**-1.9%**
79 **COLOMBIA**	**11**	3.6%	**-1.2%**	**2.2**	1.9%	**-7.6%**	**-1.7%**
81 **ARMENIA**	**8.4**	2.9%	**-1.0%**	**1.9**	1.2%	**-5.8%**	**-1.0%**
82 **ALGERIA ***	**3.1**	3.7%	**+3.8%**	**3.8**	2.6%	**-13%**	**-3.3%**
82 **N. MACEDONIA ***	**14**	1.5%	**-2.8%**	**3.6**	-1.3%	**-12%**	**-2.9%**

	Resource Consumption			CO_2 Emissions from Consumption			
	Per capita 2018	Trend 1993-2018	Reduc-tion for SD	*Per capita* 2017	Trends 1992-2017	Reduction required for	
						1.5°	2°
	Tonnes CO_2	% / yr	% / yr	Tonnes CO_2	% / yr	% / yr	% / yr
82 PERU	9.8	3.8%	-0.5%	2.0	4.3%	-6.3%	-1.2%
85 CHINA	21	5.8%	-3.9%	6.2	5.1%	-22%	-5.5%
85 ECUADOR	11	3.6%	-0.6%	2.9	3.3%	-9.8%	-2.4%
87 AZERBAIJAN	6.4	-0.7%	+0.4%	4.2	2.4%	-15%	-3.7%
88 UKRAINE	12	2.3%	-2.8%	5.4	-2.4%	-17%	-4.4%
89 DOMINICAN REP.	6.7	3.2%	+0.7%	2.5	3.4%	-8.1%	-1.8%
89 SAINT LUCIA *	-	-	-	2.4	2.4%	-7.9%	-1.8%
91 TUNISIA	6.4	1.7%	+0.7%	2.6	2.4%	-9.2%	-2.2%
92 MONGOLIA	14	0.5%	-1.5%	8.1	4.1%	-22%	-5.5%
93 LEBANON*	14	4.0%	-2.6%	3.6	3.5%	-13%	-3.2%
94 BOTSWANA	35	2.7%	-3.9%	8.0	7.6%	-54%	-13%
94 ST VINCENT& GRE. *	-	-	-	2.1	3.2%	-7.0%	-1.5%
96 JAMAICA	7.7	0.8%	-0.3%	2.9	0.9%	-9.5%	-2.3%
96 VENEZUELA	8.1	0.4%	+0.3%	4.9	2.2%	-15%	-3.8%
98 DOMINICA *	-	-	-	2.6	4.4%	-8.9%	-2.1%
98 FIJI *	7.5	0.0%	+0.4%	2.5	4.3%	-9.8%	-2.4%
98 PARAGUAY	15	3.6%	-1.9%	1.5	3.8%	-5.4%	-0.8%
98 SURINAME *	14	0.9%	-1.8%	3.2	-0.5%	-9.8%	-2.4%
102 JORDAN	6.7	4.0%	+0.8%	3.6	3.1%	-13%	-3.4%
103 BELIZE *	7.7	1.2%	+1.0%	1.5	1.7%	-5.1%	-0.7%
104 MALDIVES *	13	7.1%	-1.7%	3.0	8.5%	-11%	-2.8%
105 TONGA *	-	-	-	1.3	1.9%	-4.6%	-0.5%
106 PHILIPPINES	4.4	2.6%	+2.4%	1.4	3.4%	-5.4%	-0.8%
107 MOLDOVA *	3.9	16%	+1.1%	1.3	-4.4%	-4.3%	-0.3%
108 TURKMENISTA *	22	4.3%	-3.0%	14	4.4%	-59%	-13%
108 UZBEKISTAN *	6.1	2.1%	+1.3%	2.9	-0.9%	-8.9%	-2.1%
110 LIBYA *	3.8	1.0%	+2.7%	8.3	1.3%	-29%	-7.1%
111 INDONESIA	6.3	3.7%	+0.8%	2.3	4.6%	-7.9%	-1.8%
111 SAMOA*	8.1	1.2%	+0.4%	1.4	3.5%	-4.9%	-0.6%
113 SOUTH AFRICA	8.4	0.8%	+0.3%	6.1	2.3%	-21%	-5.2%

	Resource Consumption			CO_2 Emissions from Consumption			
	Per capita 2018	Trend 1993-2018	**Reduc-tion for SD**	***Per capita* 2017**	Trends 1992-2017	**Reduction required for**	
						1.5°	**2°**
	Tonnes CO_2	% / yr	**% / yr**	**Tonnes CO_2**	% / yr	**% / yr**	**% / yr**
114 **BOLIVIA**	**5.5**	1.8%	+1.7%	**1.8**	5.1%	-6.6%	-1.3%
115 **GABON ***	**4.3**	1.3%	+3.5%	**2.6**	0.3%	-8.3%	-1.9%
116 **EGYPT**	**4.9**	3.0%	+2.7%	**2.4**	3.9%	-7.7%	-1.7%
117 **MARSHALL IS. ***	-	-	-	**2.6**	1.7%	-9.0%	-2.1%
118 **VIET NAM**	**13**	9.0%	-2.0%	**2.1**	9.1%	-7.9%	-1.8%
119 **PALESTINE ***	-	-	-	**0.7**	5.1%	-2.1%	+0.9%
120 **IRAQ***	**2.8**	1.7%	+5.0%	**5.4**	4.8%	-20%	-5.0%
121 **MOROCCO**	**3.9**	2.2%	+2.6%	**1.9**	2.8%	-6.2%	-1.2%
122 **KYRGYZSTAN**	**8.4**	2.1%	+0.6%	**2.7**	0.5%	-8.7%	-2.0%
123 **GUYANA ***	**119**	1.6%	-8.9%	**3.2**	3.4%	-12%	-2.9%
124 **EL SALVADOR**	**6.3**	3.0%	+0.5%	**1.5**	2.7%	-5.0%	-0.7%
125 **TAJIKISTAN ***	**3.8**	4.6%	+3.7%	**0.6**	0.2%	-2.3%	+0.8%
126 **CABO VERDE ***	**8.9**	2.6%	-0.2%	**1.2**	7.2%	-4.1%	-0.2%
126 **GUATEMALA**	**3.9**	3.7%	+3.4%	**1.2**	4.2%	-4.1%	-0.3%
126 **NICARAGUA**	**4.3**	3.2%	+2.5%	**1.1**	3.5%	-3.5%	+0.1%
129 **INDIA**	**4.7**	3.4%	+1.8%	**1.7**	4.9%	-6.2%	-1.2%
130 **NAMIBIA**	**8.6**	1.3%	+0.8%	**4.1**	8.8%	-19%	-4.8%
131 **TIMOR-LESTE ***	-	-	-	**0.4**	NaN	-0.8%	+1.8%
132 **HONDURAS**	**3.9**	3.7%	+3.0%	**1.2**	5.0%	-3.9%	-0.2%
132 **KIRIBATI ***	-	-	-	**0.6**	3.5%	-2.0%	+1.0%
134 **BHUTAN ***	**11**	2.4%	-1.2%	**1.6**	8.1%	-6.1%	-1.1%
135 **BANGLADESH**	**2.5**	3.5%	+3.9%	**0.7**	6.9%	-2.2%	+0.8%
135 **MICRONESIA ***	-	-	-	**1.4**	NaN	-4.6%	-0.5%
137 **SAO TOME & P ***	**5.9**	1.1%	+2.6%	**0.6**	3.9%	-1.6%	+1.2%
138 **CONGO ***	**2.3**	2.2	+6.2%	**0.6**	3.0%	-1.6%	+1.2%
138 **ESWATINI ***	**12**	1.4%	-0.4%	**1.1**	2.1%	-3.0%	+0.3%
140 **LAOS**	**7.9**	9.0%	+0.1%	**2.4**	12%	-15%	-3.8%
141 **VANUATU ***	**7.4**	2.1%	+1.8%	**0.5**	3.7%	-1.6%	+1.2%
142 **GHANA**	**3.5**	3.2%	+4.0%	**0.8**	6.7%	-2.3%	+0.7%
143 **ZAMBIA**	**3.6**	1.6%	+4.8%	**0.6**	4.0%	-1.9%	+1.0%

	Resource Consumption			CO_2 Emissions from Consumption			
	Per capita 2018	Trend 1993-2018	**Reduc-tion for SD**	***Per capita* 2017**	Trends 1992-2017	**Reduction required for**	
						1.5°	**2°**
	Tonnes CO_2	% / yr	**% / yr**	**Tonnes CO_2**	% / yr	**% / yr**	**% / yr**
144 **EQ. GUINEA ***	-	-	-	**4.5**	19%	**-13%**	**-3.2%**
145 **MYANMAR ***	**1.5**	2.3%	**+5.7%**	**0.5**	6.6%	**-1.8%**	**+1.1%**
146 **CAMBODIA**	**3.7**	4.6%	**+2.8%**	**1.0**	8.8%	**-4.1%**	**-0.3%**
147 **KENYA**	**3.0**	3.1%	**+4.7%**	**0.6**	5.1%	**-1.8%**	**+1.1%**
147 **NEPAL**	**3.0**	3.0%	**+3.5%**	**0.6**	9.1%	**-1.9%**	**+1.0%**
149 **ANGOLA ***	**3.3**	4.6%	**+5.5%**	**1.1**	7.4%	**-3.5%**	**+0.1%**
150 **CAMEROON**	**1.9**	2.2%	**+6.7%**	**0.5**	5.6%	**-1.6%**	**+1.2%**
150 **ZIMBABWE**	**3.6**	4.1%	**+4.0%**	**0.9**	-2.2%	**-3.0%**	**+0.4%**
152 **PAKISTAN**	**3.0**	2.6%	**+4.2%**	**1.1**	4.4%	**-3.8%**	**-0.1%**
153 **SOLOMON ISL ***	-	-	-	**0.3**	0.9%	**+0.4%**	**+2.7%**
154 **SYRIAN A.R ***	**3.7**	0.9%	**+4.3%**	**1.7**	-1,.9%	**-4.9%**	**-0.6%**
155 **PAPUA N.GUIN ***	**2.5**	-0.1%	**+5.2%**	**0.9**	5.2%	**-3.4%**	**+0.1%**
156 **COMOROS ***	-	-	-	**0.3**	4.7%	**+0.2%**	**+2.5%**
157 **RWANDA**	**3.2**	3.4%	**+4.6%**	**0.1**	3.4%	**+1.9%**	**+4.0%**
158 **NIGERIA**	**2.7**	3.4%	**+5.6%**	**0.5**	3.3%	**-1.1%**	**+1.6%**
159 **TANZANIA**	**1.4**	2.5%	**+8.2%**	**0.4**	7.2%	**-0.6%**	**+1.9%**
159 **UGANDA**	**2.6**	3.5%	**+5.8%**	**0.2**	6.8%	**+0.7%**	**+2.9%**
161 **MAURITANIA ***	**2.6**	1.4%	**+5.8%**	**0.6**	4.3%	**-1.8%**	**+1.1%**
162 **MADAGASCAR**	**0.8**	2.8%	**+9.7%**	**0.2**	5.6%	**+0.4%**	**+2.7%**
163 **BENIN**	**4.4**	4.4%	**+3.9%**	**0.7**	8.3%	**-2.1%**	**+0.9%**
164 **LESOTHO ***	**12**	5.1%	**-1.2%**	**1.3**	2.0%	**-4.3%**	**-0.3%**
165 **CÔTE D'IVOIRE**	**0.9**	-0,3%	**+9.5%**	**0.6**	4.5%	**-1.9%**	**+1.0%**
166 **SENEGAL**	**2.5**	3.4%	**+5.9%**	**0.8**	4.9%	**-2.6%**	**+0.6%**
167 **TOGO**	**2.5**	2.1%	**+5.7%**	**1.0**	7.1%	**-2.9%**	**+0.4%**
168 **SUDAN ***	**5.2**	29%	**+2.8%**	**0.5**	8.5%	**-1.4%**	**+1.3%**
169 **HAITI ***	**1.4**	1.9%	**+6.4%**	**0.3**	6.1%	**+0.1%**	**+2.4%**
170 **AFGHANISTAN***	**1.2**	1.7%	**+7.9%**	**0.3**	8.1%	**+0.4%**	**+2.7%**
171 **DJIBOUTI ***	**2.3**	0.5%	**+4.6%**	**0.7**	2.6%	**-2.0%**	**+0.9%**
172 **MALAWI**	**1.3**	3.0%	**+8.3%**	**0.2**	3.0%	**+0.5%**	**+2.8%**
173 **ETHIOPIA**	**0.8**	-1.0%	**+9.4%**	**0.2**	7.1%	**+0.5%**	**+2.7%**

	Resource Consumption			CO_2 Emissions from Consumption			
	Per capita 2018	Trend 1993-2018	Reduc-tion for SD	*Per capita* 2017	Trends 1992-2017	Reduction required for 1.5°	Reduction required for 2°
	Tonnes CO_2	% / yr	% / yr	Tonnes CO_2	% / yr	% / yr	% / yr
174 GAMBIA *	2.2	1.8%	+6.3%	0.3	4.4%	+0.1%	+2.4%
174 GUINEA	2.4	1.8%	+6.1%	0.3	4.3%	+0.2%	+2.6%
176 LIBERIA *	1.5	4.0%	+7.6%	0.3	5.3%	-0.6%	+1.9%
177 YEMEN *	1.1	-1.6%	+8.0	0.4	0.6%	+0.5%	+2.7%
178 GUINEA-BISSA *	-	-	-	0.2	2.5%	+0.9%	+3.1%
179 DR CONGO *	2.0	1.2%	+7.2%	0.0	-1.1%	+4.7%	+6.6%
180 MOZAMBIQUE	2.1	3.8%	+6.7%	0.6	6.5%	-2.0%	+1.0%
181 SIERRA LEONE *	7.1	7.2%	+0.9%	0.1	3.5%	+1.5%	+3.6%
182 BURKINA FASO	4.0	4.3%	+4.3%	0.3	7.3%	-0.2%	+2.3%
182 ERITREA *	12	15%	-1.9%	0.2	0.2%	+0.6%	+2.9%
184 MALI *	4.6	5.2%	+4.0	0.2	8.5%	+0.8%	+3.0%
185 BURUNDI *	1.6	1,2%	+7.9%	0.0	3.4%	+3.2%	+5.1%
186 SOUTH SUDAN *	2.0	17%	+5.7%	0.2	8.4%	+0.9%	+3.1%
187 CHAD *	1.5	1.9%	+8.0%	0.1	3.8%	+2.8%	+4.7%
188 C.A.R.	2.6	1.1%	+5.3%	0.1	1.2%	+2.7%	+4.7%
189 NIGER *	3.1	3.8%	+6.3%	0.1	5.5%	+2.0%	+4.0
.. DPR KOREA *	1.0	-5.4%	+6.7%	1.2	-4.5%	-4.1%	-0.2%
.. NAURU *	-	-	-	4.8	-3.2%	-17%	-4.4%
.. SOMALIA *	2.3	2.1%	+6.7%	0.0	0.4%	+3.3%	+5.2%
.. TUVALU *	-	-	-	1.0	1.9%	-3.3%	+0.2%

IPCC CO_2 emission budget to limit global warming to 2°C and 1.5°C (since 1850-1900) 1

Carbon Budget	2°C limit	1.5°C limit
$GtCO_2$ on 1.1.2018[1]	**1,070**	**320**
$GtCO_2$ on 1.1.2019[2]	**1,028**	**278**
$GtCO_2$ fossil fuels & industry on 1.1.2019[3]	**905**	**245**
Tonnes CO_2 *per capita* 1.1.2019[4]	**117**	**32**

National Emissions	Sweden	Tanzania
Tonnes CO_2 *per capita* per year consumption emissions[5]	**7.4**	**0.4**
2°: CO_2 reduction in % per year now (1.7.2020)	**-6%**	**+2%**
1.5°: CO_2 reduction in % per year now (1.7.2020)	**-25%**	**-1%**

[1] Intergovernmental Panel on Climate Change 2018, Special Report Global Warming 1.5°C, table 2.2 The assessed remaining carbon budget, accounting for ``Earth system feedbacks'' - permafrost thawing or methane released by wetlands -, percentiles of TCRE: 67th;
[2] Deduct 2018 CO_2 emissions: 42.l $GtCO_2$ (Friedlingstein P. et all, Global Carbon Project (GCP), Global carbon budget 2019 (version 1.0));
[3] Allocate 88% of the budget to fossil fuels & industry emission (landuse change emissions are about 12%) (Friedlingstein P. et all, GCP, Global carbon budget 2019 (version 1.0));
[4] 2019 human population of 7.7 billion, Sweden: 10.0 million, Tanzania 58.0 million (United Nations World Population Prospects 2019 revision);
[5] Consumption emissions *per capita* (Updated from Peters et al, GCP National Carbon Emissions Global 2019 (version 1.0)).

The Intergovernmental Panel on Climate Change concluded that to limit global warming to the internationally agreed objectiv of 2°C or 1.5°C, CO_2 emissions must be limited to 1,070 or 320 $GtCO_2$ from 1 January 2018 onwards; this is the carbon budhet for a 66% chance, accounting for ``earth feedback systems'' ( 100 $GtCO_2$ until 2100), assuming rapid reduction of other greenhouse gases and with no ``negative emissions'' and no ``overshoot''. 1

42 $GtCO_2$ were emitted in 2018 2, thus 1,028 or 278 $GtCO_2$ remained by 1 Jan 2019. Land-use emissions are about 12% of total CO_2 emissions and therefor 88% of the budget is allocated to fossil fuels and industry, 905 or 245 $GtCO_2$. Equally divided among humanity (international equity), the *per capita* limit is 117 tonnes CO_2 for 2°C, 32 tonnes CO_2 for 1.5°C.

With no global government, emissions are allocated to nations, the law-making units. To take a national example, the current *per capita* consumption emissions of Sweden - an Ultra High Developed nation - are 7.4 tonnes CO_2 per year (decreasing 0.4% per year on a 25 year trend, last year increasing 1.1%). With 10 million people 4 Sweden's ``national budget `` on 1.1.2019 was 1.2 or 0.3 $GtCO_2$; not exceeding it as of 1.7.2020 requires reducing emissions 6% or 25% per year starting now (intergenerational equity) increasing with inaction.

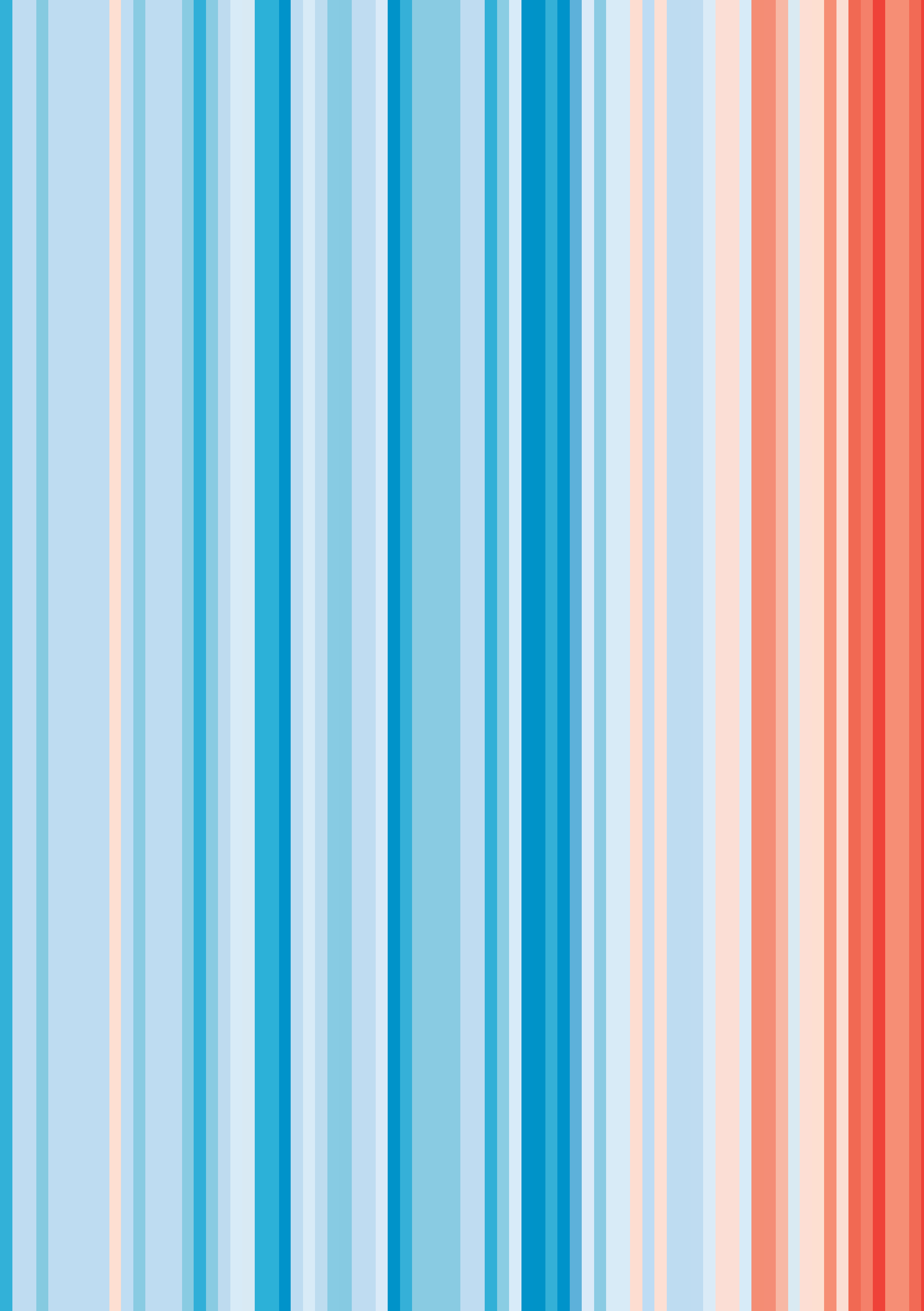
In comparison, Low Developed Tanzania, with very low *per capita* emissions of 0.4 tonnes CO_2 must reduce emissions 1% for 1.5°C but can increase emissions 2% for 2°C and not exceed its limit.

If countries have not yet reached zero emissions by 2100, their remaining limit (budget) is at least 20 years od 2100 emissions.

LTR: Michael Wadleigh, Matthew Pye & Birgit van Munster

“Justice is what love looks like in public”.

- Cornel West -



The series "*No Common Sense - Philosophy Tackles Climate Change*" mobilises some of history's greatest philosophers to bring fresh depth to our climate thinking.

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