

WARNINGS FROM THE POLES

John Scales Avery

January 26, 2022

Introduction¹

Antarctica's Thwaites Glacier

Diagonal cracks have been observed in Antarctica's enormous Thwaites Glacier, and scientists fear that it might shatter into small pieces like a windscreen. They also fear that the loss of Thwaites Glacier might trigger the collapse of other nearby glaciers, thus leading to a sea level rise of several meters.

Mediterranean temperatures in the Arctic

The World Meteorological Organization has confirmed a temperature record of 100.4 degrees Fahrenheit, measured in the Siberian town of Verkhoyansk, 70 kilometers north of the Arctic Circle. A spokesman said that such temperatures "were more appropriate for the Mediterranean than for the Arctic". High Arctic temperatures are driving wildfires in the region, as well as permafrost melting, both of which put more carbon into the atmosphere.

Loss of mass from Greenland's icecap

166 billion tonnes of ice were lost from Greenland's icecap in 2021. For the first time, rain has been observed at the high altitudes at the top of Greenland's ice sheet. Summer melt water cascades through crevices in the ice sheet, reaching the bottom, where the water lubricates to flow of the ice towards the sea.

Paleoclimate records from polar ice cores

By studying ice cores taken from both Antarctic and Greenland, scientists are able to determine the composition of the atmosphere at the time when the ice was formed and the temperature. They find a strong correlation between CO₂ content and temperature. The temperature is determined by studying the ratios of light to heavy isotopes of oxygen in the ice. The hydrogen-deuterium ratio is also used to determine temperature.

¹This book makes some use of my previously published book chapters, but most of the material is new.

Loss of Arctic sea ice

The *albedo effect* is a feedback loop that involves the reflectivity of a surface. For example, snow-covered ice in the Arctic Ocean strongly reflects the sun's radiation. However, when the ice melts, the darker sea water absorbs the radiation, thus contributing to further warming and further melting of the sea ice. Scientists predict that because of the albedo effect, the Arctic Ocean will soon be free of ice in September each year, and perhaps also in August.

The urgent need for climate action

Warning signs from both the Arctic and the Antarctic tell us that we must take urgent action to stop the use of fossil fuels and to replace these energy sources with renewable energy. We must fight against the influence that wealthy giant fossil fuel corporations have on our politicians and on the mass media. This is a matter of enormous importance, a life-or-death issue, not only for ourselves but also for all the other animals and plants with which we share the gift of life.

Contents

1	CRACKS IN ANTARCTICA’S THWAITES GLACIER	7
1.1	A British-US expedition studies Thwaites Glacier melting	7
1.2	Thwaites Glacier could shatter like a windscreen	7
2	MEDiTERRANEAN TEMPERATURES IN THE ARCTIC	9
2.1	100.4 degrees Fahrenheit north of the Arctic Circle	9
3	LOSS OF MASS FROM GREENLAND’S ICE CAP	11
3.1	166 billion tons lost in 2021	11
3.2	The threat of catastrophic destabilization	11
4	PALEOCLIMATE RECORDS FROM POLAR ICE CORES	13
4.1	Facts from the British Antarctic Survey	13
4.2	Wikipedia’s article on ice cores	18
5	LOSS OF ARCTIC SEA ICE	21
5.1	The albedo effect	21
5.2	5-meter-high waves in the Beaufort sea	21
5.3	The death spiral of Arctic sea ice	21
6	FEEDBACK LOOPS AND TIPPING POINTS	23
6.1	Antonio Guterres’ <i>State of the Planet</i> broadcast	23
6.2	Extinction events and feedback loops	28
6.3	A warning from the World Bank	31
6.4	Permian-Triassic extinction event	32
6.5	The Holocene (Anthropocene) extinction	33
6.6	Global warming and atmospheric water vapor	35
6.7	The albedo effect	36
6.8	The methane hydrate feedback loop	36
6.9	A feedback loop from warming of soils	39
6.10	Drying of forests and forest fires	39
6.11	Tipping points and feedback loops	40

7	POLAR NUCLEAR-WEAPON-FREE ZONES	51
7.1	The importance of nuclear-weapon-free zones	51
7.2	Arctic regions are no more inaccessible	51
7.3	An Antarctic NWFZ already exists	52
7.4	The Arctic is changing rapidly	53
7.5	A Northern European NWFZ?	54
7.6	A Copenhagen conference calls for an Arctic NWFZ	58
7.7	History of efforts to establish a Nordic NWFZ	60
8	THE URGENT NEED FOR CLIMATE ACTION	63
8.1	Governments gave fossil fuels \$5.9 trillion in subsidies in 2020	63
8.2	Fossil fuel industry's disinformation campaign	63
8.3	The divestment movement begins to hurt	68
8.4	Some hopeful signs of change	70
8.5	Greed is driving us towards disaster	73
8.6	Noam Chomsky on climate inaction	73
8.7	Greta Thunberg's TED talk	74
8.8	Only immediate climate action can save the future	78
8.9	Worldwide school strike, 15 March, 2019	82
8.10	The World Meteorological Organization's report	89
8.11	Only 12 years left to limit climate change catastrophe	89
8.12	COP24, the climate summit in Poland	92
8.13	The UK declares a climate emergency	103
8.14	Understatement of existential climate risk	105
8.15	Scientists leaked the newest IPCC Report	111
8.16	Media in the service of powerholders	119
8.17	Television as a part of our educational system	119
8.18	Neglect of climate change in the mass media	121
8.19	Climate change denial in mass media	122
8.20	Showing unsustainable lifestyles in mass media	126
8.21	Alternative media	126
8.22	Outstanding voices calling for climate action	127

Chapter 1

CRACKS IN ANTARCTICA'S THWAITES GLACIER

1.1 A British-US expedition studies Thwaites Glacier melting

Scientists from the multi-million-dollar expedition bored 2,000 feet through the ice to measure the water temperature at the point where the glacier leaves dry land and starts to float on the ocean. They found water temperatures more than 2 degrees C above the freezing point. "That is really bad", said David Holland, a New York University glaciologist, "That's not a sustainable situation for that glacier."

The scientists already knew that the Thwaites Glacier was losing massive amounts of ice - more than 600 billion tons over the past several decades - but until now the mechanism had not been confirmed directly. "The biggest thing to say at the moment is, indeed, there is very warm water there, and clearly, it could not have been there forever, or the glacier could not be there," Holland said.

Melting of the Thwaites Glacier could potentially unleash more than ten feet of sea level rise, threatening coastal cities and low-lying countries around the world.

1.2 Thwaites Glacier could shatter like a wind-screen

Recently diagonal cracks have been observed in Antarctica's Thwaites Glacier, and scientists fear that the glacier could shatter into many pieces, like the

windscreen of an automobile.

Here are some quotations from a January 1, 2022 article by Ella Gilbert, of the University of Reading:

“The massive Thwaites glacier in West Antarctica contains enough ice to raise global sea levels by 65cm if it were to completely collapse. And, worryingly, recent research suggests that its long-term stability is doubtful as the glacier hemorrhages more and more ice.

Adding 65cm to global sea levels would be coastline-changing amounts. For context, there’s been around 20cm of sea-level rise since 1900, an amount that is already forcing coastal communities out of their homes and exacerbating environmental problems such as flooding, saltwater contamination and habitat loss.

“But the worry is that Thwaites, sometimes called the ‘doomsday glacier’ because of its keystone role in the region, might not be the only glacier to go. Were it to empty into the ocean, it could trigger a regional chain reaction and drag other nearby glaciers in with it, which would mean several meters of sea-level rise. That’s because the glaciers in West Antarctica are thought to be vulnerable to a mechanism called Marine Ice Cliff Instability or MICI, where retreating ice exposes increasingly tall, unstable ice cliffs that collapse into the ocean.

“A sea level rise of several meters would inundate many of the world’s major cities - including Shanghai, New York, Miami, Tokyo, and Mumbai. It would also cover huge swathes of land in coastal regions and largely swallow up low-lying island nations like Kiribati, Tuvalu, and the Maldives.”

Chapter 2

MEDiTERRANEAN TEMPERATURES IN THE ARCTIC

2.1 100.4 degrees Fahrenheit north of the Arctic Circle

The Arctic is heating more than twice as fast as the remainder of the world. The World Meteorological Organization has confirmed a new high temperature Arctic record: 100.4 degrees Fahrenheit, recorded in the Siberian town of Verkhoyansk, 70 kilometers north of the Arctic Circle. The reading, taken on June 20, 2020, has now been officially confirmed by the World Meteorological Organization. A spokesman commented that “the temperature is more befitting for the Mediterranean than the Arctic”.

According to data taken from the Russian Forestry Agency, Siberia’s wildfires were the worst since records began, destroying an area of more than 46 million Acres (18.6 million hectares) of Russian forest in 2021 alone. The smoke from the enormous infernos even travelled as far as the North Pole. Black soot from the wildfires settles on Arctic snow, making it reflect less and absorb more heat. Another feedback loop is caused by the CO₂ released by Arctic wildfires, which contributes to further warming and more fires.



Figure 2.1: An Arctic wildfire. Layers of peat are burning, and the carbon stored in the peat is being released into the atmosphere.

Chapter 3

LOSS OF MASS FROM GREENLAND'S ICE CAP

3.1 166 billion tons lost in 2021

According to a report from Polar Portal,

“2021 is the 25th year in a row in which Greenland’s ice sheet lost more mass during the course of the melting season than it gained during the winter...”

The Polar Portal is a Danish service that monitors the Greenland ice sheet. According to their report, the ice sheet lost about 166 billion tonnes of ice during the 12-month period that ended in August, 2021.

3.2 The threat of catastrophic destabilization

A new report has been issued by the Potsdam Institute for Climate Impact Research, which is located at the Free University of Berlin. According to the lead author, Niklas Boers,

“Our results suggest there will be substantially enhanced melting in the future - which is quite worrying... [The] mechanism is long known, and it is one of the prime suspects for the detected destabilization of the central-western parts of the Greenland ice sheet. But we cannot exclude that other feedbacks, for example related to the albedo of the ice sheet, play an important role too,..We urgently need to better understand the interplay of the different positive and



Figure 3.1: Unstable cliffs of ice on the coast of Greenland.

negative feedback mechanisms that determine the current stability and the future evolution of the ice sheet”

Chapter 4

PALEOCLIMATE RECORDS FROM POLAR ICE CORES

4.1 Facts from the British Antarctic Survey

Here are some quotations and figures from an article on ice cores published by the British Antarctic Survey¹:

“Ice cores provide direct information about how greenhouse gas concentrations have changed in the past, and they also provide direct evidence that the climate can change abruptly under some circumstances. However, they provide no direct analogue for the future because the ice core era contains no periods with concentrations of CO₂ comparable to those of the next century.”

- Ice core. Cylinder of ice drilled out of an ice sheet or glacier. Most ice core records come from Antarctica and Greenland.
- Ice cores contain information about past temperature, and about many other aspects of the environment.
- Atmospheric carbon dioxide levels are now 40% higher than before the industrial revolution. This increase is due to fossil fuel usage and deforestation.
- The magnitude and rate of the recent increase are almost certainly unprecedented over the last 800,000 years.

¹<https://www.bas.ac.uk/data/our-data/publication/ice-cores-and-climate-change/>

- Methane also shows a huge and unprecedented increase in concentration over the last two centuries.

Fig. 2: CO_2 and CH_4 over the last 1,000 years⁽¹⁻⁴⁾

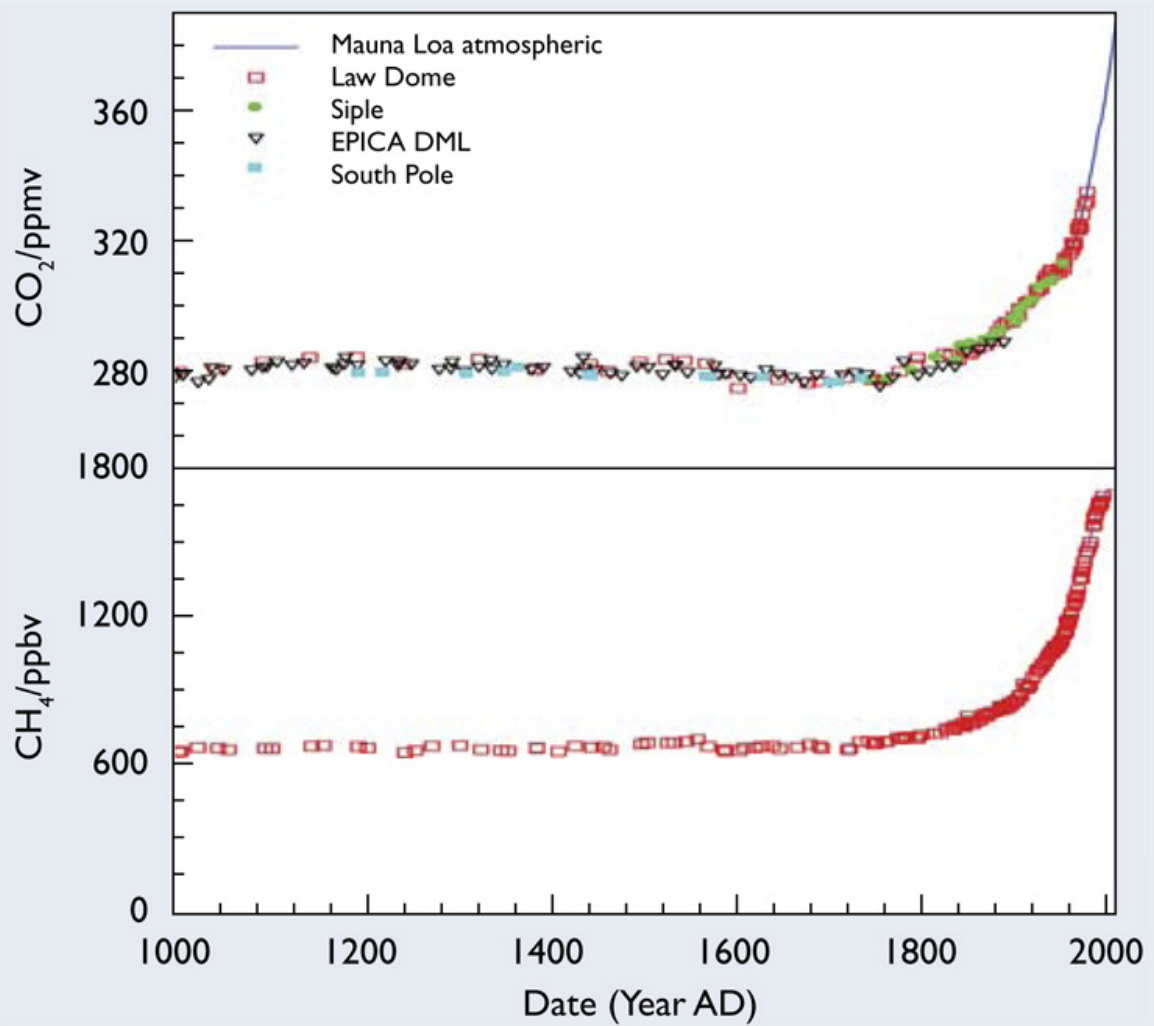


Figure 4.1: CO_2 and CH_4 over the last 1,000 years.

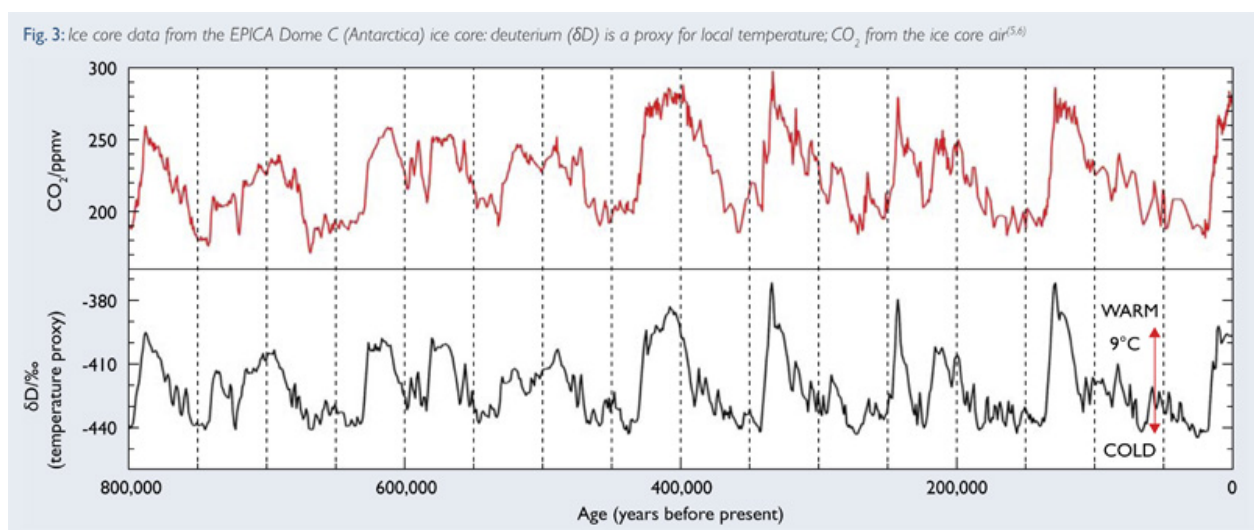


Figure 4.2: Ice core data from the EPICA Dome C (Antarctica) ice core: deuterium (D) is a proxy for local temperature; CO_2 from the ice core air. It can be seen that the temperature and the CO_2 concentration are closely correlated.

Fig. 4: Close-up of deuterium (temperature proxy) and CO_2 from the EPICA Dome C ice core over the warming from the last glacial period⁽⁷⁾

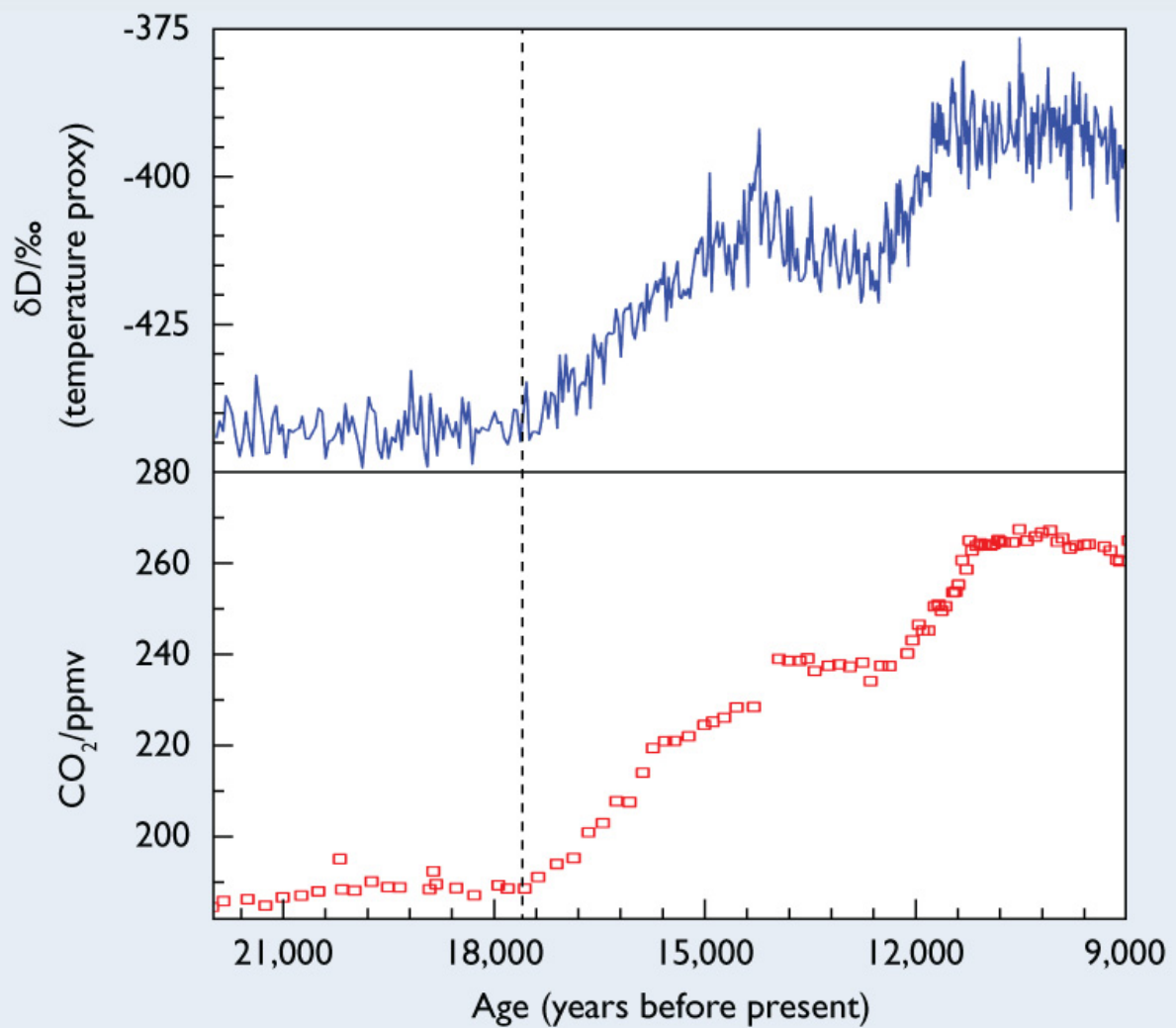


Figure 4.3: Close-up of deuterium (temperature proxy) and CO_2 from the EPICA Dome C ice core over the warming from the last glacial period.

4.2 Wikipedia's article on ice cores

The Wikipedia article, *Ice core*, gives the following description of how isotope analysis can be used to deduce the temperature at which the ancient snow fell before turning to ice:

“The isotopic composition of the oxygen in a core can be used to model the temperature history of the ice sheet. Oxygen has three stable isotopes, ^{16}O , ^{17}O and ^{18}O . The ratio between ^{18}O and ^{16}O indicates the temperature when the snow fell...

“Hydrogen ratios can also be used to calculate a temperature history. Deuterium (^2H , or D) is heavier than hydrogen (^1H) and makes water more likely to condense and less likely to evaporate.”

“

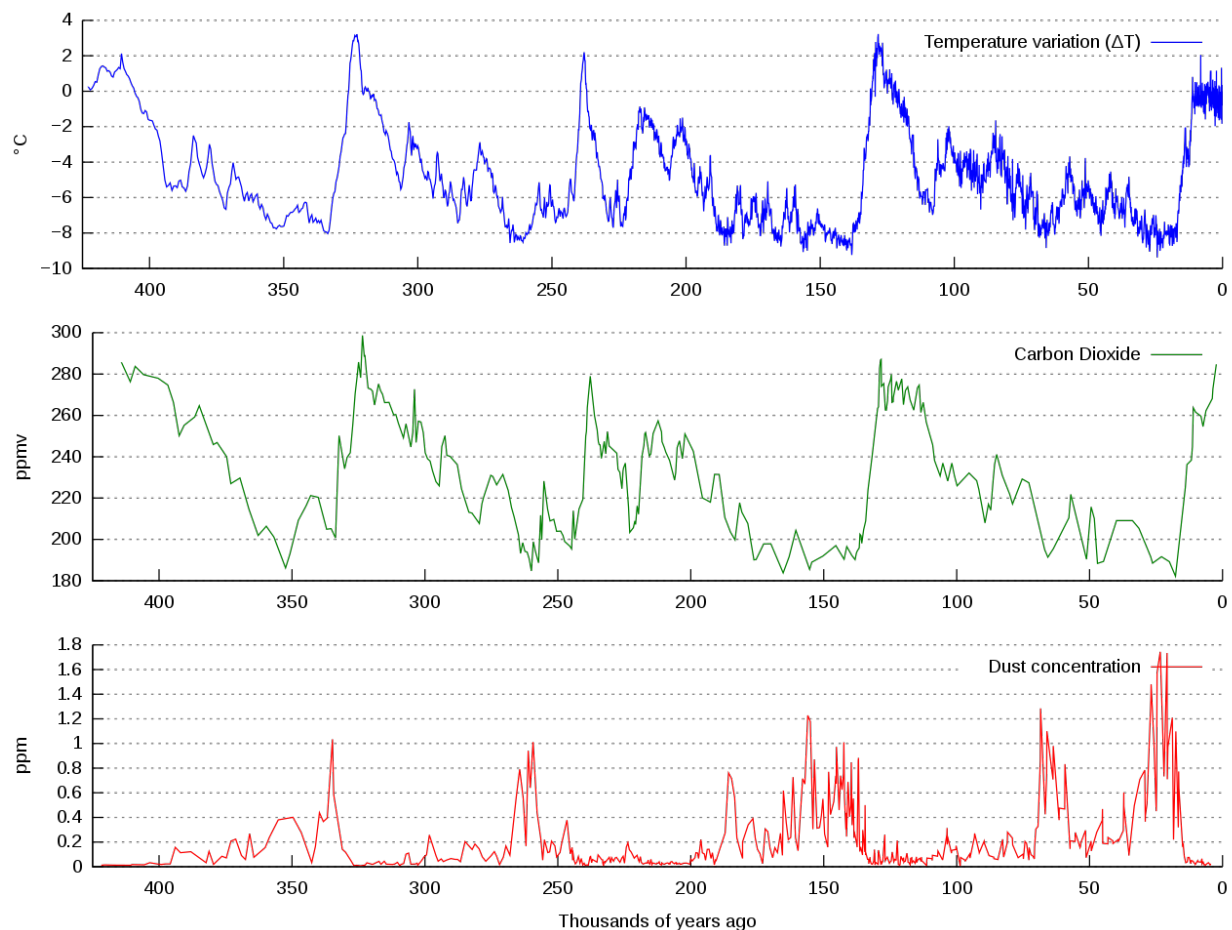


Figure 4.4: Graph of CO₂ (green), reconstructed temperature (blue) and dust (red) from the Vostok ice core for the past 420,000 years. Notice the strong correlation between CO₂ concentration and temperature. The dust content is helpful in determining the age of the core samples. The figure is taken from the Wikipedia article.

Chapter 5

LOSS OF ARCTIC SEA ICE

5.1 The albedo effect

There is a dangerous feedback loop involving ice on the Arctic Ocean through the *albedo effect*: Ice-free water is dark on color, and it absorbs the sun's warmth strongly. By contrast, snow-covered ice fields reflect much of the sun's warmth. Thus, the lower the ice cover, the more the sun's rays are absorbed, warming the region and causing further sea ice melting - a dangerous feedback loop.

5.2 5-meter-high waves in the Beaufort sea

According to Wikipedia,

“Scientists recently measured sixteen-foot (five-meter) wave heights during a storm in the Beaufort Sea in mid-August until late October 2012. This is a new phenomenon for the region, since a permanent sea ice cover normally prevents wave formation. Wave action breaks up sea ice, and thus could become a feedback mechanism, driving sea ice decline.”

5.3 The death spiral of Arctic sea ice

As is shown in the figure below, the Arctic Ocean will soon be entirely free of sea ice in September. This change will have many impacts on the ecology of the region.

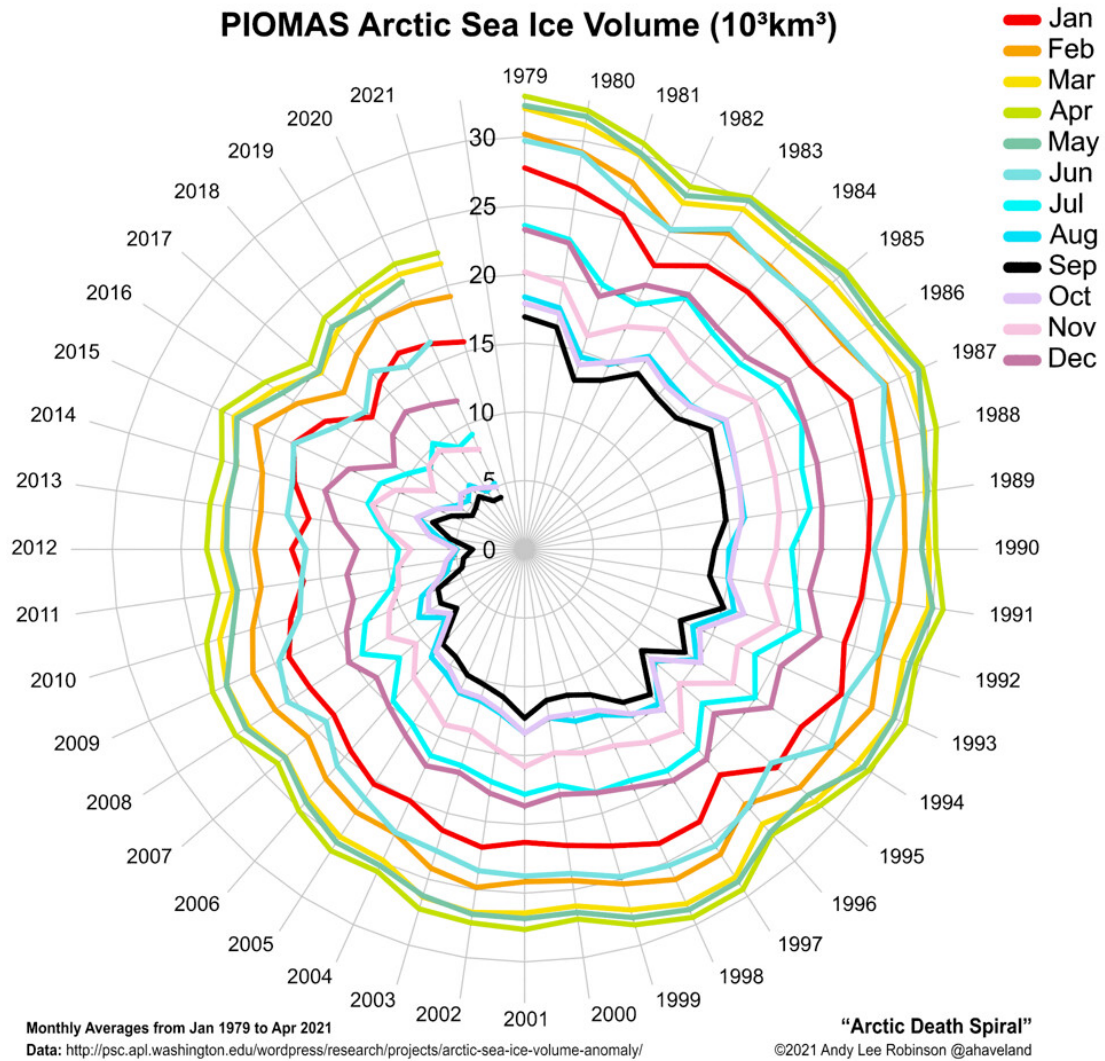


Figure 5.1: Monthly averages 1979-2021. Data source via the Polar Science Center (University of Washington). The September monthly average is spiraling in towards zero, implying that September will soon be a month when the Arctic ocean is completely free of ice.

Chapter 6

FEEDBACK LOOPS AND TIPPING POINTS

6.1 Antonio Guterres' *State of the Planet* broadcast

Guterres warns world leaders

Below are excerpts from an article by Margaret Besheer entitled *Guterres Warns World Leaders They Are Losing Battle Against Climate Change*¹:

UNITED NATIONS - U.N. Secretary-General Antonio Guterres said at the annual meeting of the General Assembly the world is losing the battle against climate change but that there is still time to reverse the effects of the global phenomenon.

“We are seeing unprecedented temperatures, unrelenting storms and undeniable science,” Guterres said. “The world is starting to move - not fast enough but in the right direction - away from fossil fuels and towards the opportunities of the green economy.”

Guterres said solutions to what he now calls a “climate crisis” were discussed at the U.N.’s Climate Action Summit on Monday. He noted the need for world leaders to “scale up” the solutions to “keep temperature rise to 1.5 degrees and reach carbon neutrality by 2050.”

Guterres has called for the phasing out of fossil fuels and an end to construction of new coal power plants. He has also said it is

¹<https://www.voanews.com/usa/guterres-warns-world-leaders-they-are-losing-battle-against-climate-change>



Figure 6.1: United Nations Secretary General Antonio Guterres addressing the UN General Assembly on September 24, 2019.



Figure 6.2: Swedish climate activist Greta Thunberg speaks with other child petitioners from 12 countries who presented a landmark complaint to protest the lack of government action on the climate crisis during a press conference in New York, Sept. 23, 2019.



Figure 6.3: Germany's Chancellor Angela Merkel addresses the Climate Action Summit in the United Nations General Assembly, at U.N. headquarters, Sept. 23, 2019.

time to end subsidies to the fossil fuel industry and shift taxes from salaries to carbon - taxing pollution, not people.

Guterres was the first in a series of world leaders involved in some of the most high profile geopolitical issues to speak on the first day of the U.N. General Assembly in New York...

After opening remarks from Guterres, those gathered for the annual meeting also heard from a group that included U.S. President Donald Trump, Turkish President Recep Tayyip Erdogan, Korean President Moon Jae-in and French President Emmanuel Macron.

The addresses came a day after Swedish teen activist Greta Thunberg scolded world leaders at a U.N. summit calling for climate action, saying people are suffering and dying from the effects of global warming and that all the leaders have are empty words.

"We are in [the] beginning of a mass extinction and all you can talk about is money," said Thunberg, who ignited a youth movement with her Friday school strikes for climate action.

She said the science has been clear for 30 years, and still they are not doing enough.

"You are failing us! But the young people are starting to understand your betrayal," Thunberg said in a voice filled with emotion. "The eyes of all future generations are upon you. And if you choose to fail us, I say we will never forgive you."

The 16-year-old warned the more than 60 presidents and prime ministers gathered in the General Assembly hall for the summit that the youth would not let them "get away with this." She said they draw the line here and now and "change is coming," whether they like it or not.

"Is it common sense to build ever more coal plants that are choking our future?" the secretary-general asked. "Is it common sense to reward pollution that kills millions with dirty air and makes it dangerous for people in cities around the world to sometimes even venture out of their homes?"

India, which has one of the world's highest levels of air pollution, said it would increase its renewable energy capacity to 175 gigawatts by 2022. Prime Minister Narendra Modi highlighted his country's expansion into solar energy.

German Chancellor Angela Merkel, in a rare U.N. appearance, pledged that her country would reduce its carbon emissions by 2030 by 55

"In 2030 we want to get two-thirds of our energy from renewables," Merkel said. "In 2022, we will phase out the last of our nu-

clear power plants, and at latest, in 2038, we will phase out coal.”...

The U.N. released a report ahead of the summit compiled by the World Meteorological Organization showing there has been an acceleration in carbon pollution, sea-level rise, warming global temperatures, and shrinking ice sheets.

It warns that the average global temperature for the period of 2015 through the end of 2019 is on pace to be the “warmest of any equivalent period on record” at 1.1 degrees Celsius above pre-industrial levels.

The 2015 Paris Climate Agreement, which has been ratified by 186 nations, calls for actions to prevent global temperatures from surpassing 2 degrees, and ideally remain within 1.5 degrees by cutting greenhouse gas emissions. One of the world’s biggest emitters - the United States - announced under President Trump that it would leave the pact. The U.S. decision has not stopped climate action at the state, local and private sector levels.

6.2 Extinction events and feedback loops

Introduction

Scientists warn that if the transition to renewable energy does not happen within very few decades, there is a danger that we will reach a tipping point beyond which feedback loops, such as the albedo effect and the methane hydrate feedback loop, will take over and produce an out-of-control and fatal increase in global temperature.

In 2012, the World Bank issued a report warning that without quick action to curb CO₂ emissions, global warming is likely to reach 4 °C during the 21st century. This is dangerously close to the temperature which initiated the Permian-Triassic extinction event: 6 °C above normal. During the Permian-Triassic extinction event, which occurred 252 million years ago, 96% of all marine species were wiped out, as well as 70% of all terrestrial vertebrates.²

²<http://science.nationalgeographic.com/science/prehistoric-world/permian-extinction/>
<http://www.worldbank.org/en/news/feature/2012/11/18/Climate-change-report-warns-dramatically-warmer-world-this-century>

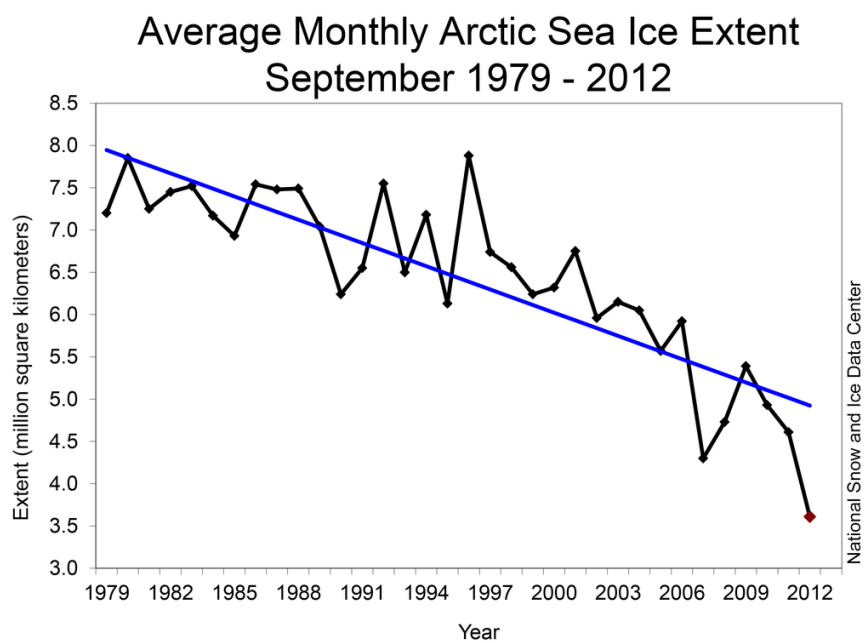


Figure 6.4: Monthly September ice extent for 1979 to 2012 shows a decline of 13.0% per decade. One can also see that the straight line does not really fit the data, which more nearly resemble a downward curve. Source: National Snow and Ice Data Center. Wikimedia Commons

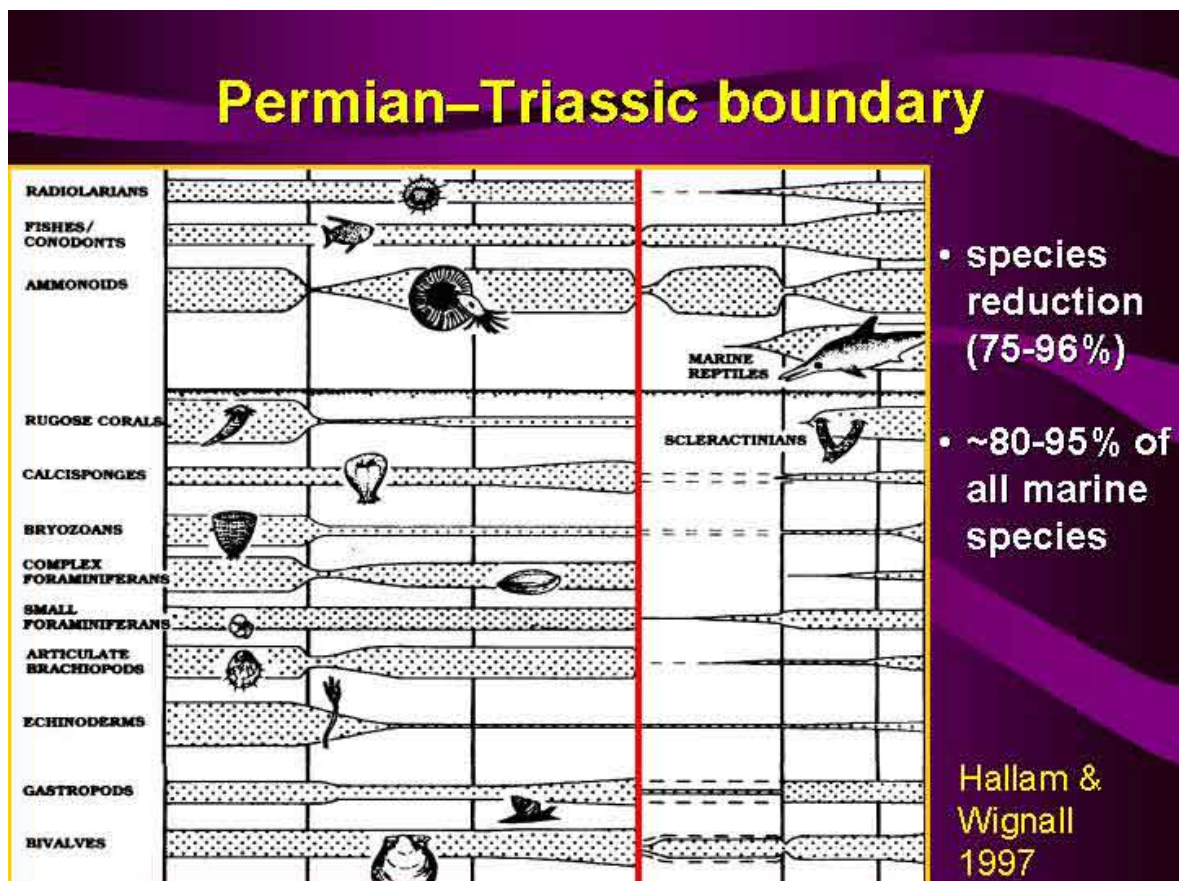


Figure 6.5: Loss of species caused by the Permian-Triassic extinction event. Unless quick steps are taken to lower our greenhouse gas emissions, we may cause a similar extinction event, which will threaten the survival of our own species. Source: Australian Frontiers of Science, www.sciencearchive.org.au

6.3 A warning from the World Bank

In 2012, the World Bank issued a report warning that without quick action to curb CO₂ emissions, global warming is likely to reach 4 °C during the 21st century. This is dangerously close to the temperature which initiated the Permian-Triassic extinction event: 6 °C above normal. During the Permian-Triassic extinction event, which occurred 252 million years ago, 96% of all marine species were wiped out, as well as 70% of all terrestrial vertebrates.³

The 4°C scenarios are devastating: the inundation of coastal cities; increasing risks for food production potentially leading to higher malnutrition rates; many dry regions becoming dryer, wet regions wetter; unprecedented heat waves in many regions, especially in the tropics; substantially exacerbated water scarcity in many regions; increased frequency of high-intensity tropical cyclones; and irreversible loss of biodiversity, including coral reef systems.

And most importantly, a 4°C world is so different from the current one that it comes with high uncertainty and new risks that threaten our ability to anticipate and plan for future adaptation needs. The lack of action on climate change not only risks putting prosperity out of reach of millions of people in the developing world, it threatens to roll back decades of sustainable development. It is clear that we already know a great deal about the threat before us. The science is unequivocal that humans are the cause of global warming, and major changes are already being observed: global mean warming is 0.8°C above pre industrial levels; oceans have warmed by 0.09°C since the 1950s and are acidifying; sea levels rose by about 20 cm since pre-industrial times and are now rising at 3.2 cm per decade; an exceptional number of extreme heat waves occurred in the last decade; major food crop growing areas are increasingly affected by drought.

Despite the global community's best intentions to keep global warming below a 2°C increase above pre-industrial climate, higher levels of warming are increasingly likely. Scientists agree that countries' current United Nations Framework Convention on Climate Change emission pledges and commitments would most likely result in 3.5 to 4°C warming. And the longer those pledges remain unmet, the more likely a 4°C world becomes.

Data and evidence drive the work of the World Bank Group. Science reports, including those produced by the Intergovernmental Panel on Climate Change, informed our decision to ramp up work on these issues, leading to, a World Development Report on climate change designed to improve our understanding of the implications of a warming planet; a Strategic Framework on

³<http://science.nationalgeographic.com/science/prehistoric-world/permian-extinction/>
<http://www.worldbank.org/en/news/feature/2012/11/18/Climate-change-report-warns-dramatically-warmer-world-this-century>

Development and Climate Change, and a report on Inclusive Green Growth. The World Bank is a leading advocate for ambitious action on climate change, not only because it is a moral imperative, but because it makes good economic sense.

But what if we fail to ramp up efforts on mitigation? What are the implications of a 4°C world? We commissioned this report from the Potsdam Institute for Climate Impact Research and Climate Analytics to help us understand the state of the science and the potential impact on development in such a world.

It would be so dramatically different from today's world that it is hard to describe accurately; much relies on complex projections and interpretations. We are well aware of the uncertainty that surrounds these scenarios and we know that different scholars and studies sometimes disagree on the degree of risk. But the fact that such scenarios cannot be discarded is sufficient to justify strengthening current climate change policies. Finding ways to avoid that scenario is vital for the health and welfare of communities around the world. While every region of the world will be affected, the poor and most vulnerable would be hit hardest. A 4°C world can, and must, be avoided.

The World Bank Group will continue to be a strong advocate for international and regional agreements and increasing climate financing. We will redouble our efforts to support fast growing national initiatives to mitigate carbon emissions and build adaptive capacity as well as support inclusive green growth and climate smart development. Our work on inclusive green growth has shown that, through more efficiency and smarter use of energy and natural resources, many opportunities exist to drastically reduce the climate impact of development, without slowing down poverty alleviation and economic growth.

This report is a stark reminder that climate change affects everything. The solutions don't lie only in climate finance or climate projects. The solutions lie in effective risk management and ensuring all our work, all our thinking, is designed with the threat of a 4°C degree world in mind. The World Bank Group will step up to the challenge.

6.4 Permian-Triassic extinction event

The geological record shows five major extinction events.

- Ordovician-Silurian Extinction. around 439 million years ago.
- Late Devonian Extinction. 375-360 million years ago.
- Permian-Triassic extinction. 352 million years ago.

- Triassic-Jurassic extinction, 201 million years ago.
- Cretaceous-Paleogene extinction, 66 million years ago.

The most devastating of these was the Permian-Triassic extinction, which occurred 252 million years ago.⁴ In the Permian-Triassic extinction, 96% of all marine species and 76% of all terrestrial vertebrates disappeared forever. The cause of this extremely severe event is disputed, but according to one of the most plausible theories it was triggered by a massive volcanic eruption in Siberia, which released enormous amounts of CO₂ into the earth's atmosphere.

The region where massive volcanic eruptions are known to have occurred 252 million years ago called the "Siberian Traps". (The "Traps" part of the name comes from the fact that many of the volcanic rock formations in the region resemble staircases. The Swedish word for staircase is "trappe".) The eruptions continued for about a million years.

Today the area covered is about 2 million square kilometers, roughly equal to western Europe in land area. Estimates of the original coverage are as high as 7 million square kilometers. The original volume of lava is estimated to range from 1 to 4 million cubic kilometers.

The CO₂ released by the Siberian Traps eruption is believed to have caused a global temperature increase of 6°C, and this was enough to trigger the methane-hydrate feedback loop, which will be discussed below. The earth's temperature is thought to have continued to rise for 85,000 years, finally reaching 15° above normal.

6.5 The Holocene (Anthropocene) extinction

We are now living in the midst of a sixth, human-caused, mass extinction. How severe it becomes is up to us.

Recently a group of scientists stated that the scope of human impact on planet Earth is so great that the *Anthropocene* warrants a formal place in the Geological Time Scale.

In a statement issued by University of Leicester Press Office on 2 October 2017, professor Jan Zalasiewicz from the University of Leicester's School of

⁴ <https://www.thomhartmann.com/bigpicture/last-hours-climate-change>
The Last Hours of Humanity: Warming the World To Extinction (book), by Thom Hartmann
<https://www.amazon.com/Last-Hours-Humanity-Warming-Extinction/dp/1629213640>
<http://www.mediaite.com/online/leonardo-dicaprio-boosts-thom-hartmann-apocalyptic-global-warming-film-last-hours/>

Geography, Geology, and the Environment said: “Our findings suggest that the Anthropocene should follow on from the Holocene Epoch that has seen 11.7 thousand years of relative environmental stability, since the retreat of the last Ice Age, as we enter a more unstable and rapidly evolving phase of our planet’s history,”⁵

“We conclude that human impact has now grown to the point that it has changed the course of Earth history by at least many millennia, in terms of the anticipated long-term climate effects (e.g. postponement of the next glacial maximum: see Ganopolski et al., 2016; Clark et al., 2016), and in terms of the extensive and ongoing transformation of the biota, including a geologically unprecedented phase of human-mediated species invasions, and by species extinctions which are accelerating (Williams et al., 2015, 2016).”

The report stated that defining characteristics of the period include “marked acceleration of rates of erosion and sedimentation; large-scale chemical perturbations to the cycles of carbon, nitrogen, phosphorus and other elements; the inception of significant change in global climate and sea level; and biotic changes including unprecedented levels of species invasions across the Earth. Many of these changes are geologically long-lasting, and some are effectively irreversible.”

Loss of biodiversity

Tropical rain forests are the most biologically diverse places in the world. This is because they have not been affected by the periods of glaciation that have periodically destroyed the forests of temperate and boreal regions. The destruction of species-rich tropical rain forests is one of the mechanisms driving the present high rate of species loss.

According to a recent article published in *The Guardian*⁶ “Conservation experts have already signalled that the world is in the grip of the ”sixth great extinction” of species, driven by the destruction of natural habitats, hunting, the spread of alien predators and disease, and climate change.

“The IUCN⁷ created shock waves with its major assessment of the world’s biodiversity in 2004, which calculated that the rate of extinction had reached 100-1,000 times that suggested by the fossil records before humans.

“No formal calculations have been published since, but conservationists agree the rate of loss has increased since then, and Stuart said it was possible that the dramatic predictions of experts like the renowned Harvard biologist E

⁵<http://www2.le.ac.uk/offices/press/press-releases/2017/october/significant-scale-of-human-impact-on-planet-has-changed-course-of-earth2019s-history-scientists-suggest>

⁶<https://www.theguardian.com/environment/2010/mar/07/extinction-species-evolve>

⁷International Union for the Conservation of Nature

O Wilson, that the rate of loss could reach 10,000 times the background rate in two decades, could be correct.”

A recent article by Profs. Gerardo Ceballos, Paul R. Ehrlich and Rodolfo Dirzo in the *Proceedings of the National Academy of Sciences* was entitled “Biological Annihilation via the Ongoing Sixth Mass Extinction Signaled by Vertebrate Population Losses and Declines”.

The Abstract of the paper reads as follows: “The population extinction pulse we describe here shows, from a quantitative viewpoint, that Earth’s sixth mass extinction is more severe than perceived when looking exclusively at species extinctions. Therefore, humanity needs to address anthropogenic population extirpation and decimation immediately. That conclusion is based on analyses of the numbers and degrees of range contraction (indicative of population shrinkage and/or population extinctions according to the International Union for Conservation of Nature) using a sample of 27,600 vertebrate species, and on a more detailed analysis documenting the population extinctions between 1900 and 2015 in 177 mammal species. We find that the rate of population loss in terrestrial vertebrates is extremely high, even in ‘species of low concern.’ In our sample, comprising nearly half of known vertebrate species, 32% (8,851/27,600) are decreasing; that is, they have decreased in population size and range. In the 177 mammals for which we have detailed data, all have lost 30% or more of their geographic ranges and more than 40% of the species have experienced severe population declines (>80% range shrinkage). Our data indicate that beyond global species extinctions Earth is experiencing a huge episode of population declines and extirpations, which will have negative cascading consequences on ecosystem functioning and services vital to sustaining civilization. We describe this as a ‘biological annihilation’ to highlight the current magnitude of Earth’s ongoing sixth major extinction event.”

6.6 Global warming and atmospheric water vapor

A feedback loop is a self-re-enforcing trend. One of the main positive feedback loops in global warming is the tendency of warming to increase the atmospheric saturation pressure for water vapor, and hence amount of water vapor in the atmosphere, which in turn leads to further warming, since water vapor is a greenhouse gas.

Wikipedia’s article on greenhouse gases states that, “Water vapor accounts for the largest percentage of the greenhouse effect, between 36% and 66% for clear sky conditions and between 66% and 85% when including clouds.”

6.7 The albedo effect

Albedo is defined to be the fraction of solar energy (shortwave radiation) reflected from the Earth back into space. It is a measure of the reflectivity of the earth's surface. Ice, especially with snow on top of it, has a high albedo: most sunlight hitting the surface bounces back towards space.

Loss of sea ice

Especially in the Arctic and Antarctic regions, there exists a dangerous feedback loop involving the albedo of ice and snow. As is shown in Figure 4.1, Arctic sea ice is rapidly disappearing. It is predicted that during the summers, the ice covering arctic seas may disappear entirely during the summers. As a consequence, incoming sunlight will encounter dark light-absorbing water surfaces rather than light-reflecting ice and snow.

This effect is self-re-enforcing. In other words, it is a feedback loop. The rising temperatures caused by the absorption of more solar radiation cause the melting of more ice, and hence even more absorption of radiation rather than reflection, still higher temperatures, more melting, and so on.

The feedback loop is further strengthened by the fact that water vapor acts like a greenhouse gas. As polar oceans become exposed, more water vapor enters the atmosphere, where it contributes to the greenhouse effect and rising temperatures.

Darkened snow on Greenland's icecap

Greenland's icecap is melting, and as it melts, the surface becomes darker and less reflective because particles of soot previously trapped in the snow and ice become exposed. This darkened surface absorbs an increased amount of solar radiation, and the result is accelerated melting.

6.8 The methane hydrate feedback loop

If we look at the distant future, by far the most dangerous feedback loop involves methane hydrates or methane clathrates. When organic matter is carried into the oceans by rivers, it decays to form methane. The methane then combines with water to form hydrate crystals, which are stable at the temperatures and pressures which currently exist on ocean floors. However, if the temperature rises, the crystals become unstable, and methane gas bubbles up to the surface. Methane is a greenhouse gas which is 70 times as potent as CO₂.

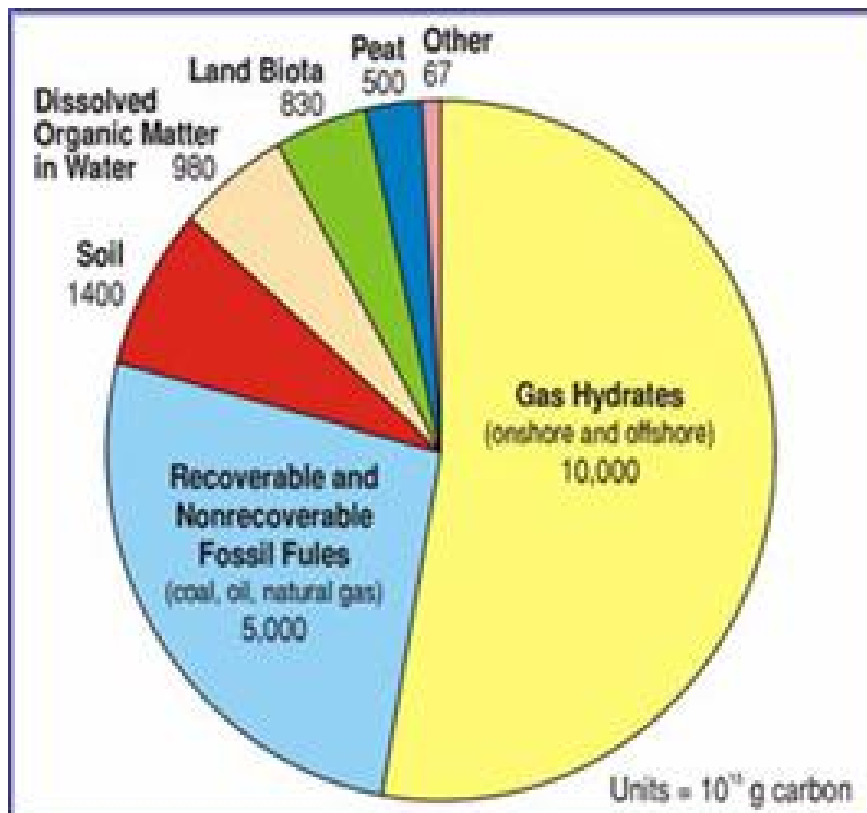


Figure 6.6: The worrying thing about the methane/hydrate feedback loop is the enormous amount of carbon in the form of hydrate crystals, 10,000 gigatons most of it on the continental shelves of oceans. This greater than the amount of carbon in all other forms that might potentially enter the earth's atmosphere.



Figure 6.7: When ocean temperatures rise, methane hydrate crystals become unstable, and methane gas bubbles up to ocean surfaces.

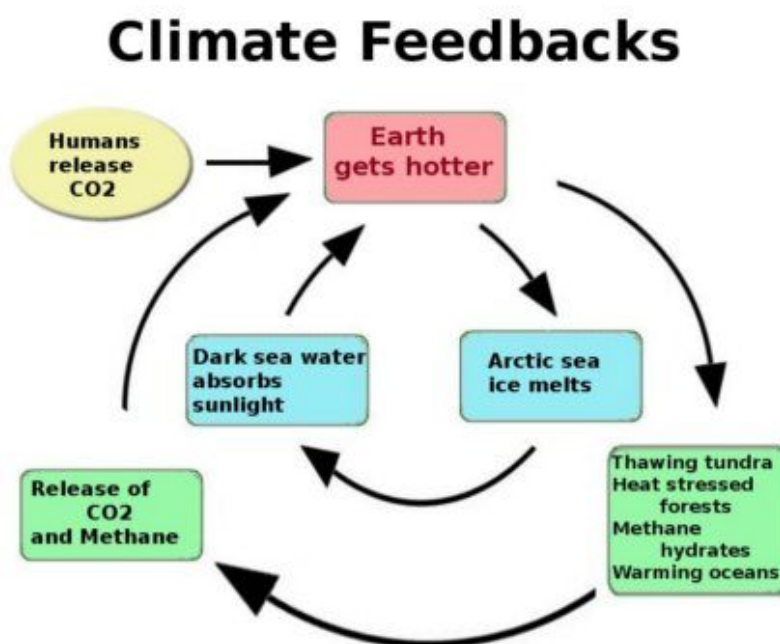


Figure 6.8: This diagram shows two important feedback loops, one involving the albedo effect, and the other involving methane hydrates.

The worrying thing about the methane hydrate deposits on ocean floors is the enormous amount of carbon involved: roughly 10,000 gigatons. To put this huge amount into perspective, we can remember that the total amount of carbon in world CO₂ emissions since 1751 has only been 337 gigatons.

A runaway, exponentially increasing, feedback loop involving methane hydrates could lead to one of the great geological extinction events that have periodically wiped out most of the animals and plants then living. This must be avoided at all costs.

6.9 A feedback loop from warming of soils

On October 6, 2017, the journal *Science* published an article entitled *Long-term pattern and magnitude of soil carbon feedback to the climate system in a warming world*⁸. The lead author, Jerry Melillo, is an ecologist working at the Marine Biological Laboratory, Woods Hole Massachusetts. In an interview with *Newsweek*, he said: “This self-reinforcing feedback is potentially a global phenomenon with soils, and once it starts it may be very difficult to turn off. It’s that part of the problem that I think is sobering... We think that one of the things that may be happening is both a reorganization of the microbial community structure and its functional capacity,”

The study reported on three decades of observations of heated sections of a forest owned by Harvard University. The heated sections were 5°C warmer than control sections.

6.10 Drying of forests and forest fires

According to a recent article in *Nature*⁹, “Across the American west, the area burned each year has increased significantly over the past several decades, a trend that scientists attribute both to warming and drying and to a century of wildfire suppression and other human activities. Allen suggests that the intertwined forces of fire and climate change will take ecosystems into new territory, not only in the American west but also elsewhere around the world. In the Jemez, for example, it could transform much of the ponderosa pine (*Pinus ponderosa*) forest into shrub land. ‘We’re losing forests as we’ve known them for a very long time,’ says Allen. ‘We’re on a different trajectory, and we’re not yet sure where we’re going.’

⁸J.M. Melillo et al., *Long-term pattern and magnitude of soil carbon feedback to the climate system in a warming world*, *Science*, Vol. 358, pp. 101-105, (2017).

⁹<http://www.nature.com/news/forest-fires-burn-out-1.11424>

“All around the American west, scientists are seeing signs that fire and climate change are combining to create a ‘new normal’. Ten years after Colorado’s largest recorded fire burned 56,000 hectares southwest of Denver, the forest still has not rebounded in a 20,000-hectare patch in the middle, which was devastated by an intense crown fire. Only a few thousand hectares, which the US Forest Service replanted, look anything like the ponderosa-pine stands that previously dominated the landscape.”

6.11 Tipping points and feedback loops

A tipping point is usually defined as the threshold for an abrupt and irreversible change¹⁰. To illustrate this idea, we can think of a book lying on a table. If we gradually push the book towards the edge of the table, we will finally reach a point after which more than half of the weight of the book will not be supported by the table. When this “tipping point” is passed the situation will suddenly become unstable, and the book will fall to the floor. Analogously, as the earth’s climate gradually changes, we may reach tipping points. If we pass these points, sudden instabilities and abrupt climatic changes will occur.

Greenland ice cores supply a record of temperatures in the past, and through geological evidence we have evidence of sea levels in past epochs. These historical records show that abrupt climatic changes have occurred in the past.

Timothy Michael Lenton, FRS, Professor of Climate Change and Earth System Science at the University of Exeter, lists the following examples of climatic tipping points:

- Boreal forest dieback
- Amazon rainforest dieback
- Loss of Arctic and Antarctic sea ice (Polar ice packs) and melting of Greenland and Antarctic ice sheets
- Disruption to Indian and West African monsoon
- Formation of Atlantic deep water near the Arctic ocean, which is a component process of the thermohaline circulation.
- Loss of permafrost, leading to potential Arctic methane release and clathrate gun effect

¹⁰Other definitions of tipping points are possible. A few authors define these as points beyond which change is inevitable, emphasizing that while inevitable, the change may be slow.

It can be seen from this list that climate tipping points are associated with feedback loops. For example, the boreal forest dieback and the Amazon rain-forest dieback tipping points are associated with the feedback loop involving the drying of forests and forest fires, while the tipping point involving loss of Arctic and Antarctic sea ice is associated with the Albedo effect feedback loop. The tipping point involving loss of permafrost is associated with the methane hydrate feedback loop.

Once a positive feedback loop starts to operate in earnest, change may be abrupt.

Suggestions for further reading

1. Naomi Klein, *This Changes Everything: Capitalism and the Climate*, Simon and Schuster, New York, (2014).
2. Naomi Klein, *The Shock Doctrine: The Rise of Disaster Capitalism*, Knopf Canada, (2007).
3. Noam Chomsky, *Because We Say So*, City Lights Open Media, (2015).
4. Noam Chomsky, *Democracy and Power: The Delhi Lectures*, Open Book Publishers, (2014).
5. Noam Chomsky, *Masters of Mankind: Essays and Lectures, 1969-2013*, Haymarket Books, (2014).
6. Noam Chomsky, *Nuclear War and Environmental Catastrophe*, Seven Stories Press, New York, (2013).
7. A. Gore, *An Inconvenient Truth: The Planetary Emergency of Global Warming and What We Can Do About It*, Rodale Books, New York, (2006).
8. A. Gore, *Earth in the Balance: Forging a New Common Purpose*, Earthscan, (1992).
9. A.H. Ehrlich and P.R. Ehrlich, *Earth*, Thames and Methuen, (1987).pro Simon and Schuster, (1990).
10. P.R. Ehrlich and A.H. Ehrlich, *Healing the Planet: Strategies for Resolving the Environmental Crisis*, Addison-Wesley, (1991).
11. P.R. Ehrlich and A.H. Ehrlich, *Betrayal of Science and Reason: How Anti-Environmental Rhetoric Threatens our Future*, Island Press, (1998).
12. P.R. Ehrlich and A.H. Ehrlich, *One With Nineveh: Politics, Consumption and the Human Future*, Island Press, (2004).
13. A.H. Ehrlich and U. Lele, *Humankind at the Crossroads: Building a Sustainable Food System*, in *Draft Report of the Pugwash Study Group: The World at the Crossroads*, Berlin, (1992).
14. P.R. Ehrlich, *The Population Bomb*, Sierra/Ballentine, New York, (1972).

15. P.R. Ehrlich, A.H. Ehrlich and J. Holdren, *Human Ecology*, W.H. Freeman, San Francisco, (1972).
16. P.R. Ehrlich, A.H. Ehrlich and J. Holdren, *Ecoscience: Population, Resources, Environment*, W.H. Freeman, San Francisco, (1977)
17. P.R. Ehrlich and A.H. Ehrlich, *Extinction*, Victor Gollancz, London, (1982).
18. D.H. Meadows, D.L. Meadows, J. Randers, and W.W. Behrens III, *The Limits to Growth: A Report for the Club of Rome's Project on the Predicament of Mankind*, Universe Books, New York, (1972).
19. D.H. Meadows et al., *Beyond the Limits. Confronting Global Collapse and Envisioning a Sustainable Future*, Chelsea Green Publishing, Post Mills, Vermont, (1992).
20. D.H. Meadows, J. Randers and D.L. Meadows, *Limits to Growth: the 30-Year Update*, Chelsea Green Publishing, White River Jct., VT 05001, (2004).
21. A. Peccei and D. Ikeda, *Before it is Too Late*, Kodansha International, Tokyo, (1984).
22. A. Peccei, *The Human Quality*, Pergamon Press, Oxford, (1977).
23. A. Peccei, *One Hundred Pages for the Future*, Pergamon Press, New York, (1977).
24. V.K. Smith, ed., *Scarcity and Growth Reconsidered*, Johns Hopkins University Press, Baltimore, (1979).
25. R. Costanza, ed., *Ecological Economics: The Science and Management of Sustainability*, Columbia University Press, New York, (1991).
26. M. McCarthy, *China Crisis: Threat to the Global Environment*, The Independent, (19 October, 2005).
27. L.R. Brown, *The Twenty-Ninth Day*, W.W. Norton, New York, (1978).
28. N. Myers, *The Sinking Ark*, Pergamon, New York, (1972).
29. N. Myers, *Conservation of Tropical Moist Forests*, National Academy of Sciences, Washington D.C., (1980).
30. National Academy of Sciences, *Energy and Climate*, NAS, Washington D.C., (1977).
31. W. Ophuls, *Ecology and the Politics of Scarcity*, W.H. Freeman, San Francisco, (1977).
32. E. Eckholm, *Losing Ground: Environmental Stress and World Food Prospects*, W.W. Norton, New York, (1975).
33. E. Eckholm, *The Picture of Health: Environmental Sources of Disease*, New York, (1976).
34. Economic Commission for Europe, *Air Pollution Across Boundaries*, United Nations, New York, (1985).

35. G. Hagman and others, *Prevention is Better Than Cure*, Report on Human Environmental Disasters in the Third World, Swedish Red Cross, Stockholm, Stockholm, (1986).
36. G. Hardin, "The Tragedy of the Commons", *Science*, December 13, (1968).
37. K. Newland, *Infant Mortality and the Health of Societies*, Worldwatch Paper 47, Worldwatch Institute, Washington D.C., (1981).
38. D.W. Orr, *Ecological Literacy*, State University of New York Press, Albany, (1992).
39. E. Pestel, *Beyond the Limits to Growth*, Universe Books, New York, (1989).
40. D.C. Pirages and P.R. Ehrlich, *Ark II: Social Responses to Environmental Imperatives*, W.H. Freeman, San Francisco, (1974).
41. Population Reference Bureau, *World Population Data Sheet*, PRM, 777 Fourteenth Street NW, Washington D.C. 20007, (published annually).
42. R. Pressat, *Population*, Penguin Books Ltd., (1970).
43. M. Rechcigl (ed.), *Man/Food Equation*, Academic Press, New York, (1975).
44. J.C. Ryan, *Life Support: Conserving Biological Diversity*, Worldwatch Paper 108, Worldwatch Institute, Washington D.C., (1992).
45. J. Shepard, *The Politics of Starvation*, Carnegie Endowment for International Peace, Washington D.C., (1975).
46. B. Stokes, *Local Responses to Global Problems: A Key to Meeting Basic Human Needs*, Worldwatch Paper 17, Worldwatch Institute, Washington D.C., (1978).
47. L. Timberlake, *Only One Earth: Living for the Future*, BBC/ Earthscan, London, (1987).
48. UNEP, *Environmental Data Report*, Blackwell, Oxford, (published annually).
49. UNESCO, *International Coordinating Council of Man and the Biosphere*, MAB Report Series No. 58, Paris, (1985).
50. United Nations Fund for Population Activities, *A Bibliography of United Nations Publications on Population*, United Nations, New York, (1977).
51. United Nations Fund for Population Activities, *The State of World Population*, UNPF, 220 East 42nd Street, New York, 10017, (published annually).
52. United Nations Secretariat, *World Population Prospects Beyond the Year 2000*, U.N., New York, (1973).
53. J. van Klinken, *Het Dierde Punte*, Uitgiversmaatschappij J.H. Kok-Kampen, Netherlands (1989).
54. B. Ward and R. Dubos, *Only One Earth*, Penguin Books Ltd., (1973).

55. WHO/UNFPA/UNICEF, *The Reproductive Health of Adolescents: A Strategy for Action*, World Health Organization, Geneva, (1989).
56. E.O. Wilson, *Sociobiology*, Harvard University Press, (1975).
57. E.O. Wilson (ed.), *Biodiversity*, National Academy Press, Washington D.C., (1988).
58. E.O. Wilson, *The Diversity of Life*, Allen Lane, The Penguin Press, London, (1992).
59. G. Woodwell (ed.), *The Earth in Transition: Patterns and Processes of Biotic Impoverishment*, Cambridge University Press, (1990).
60. World Resources Institute (WRI), *Global Biodiversity Strategy*, The World Conservation Union (IUCN), United Nations Environment Programme (UNEP), (1992).
61. World Resources Institute, *World Resources 200-2001: People and Ecosystems: The Fraying Web of Life*, WRI, Washington D.C., (2000).
62. D.W. Pearce and R.K. Turner, *Economics of Natural Resources and the Environment*, Johns Hopkins University Press, Baltimore, (1990).
63. T. Jackson, *Material Concerns: Pollution, Profit and the Quality of Life*, Routledge, (2004).
64. T. Jackson, *Motivating Sustainable Consumption*, Report to the Sustainable Development Research Network, January (2005).
65. T. Jackson, *The Earthscan Reader in Sustainable Consumption*, Earthscan, (2006).
66. J.S. Avery, *Information Theory and Evolution, 2nd Edition*, World Scientific, (2012).
67. A.J. Lotka, *Elements of Mathematical Biology*, Dover, (1956).
68. E.O. Wilson *Sociobiology: The New Synthesis*, Harvard University Press, (1975).
69. E.O. Wilson, *The Superorganism: The Beauty, Elegance, and Strangeness of Insect Societies*, W.W. Norton, (2009).
70. F. Soddy, *Wealth, Virtual Wealth and Debt. The solution of the economic paradox*, George Allen and Unwin, (1926).
71. F. Soddy, *The Role of Money*, George Routledge and Sons, London, (1934)
72. N. Georgescu-Roegen, *Energy and Economic Myths : Institutional and Analytical Economic Essays*, Pergamon Press, (1976).
73. N. Georgescu-Roegen, *The Entropy Law and the Economic Process*, Harvard University Press, (1971).
74. J. Rifkin and T. Howard, *Entropy: A New World View* The Viking Press, New York (1980).
75. P. Bartelmus, *Environment, Growth and Development: The Concepts and Strategies of Sustainability*, Routledge, New York, (1994).

76. H.E. Daly and K.N. Townsend, (editors), *Valuing the Earth. Economics, Ecology, Ethics*, MIT Press, Cambridge, Massachusetts, (1993)
77. C. Flavin, *Slowing Global Warming: A Worldwide Strategy*, Worldwatch Paper 91, Worldwatch Institute, Washington D.C., (1989).
78. S.H. Schneider, *The Genesis Strategy: Climate and Global Survival*, Plenum Press, (1976).
79. WHO/UNFPA/UNICEF, *The Reproductive Health of Adolescents: A Strategy for Action*, World Health Organization, Geneva, (1989).
80. World Commission on Environment and Development, *Our Common Future*, Oxford University Press, (1987).
81. W. Jackson, *Man and the Environment*, W.C. Brown, Dubuque, Iowa, (1971).
82. T. Berry, *The Dream of the Earth*, Sierra Club Books, San Francisco, (1988).
83. T.M. Swanson, ed., *The Economics and Ecology of Biodiversity Decline: The Forces Driving Global Change*, Cambridge University Press, (1995).
84. F.H. Bormann, *Unlimited Growth: Growing, Growing, and Gone?*, Bio-Science 22: 706-9, (1972).
85. L.G. Brookes, *A Low-Energy Strategy for the United Kingdom*, Atom 269: 73-8, (1979).
86. J. Cherfas, *Skeptics and Visionaries Examine Energy Saving*, Science 251: 154-6, (1991).
87. C.J. Cleveland, *Energy Quality and Energy Surplus in the Extraction of Fossil Fuels in the US*, Ecological Economics 6: 139-62, (1992).
88. C.J. Cleveland, Robert Costanza, Charlie A.S. Hall and Robert Kaufmann, *Energy and the US Economy: A Biophysical Perspective*, Science 225 (4665): 890-7, (1984).
89. P. Cloud, *Entropy, Materials, and Prosperity*, Geologische Rundschau 66: 678-96, (1978).
90. H.E. Daly, *From Empty-World Economics to Full-World Economics: Recognizing a Historical Turning Point in Economic Development*, in R. Goodland, H. E. Daly and S. Serafy (eds) *Population, Technology, and Lifestyle*, pp. 23-37. Washington, DC: Island Press, (1992).
91. H.E. Daly, *On Nicholas Georgescu-Roegen's Contributions to Economics: An Obituary Essay*, Ecological Economics 13: 149-54, (1995).
92. H.E. Daly, *Georgescu-Roegen versus Solow/Stiglitz*, Ecological Economics 22: 267-8, (1997).
93. M. Eigen, *Selforganization of Matter and the Evolution of Biological Macro- molecules*, Naturwissenschaften 58(10): 465-523, (1971).
94. S.O. Funtowicz and Jerry R. Ravetz, *Post Normal Science: A New Science for New Times*, Scientific European 266: 20-2, (1990).

95. N. Georgescu-Roegen, *Fixed Coefficients of Production and the Marginal Productivity Theory*, Review of Economic Studies 3: 40-9, (1935a).
96. N. Georgescu-Roegen, (1935b) *Note on a Proposition of Pareto*, Quarterly Journal of Economics 49: 706-14.
97. N. Georgescu-Roegen, *Marginal Utility of Money and Elasticities of Demand*, Quarterly Journal of Economics 50: 533-9, (1936a).
98. N. Georgescu-Roegen, *The Pure Theory of Consumer'-s Behavior*, Quarterly Journal of Economics 50: 545-93, (1936b).
99. N. Georgescu-Roegen, *Process in Farming versus Process in Manufacturing: A Problem of Balanced Development*, in U. Papi and C. Nunn (eds) Economic Problems of Agriculture in Industrial Societies, pp. 497-528. London: Macmillan, (1969).
100. N. Georgescu-Roegen, *The Entropy Law and the Economic Process*, Cambridge, MA: Harvard University Press, (1971).
101. N. Georgescu-Roegen, *Energy and Economic Myths*, Southern Economic Journal 41: 347-81, (1975).
102. N. Georgescu-Roegen, *Energy and Economic Myths*. New York: Pergamon Press, (1976).
103. N. Georgescu-Roegen, *Inequality, Limits and Growth from a Bioeconomic View- point*, Review of Social Economy 35: 361-75, (1977a).
104. N. Georgescu-Roegen, *The Steady State and Ecological Salvation: A Thermodynamic Analysis*, BioScience 27: 266-70, (1977b).
105. N. Georgescu-Roegen, *Energy Analysis and Economic Valuation*, Southern Economic Journal 45: 1023-58, (1979a).
106. N. Georgescu-Roegen, *Methods in Economic Science*, Journal of Economic Issues 13 (2): 317-28, (1979b).
107. N. Georgescu-Roegen, *Methods in Economic Science: A Rejoinder*, Economic Issues 15: 188-93, (1981).
108. N. Georgescu-Roegen, *The Promethean Condition of Viable Technologies*, Materials and Society 7: 425-35, (1983).
109. Georgescu-Roegen, Nicholas, *Man and Production*, in M. Baranzini and R. Scazzieri (eds) Foundations of Economics: Structures of Inquiry and Economic Theory, pp. 247-80. Oxford: Basil Blackwell, (1986).
110. N. Georgescu-Roegen, *An Emigrant from a Developing Country: Autobiographical Notes-I*, Banca Nazionale del Lavoro Quarterly Review 164: 3-31, (1988a).
111. N. Georgescu-Roegen, *The Interplay between Institutional and Material Factors: The Problem and Its Status*, in J.A. Kregel, E. Matzner and A. Roncaglia (eds) Barriers to Employment, pp. 297-326. London: Macmillan, (1988b).

112. N. Georgescu-Roegen, *Production Process and Dynamic Economics*, in M. Baranzini and R. Scazzieri (eds) *The Economic Theory of Structure and Change*, pp. 198-226. Cambridge: Cambridge University Press, (1990).
113. N. Georgescu-Roegen, *Nicholas Georgescu-Roegen about Himself*, in M. Szenberg (ed.) *Eminent Economists: Their Life Philosophies*, pp. 128-59. Cambridge: Cambridge University Press, (1992).
114. J. Gever, Robert Kaufmann, David Skole and Charles Vörösmarty, *Beyond Oil: The Threat to Food and Fuel in the Coming Decades*, Niwot, CO: University Press of Colorado, (1991).
115. M. Giampietro, *Sustainability and Technological Development in Agriculture: A Critical Appraisal of Genetic Engineering*, *BioScience* 44(10): 677-89, (1994).
116. M. Giampietro and Kozo Mayumi, *Another View of Development, Ecological Degradation and North-South Trade*, *Review of Social Economy* 56: 21-37, (1998).
117. M. Giampietro and Kozo Mayumi, *The Biofuel Delusion: The Fallacy of Large Scale Agro-biofuel Production*, London: Earthscan, (2009).
118. R. Goldschmidt, *Some Aspects of Evolution*, *Science* 78: 539-47, (1933).
119. S.J. Gould, *The Return to Hopeful Monsters*, *Natural History* 86: 22-30, (1977).
120. S.J. Gould and Niles Eldredge, *Punctuated Equilibria: The Tempo and Mode of Evolution Reconsidered*, *Paleobiology* 3: 115-51, (1977).
121. J. Gowdy, *The Value of Biodiversity: Markets, Society and Ecosystems*, *Land Economics* 73(1): 25-41, (1997).
122. J. Gribbin, *The Death of the Sun* New York: Delacorte Press, (1980).
123. C.A.S. Hall, Cutler J. Cleveland and Robert Kaufman, *Energy and Resource Quality* New York: John Wiley and Sons, (1986).
124. S.R. Ichtiaque and Stephen H. Schneider, *Atmospheric Carbon Dioxide and Aerosols: Effects of Large Increases on Global Climate*, *Science* 173: 138-41, (1971).
125. K. Ito, *Setting Goals and Action Plan for Energy Efficiency Improvement*. Paper presented at the EAS Energy Efficiency and Conservation Conference, Tokyo (19 June), (2007).
126. F. Jevons, *Greenhouse: A Paradox*, *Search* 21: 171-2, (1990).
127. W.S. Jevons, *The Coal Question* (reprint of 3rd edn, 1906). New York: Augustus M. Kelley, (1965).
128. N. Kawamiya, *Entropii to Kougyoushakai no Sentaku (Entropy and Future Choices for the Industrial Society)*, Tokyo: Kaimei, (1983).
129. J.D. Khazzoom, *Economic Implications of Mandated Efficiency Standards for Household Appliances*, *Energy Journal* 1: 21-39, (1980).

130. J.D. Khazzoom, *Energy Saving Resulting from the Adoption of More Efficient Appliances*, Energy Journal 8: 85-9, (1987).
131. T.C. Koopmans, *Three Essays on the State of Economic Science*, New York: McGraw-Hill Book Company, (1957).
132. T.S. Kuhn, *The Structure of Scientific Revolutions*, Chicago, IL: The University of Chicago Press, (1962).
133. J. von Liebig, *Letters on Modern Agriculture* (J. Blyth ed.). New York: John Wiley, (1959).
134. A.J. Lotka, *Elements of Mathematical Biology*, New York: Dover Publications, (1956).
135. G. Luft, *Fueling the Dragon: China's Race Into the Oil Market*. <http://www.iags.org/china.htm>, (2007).
136. K. Mayumi, *The Origins of Ecological Economics: The Bioeconomics of Georgescu-Roegen*, London: Routledge, (2001).
137. K. Mayumi, *An Epistemological Critique of the Open Leontief Dynamic Model: Balanced and Sustained Growth, Delays, and Anticipatory Systems Theory*, Structural Change and Economic Dynamics 16: 540-56m (2005).
138. K. Mayumi, Mario Giampietro and John Gowdy, *Georgescu-Roegen/Daly versus Solow/Stiglitz Revisited*, Ecological Economics 27: 115-17. Legacies: Nicholas Georgescu-Roegen 1253, (1998).
139. W.H. Miernyk, *Economic Growth Theory and the Georgescu-Roegen Paradigm*, in K. Mayumi and J. Gowdy (eds) Bioeconomics and Sustainability: Essays in Honour of Nicholas Georgescu-Roegen, pp. 69-81. Cheltenham: Edward Elgar, (1999).
140. Newman, Peter, *Greenhouse, Oil and Cities*, Futures May: 335-48, (1991).
141. D. Pearce, *Substitution and Sustainability: Some Reflections on Georgescu-Roegen*, Ecological Economics 22: 295-7, (1997).
142. D. Pearce, Edward Barbier and Anil Markandya, *Sustainable Development*, Hampshire: Edward Elgar, (1990).
143. J. Polimeni, Kozo Mayumi, Mario Giampietro and Blake Alcott, *The Jevons Paradox and the Myth of Resource Efficiency Improvements*, London: Earthscan, (2008).
144. J.F. Randolph, *Basic Real and Abstract Analysis*, New York: Academic Press, (1968).
145. D. Ricardo, *On the Principles of Political Economy and Taxation*, in P. Sraffa (ed.) The Works and Correspondence of David Ricardo, Vol. 1. Cambridge: Cambridge University Press, (1951).
146. E. Schrödinger, *What is Life? With Mind and Matter and Autobiographical Sketches*, Cambridge: Cambridge University Press, (1967).
147. J.A. Schumpeter, *The Theory of Economic Development*, Cambridge, MA: Harvard Economic Press, (1951).

148. G.T. Seaborg, *The Erehwon Machine: Possibilities for Reconciling Goals by Way of New Technology*, in S.H. Schurr (ed.) *Energy, Economic Growth, and the Environment*, pp. 125-38. Baltimore, MD: Johns Hopkins University Press, (1972).
149. M.R. Simmons, *Twilight in the Desert: The Coming Saudi Oil Shock and the World Economy* New Jersey: John Wiley and Sons, Inc., (2005).
150. B.J. Skinner, *Earth Resource (3rd edn)*, New Jersey: Prentice Hall, (1986).
151. V. Smil, *Global Catastrophes and Trends: The Next Fifty Years* Cambridge, MA: MIT Press, (2008).
152. R. Solow, *Technical Change and the Aggregate Production Function*, *Review of Economics and Statistics* 39: 312-20, (1957).
153. R. Solow, *The Economics of Resources or the Resources of Economics*, *American Economic Review* 64: 1-14, (1974).
154. R.E. Ulanowicz, *Growth and Development: Ecosystem Phenomenology* New York: Springer-Verlag, (1986).
155. US Geological Survey, *Commodity Statistics and Information*, (2005).
156. G.K. Zipf, *National Unity and Disunity: The Nation as a Bio-social Organism*. Bloomington, IN: Principia Press, (1941).

Chapter 7

POLAR NUCLEAR-WEAPON-FREE ZONES

7.1 The importance of nuclear-weapon-free zones

An important and active element of the Non-Proliferation Regime has been the establishment of a growing number of Nuclear-Weapon-Free Zones (NWFZ). The major nuclear-weapon-free zones established so far, cover more than half of the world's landmass including some 75 % of all land outside of nuclear-weapon state territory and 99 % of the Southern Hemisphere land areas. They encompass 119 states (out of some 195) and 19 other territories with about 1.9 billion inhabitants. The establishment of more such zones is proposed. The Middle East is frequently mentioned as the possible next zone.

Another possible zone candidate that has been discussed for quite some time is the circumpolar Arctic which has now become an urgent issue, not primarily because of a specific political need but because of the current climate change.

7.2 Arctic regions are no more inaccessible

The Arctic and the High North has for centuries been generally inaccessible for other than a few explorers. Since the 1950s, regular airlines passed above the surface, nuclear propelled submarines passed under the ice and a few ice-breakers occasionally passed through the ice.

In recent years, however, the average world surface temperature has risen. The Arctic polar ice has for a number of subsequent summers been melting

more than before. According to many experts, the northern polar sea, now covered by ice year around, may in a not too distant future become open waters first in the summers, and eventually on a permanent basis.

Should the Arctic sea turn unfrozen the year around, substantial new opportunities of great economic value would be available. Shipping between harbors in the Atlantic and the Pacific oceans shortcutting by the North Pole would spare time and cost. New areas could be opened up for large scale fishing.

Future exploitation of a more accessible Arctic would require international cooperation on a wide range of political, economic, navigational, and other matters. Disputes and competing or overlapping claims would have to be solved in an orderly and peaceful way. Militarization of the presence and activities should be avoided. Therefore, arms control measures should be instituted at an early stage, beginning with restricting weapons of mass destruction and the establishment of a nuclear-weapon-free zone in the region.

7.3 An Antarctic NWFZ already exists

The early negotiation and establishment of a nuclear-weapon-free zone in the Arctic thus seems timely, urgent and very important. Historically, the negotiation and establishment of a NWFZ has proved to be time-consuming, requiring years and in some cases decades, and thus motivating immediate initiation of the process of establishing an Arctic NWFZ.

A first question is whether it would be possible to draft an Arctic nuclear-weapon-free zone treaty by just copying the Antarctic treaty of 1959. But the political and geographic differences between the two regions are too large to make such a simple procedure possible. Antarctica is an almost uninhabited continent not subject to any national jurisdiction. The Arctic region is primarily an ocean surrounded by inhabited land areas subject to national sovereignties.

But many lessons could be learned from the zones established so far. In addition, a thorough discussion within the United Nations Disarmament Commission 1997-1999 resulted in a set of recommendations for zone-making unanimously endorsed by the UN General Assembly. In addition, a thorough discussion within the United Nations Disarmament Commission 1997-1999 resulted in a set of recommendations for zone-making unanimously endorsed by the UN General Assembly.

The geographical scope of the zone has to be based upon the Arctic Circle which, however, has itself no political significance. The states to be invited to negotiate such a zone would be those having territory north of the circle, i.e.

the eight states of Canada, Denmark (Greenland), Finland, Iceland, Norway, Russia, Sweden, and the USA (Alaska). However, a zone project with such geography will have to address issues having no historical precedents. Two of these states are nuclear-weapon states and six are non-nuclear-weapon states. Among the latter, four are members of the NATO alliance having a nuclear weapon role included in its strategic concept. In addition, the major part of the zone area would be ocean.

7.4 The Arctic is changing rapidly

The climate change and the possible turning of the Arctic from a mostly barren ice-desert into an attractive area for man has made international regulation of a number of issues urgently needed, e.g. security including conventional and non-conventional military matters, economic cooperation, exploitation of mineral resources, fishing, shipping and navigation, protection of the environment, and rights and participation of indigenous populations. International treaties covering these issues and possibly others will soon have to be negotiated. All such new agreements, an Arctic NWFZ included, should be coordinated and harmonized to avoid contradiction and overlap. Negotiation of an Arctic NWFZ would have to adapt to such a context, although initiated at an early stage.

Several existing zones were established step by step. States in a region met and negotiated the obligations and terms related to an envisaged NWFZ¹. A treaty text was negotiated, agreed, and signed. An entry-into-force process followed that often lasted for many years during which time the zone was built up and consolidated. Considering the complicated geography of an Arctic zone, it is reasonable to suggest that such a zone would also be established that way. It should be noted that two steps were already taken.

One is the 1920 Treaty on Spitsbergen² article 9 of which prohibits the establishment of naval bases and fortifications in the area of application, “which may never be used for warlike purposes”. Modern interpretation of this old-fashioned language implies that the Spitsbergen area should be considered a demilitarized zone and by implication also a nuclear-weapon-free zone.

The other step is the 1971 Sea-Bed Treaty prohibiting the parties to emplace “Nuclear Weapons and Other Weapons of Mass Destruction on the Sea-Bed and the Ocean Floor and in the Subsoil Thereof” including in the waste sea

¹A/54/42, Annex I: *Establishment of nuclear-weapon-free Zones on the basis of arrangements freely arrived at among the States of the region concerned*. The report was later unanimously endorsed by the UN General Assembly (A/RES/55/56 A).

²*League of Nations Treaty Series*, Vol. 2.

areas of the Arctic regardless of any future delimitation of the Arctic shelves.

7.5 A Northern European NWFZ?

Another potential step that was widely discussed in the years 1963-1991 but which never materialized was a Northern European NWFZ. An official report on that zone proposal was issued in 1991³. This idea could be relevant again today as a step towards an Arctic zone. Further steps could be envisaged.

One step today could be to initiate a UN study by the Secretary General with the assistance of governmental experts to explore the many political, legal, geophysical, military and administrative issues involved.

³*Nuclear-Weapon-Free Zone in the Nordic Area. Report from the Nordic Senior Officials Group.* Ministry of Foreign Affairs of Sweden. March 1991. The study of the group was based on preceding national studies.



Figure 7.1: The present reality: Exactly what we don't want! At present nuclear-armed submarines of both the USA and Russia regularly patrol Arctic waters, even colliding under the ice. (U.S. Navy photo by Chief Yeoman Alphonso Braggs).

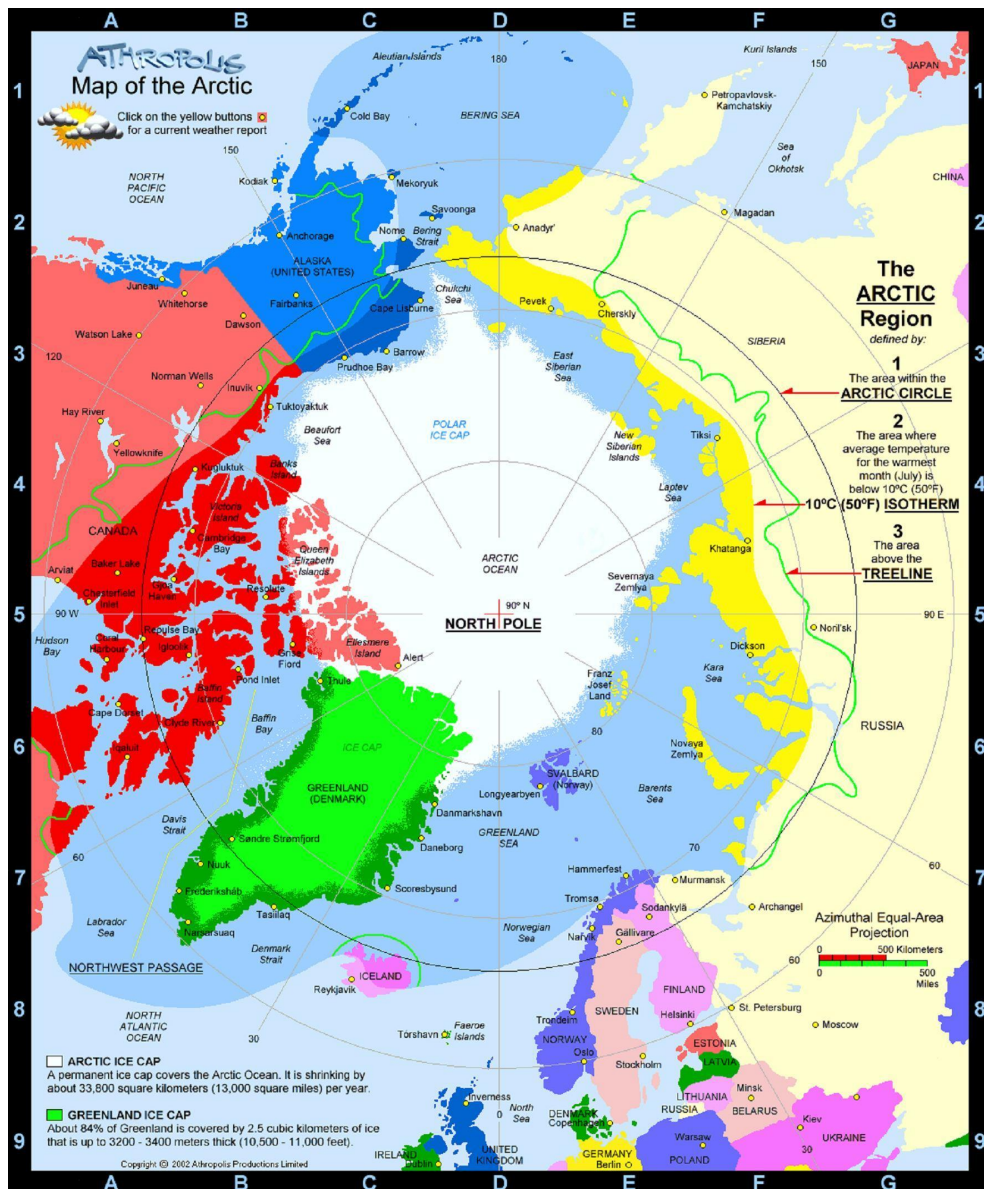


Figure 7.2: A political map of the Arctic region. Rights to some of the water- ways are disputed.



Figure 7.3: Polar sea ice is melting much faster than expected. The rapidly- warming climate of the Arctic threatens both the fragile ecology of the region and its indigenous peoples. At the same time it presages a massive geoeconomic shift to the north. (<http://cos-webster.st.unh.edu>)

7.6 A Copenhagen conference calls for an Arctic NWFZ

In August, 2009, the participants at a conference in Copenhagen issued the following Call for an Arctic NWFZ:

We the participants in the Conference on an Arctic Nuclear-Weapon-Free Zone, held in Copenhagen 10-11 August 2009:

- *Recognizing* that polar-ice-cap melting, caused by climate change, increases the potential for greater human and economic activity as well as conflict in the Arctic region, making more urgent the establishment of non-military, cooperative mechanisms for environmental protection, adaptation and security;
- *Inspired* by promising new opportunities and political momentum for the achievement of a nuclear-weapon-free world;
- *Believing* that nuclear-weapon-free zones play an important role in building regional security and confidence in order to achieve a nuclear-weapon-free world;
- *Recognizing* the value of international treaties as instruments for building mutually beneficial collaborative arrangements and ensuring verification and compliance;
- *Welcoming* treaties prohibiting nuclear weapons in specific regions, including Antarctica (1959), Outer Space (1967), Sea-Bed (1971), Latin America and the Caribbean (1968), the South Pacific (1986), South East Asia (1995), Africa (1996), Mongolia (2000), and Central Asia (2006);
- *Encouraged* by the April 2009 resolution adopted by the Inter-Parliamentary Union, representing 150 national parliaments, calling for the establishment of additional Nuclear-Weapon-Free Zones;
- *Welcoming* international treaties which take additional steps to completely demilitarize geographic zones, such as the 1959 Antarctic Treaty;
- *Welcoming especially* the 1971 Seabed Treaty which prohibits the placement of nuclear weapons on the ocean floor including in the Arctic region;
- *Recognizing* that each region, including the Arctic, has its own unique security environment which requires creative, multifaceted negotiations in order to achieve the establishment of the desired Nuclear-Weapon-Free Zone;

7.6. A COPENHAGEN CONFERENCE CALLS FOR AN ARCTIC NWFZ⁵⁹

- *Encouraged* by the May 2008 declaration of Illulissat in which the Foreign Ministers of the littoral states of the Arctic region agreed to work together to promote peaceful cooperation in the Arctic region, on the basis of international law, including the 1982 United Nations Convention on the Law of the Sea.

Recommend:

1. That governments and relevant sectors of civil society collaborate in developing the modalities for establishing a nuclear-weapon-free and demilitarized Arctic region;
2. That such collaboration should include active participation of, among others, indigenous and northern peoples, inhabitants of the region, parliamentarians, scientists, health professionals and academics;
3. That the aim of a Nuclear-Weapon-Free Arctic should be promoted in relevant environmental and development forums;
4. That the aim should also be promoted in relevant national and international political forums including, but not limited to, the United Nations, Arctic Council, Organization for Security and Cooperation in Europe, Nordic Council, North Atlantic Treaty Organization, Cooperative Security Treaty Organization (Tashkent Treaty), Non Proliferation Treaty Review Conferences and the Conference on Disarmament;
5. That countries in nuclear alliances be encouraged to reduce the role of nuclear weapons in their security doctrines in order to better facilitate the establishment of Nuclear-Weapon-Free Zones involving these countries, including in the Arctic region;
6. That countries in the Arctic region not possessing nuclear weapons (Canada, Denmark, Finland, Iceland, Norway, Sweden) take initial steps towards a Nuclear-Weapon-Free Zone in close cooperation with the United States and the Russian Federation; That countries in the Arctic region not possessing nuclear weapons (Canada, Denmark, Finland, Iceland, Norway, Sweden) take initial steps towards a Nuclear-Weapon-Free Zone in close cooperation with the United States and the Russian Federation;
7. That governments undertake steps to increase transparency and to redress negative impacts on inhabitants and the environment from military activities in the Arctic region including those in the past.

7.7 History of efforts to establish a Nordic NWFZ

The governments of Denmark, Norway, Sweden Finland and Iceland are opposed to nuclear weapons, and there none stationed on Scandinavian territory. Therefore a Nordic Nuclear Weapon Free Zone is a possible first step towards an Arctic NWFZ.

The Nordic countries already fulfill two important criteria of NWFZ's - non-possession of nuclear weapons and non-stationing of nuclear weapons by any state within their zone. Regarding non-use or no threat of use against targets within the zone, we think that the nuclear weapons states would agree not to threaten to use their weapons against the Nordic countries.

In 1957, Denmark enacted a ban on nuclear weapons on its territories, and that ban is still in force, despite Danish membership in NATO. This demonstrates that membership of several Scandinavian countries in NATO is not a hindrance to the formation of a Nordic NWFZ. Further support for this view can be found in the precedent of the 2006 Semipalitinsk Treaty, which involves Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan. Several of the member states of the Semipalitinsk NWFZ are members of a treaty organization with Russia, the Tashkent Treaty, but this did not prevent them from signing the Semipalitinsk Treaty.

The idea of a Nordic NWFZ was first proposed by Nikolai Bulganin in 1958. Bulganin's proposal was supported by President Kekkonen of Finland but it was initially rejected by the other Nordic countries. Kekkonen continued to promote the idea of a Nordic NWFZ, but it took more than 20 years before other Nordic governments gave serious support to the idea.

In September 1980 when the Norwegian diplomat Jens Evensen suggested 1958. Bulganin's proposal was supported by President Kekkonen of Finland but it was initially rejected by the other Nordic countries. Kekkonen continued to promote the idea of a Nordic NWFZ, but it took more than 20 years before other Nordic governments gave serious support to the idea.

In September 1980 when the Norwegian diplomat Jens Evensen suggested that Norway should take the lead in establishing a Nordic zone. Evensen's proposal sparked a grand debate among the political parties in Norway, and particularly within the Labor party. In 1982, former Norwegian Prime Minister Gro Harlem Brundtland presented a list of preconditions for supporting a Nordic zone:

1. Maintaining a low level of tension in the Nordic region was imperative.
2. It had to be based on mutual commitments and restraints, in a balanced manner.

3. The broader disarmament framework, such as the negotiations on the reduction of long range missiles, was to be given priority. The zone had to be seen as a part of the bigger picture.
4. Solutions had to be found that could be accommodated into the NATO-cooperation, and that would result in less nuclear weapons both in the east and the west.

Between 1984-85, a bipartisan commission studied the feasibility of the zone and presented its recommendations to the Norwegian Parliament. In the period from 1987 til 1991, a Nordic Senior Officials Group also discussed the possibility of the zone and in 1993, the Nordic Council recommended its establishment. But the end of the Cold War led to the mistaken belief that nuclear abolition was no longer urgent, and the idea lost momentum.

Today, however, the issue of nuclear weapons is once again at the center of the global stage. I strongly believe that the time has come for the Scandinavian countries to take a united stance on this issue. Most of the world's nations live in nuclear weapon free zones. This does not give them any real protection, since the catastrophic environmental effects of nuclear war would be global, not sparing any nation. However, by becoming members of NWFZ's, nations can state that they consider nuclear weapons to be morally unacceptable, a view that must soon become worldwide if human civilization is to survive.

By establishing a Nordic Nuclear Weapon Free Zone we in Scandinavia can express our belief that nuclear weapons are an absolute evil; that their possession does not increase anyone's security; that their continued existence is a threat to the life of every person on the planet; and that these genocidal and potentially omnicidal weapons have no place in a civilized society.

Chapter 8

THE URGENT NEED FOR CLIMATE ACTION

8.1 Governments gave fossil fuels \$5.9 trillion in subsidies in 2020

According to a new analysis from the International Monetary Fund, coal, oil and natural gas received \$5.9 trillion in subsidies from governments in 2020. These subsidies were partially direct, but also in the form of tax breaks and failure to include the environmental costs of fossil fuels in their pricing. This enormous sum, about 5.8% of the global GDP, should instead have been used to subsidize renewable energy infrastructure. The problem is that giant fossil fuel corporations are so wealthy that they can easily buy the votes of politicians.

8.2 Fossil fuel industry's disinformation campaign

The Wikipedia article on climate change denial describes it with the following words: “Although scientific opinion on climate change is that human activity is extremely likely to be the primary driver of climate change, the politics of global warming have been affected by climate change denial, hindering efforts to prevent climate change and adapt to the warming climate. Those promoting denial commonly use rhetorical tactics to give the appearance of a scientific controversy where there is none.”

It is not surprising that the fossil fuel industry supports, on a vast scale, politicians and mass media that deny the reality of climate change. The amounts of money at stake are vast. If catastrophic climate change is to

be avoided, coal, oil and natural gas “assets” worth trillions of dollars must be left in the ground. Giant fossil fuel corporations are desperately attempting to turn these “assets” into cash.

According to a recent article published in “The Daily Kos”¹, companies like Shell and Exxon, knew, as early as the 1970s, how their combustible products were contributing to irreversible warming of the planet, became public knowledge over the last few years.

A series of painstakingly researched articles² published in 2015 by the Pulitzer-prize winning Inside Climate News revealed an industry totally aware and informed for decades about the inevitable warming certain to occur as more and more carbon dioxide from the burning of fossil fuels was released into the atmosphere.

The article states that “In fact, the oil industry, and Exxon in particular, had the best climate models available, superior to those relied on by scientific community.”³ And armed with the foreknowledge developed through those models, Exxon and the other oil companies planned and executed an elaborate, cynical long term strategy: to invest hundreds of millions of dollars in a comprehensive propaganda effort designed to raise doubts about the existence and cause of climate change, a phenomenon they well knew was irrefutable, based on their own research. By 2016 the industry’s lobbying to discredit the science of climate change had surpassed two billion dollars.

“Meanwhile, as newly discovered documents reported in The Guardian⁴ attest, the same companies were preparing projections of what type of world they would be leaving for the rest of humanity. In the 1980s, oil companies like Exxon and Shell carried out internal assessments of the carbon dioxide released by fossil fuels, and forecast the planetary consequences of these emissions. In 1982, for example, Exxon predicted that by about 2060, CO₂ levels would reach around 560 parts per million - double the preindustrial level - and that this would push the planet’s average temperatures up by about 2°C over then-current levels (and even more compared to pre-industrial levels).”⁵

¹www.dailykos.com/stories/2018/9/23/1797888/-The-Oil-Companies-not-only-knew-fossil-fuels-caused-climate-change-they-knew-how-bad-it-would-get?detail=emaildkre

²<https://insideclimatenews.org/news/15092015/Exxons-own-research-confirmed-fossil-fuels-role-in-global-warming>

³<https://insideclimatenews.org/news/18092015/exxon-confirmed-global-warming-consensus-in-1982-with-in-house-climate-models>

⁴<https://www.theguardian.com/environment/climate-consensus-97-per-cent/2018/sep/19/shell-and-exxons-secret-1980s-climate-change-warnings>

⁵See also <https://truthout.org/articles/self-immolation-as-the-world-burns-an-earth-day-report/>
<https://countercurrents.org/2018/04/29/the-methane-time-bomb-and-the-future-of-the-biosphere/>

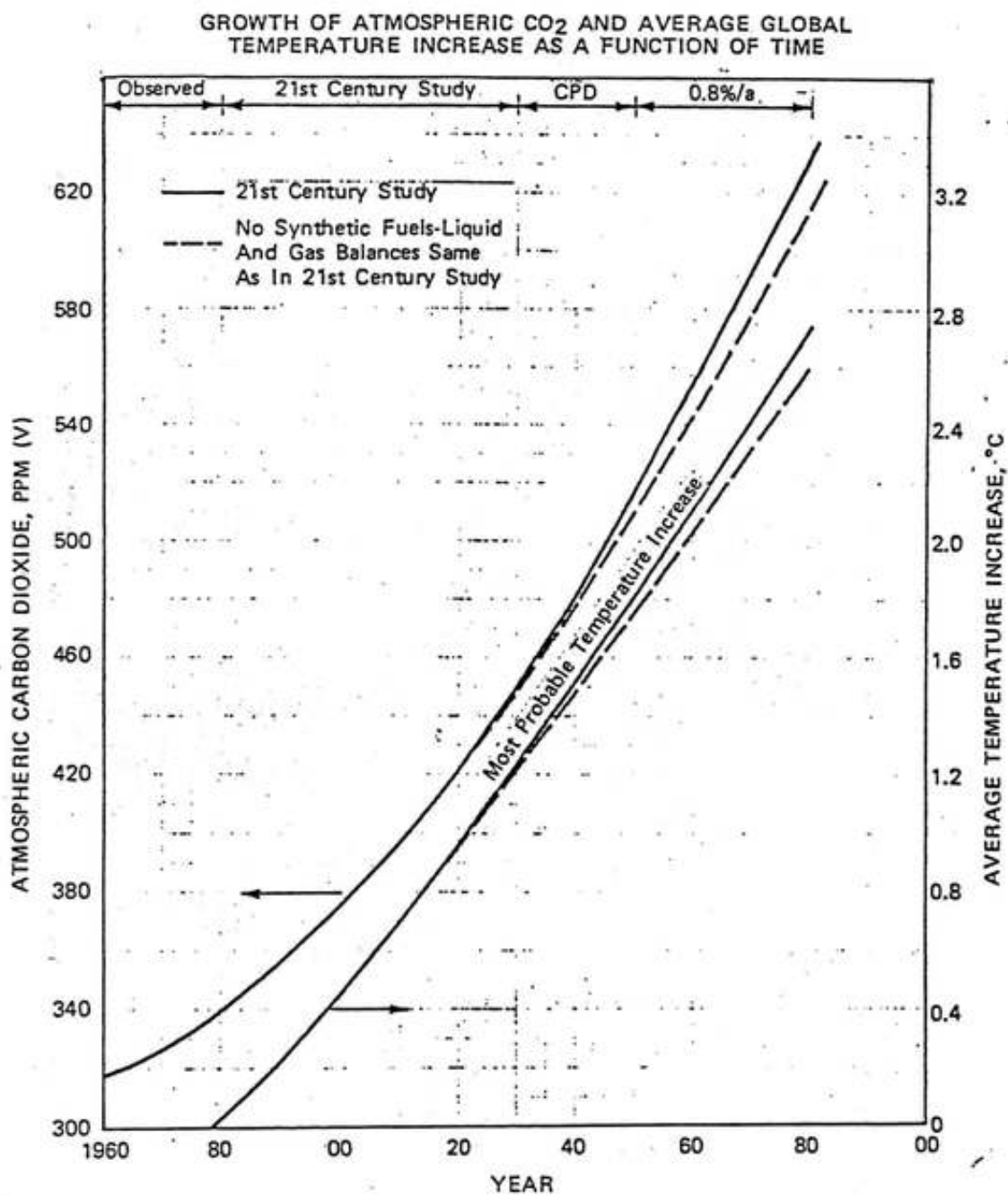


Figure 8.1: Exxon's 1982 internal projections of the future increase in carbon dioxide levels shows CO₂ percentages increasing to 600 ppm and temperature increases of up to 3°C.

The Fossil Free MIT report, 2014

Here are some excerpts from a report entitled “The Fossil Fuel Industry’s Role in Hindering Climate Change Action: Lobbying and Disinformation Against Science and Scientists”⁶:

In response to the unprecedented urgency of global climate change, Fossil Free MIT’s petition, signed by more than 2,400 MIT members, is calling on MIT to divest its \$11 billion endowment from the 200 fossil fuel companies with the world’s largest publicly traded carbon reserves.

Fossil Free MIT believes that divestment from the fossil fuel industry presents MIT with a unique opportunity to lead the global effort to combat climate change. We wholeheartedly support our Institute’s cutting-edge climate science and renewable energy technology research, as well as MIT’s campus sustainability initiatives, and we propose divestment as a highly complementary strategy that will bring MIT’s investments in line with the goals of its research and sustainability activities. There are three central reasons why we urge MIT to divest from the fossil fuel industry:

- The fossil fuel industry’s business practice is fundamentally inconsistent with the science of climate change mitigation. A 66% chance of limiting global warming to less than 2°C above pre-industrial temperatures demands that no more than 35% of proven fossil fuel reserves can be burned prior to 2100. Yet in 2012, the fossil fuel industry spent \$674 billion developing new reserves.
- The fossil fuel industry spends hundreds of millions of dollars lobbying and donating in Washington, D.C. against legislation for climate change action.
- Many fossil fuel companies are responsible for funding or orchestrating targeted anti-science disinformation campaigns that

<https://countercurrents.org/2018/08/07/hothouse-earth-evidence-for-ademise-of-the-planetary-life-support-system/>

<https://www.independent.co.uk/environment/global-warming-temperature-rise-climate-change-end-century-science-a8095591.html>

<http://www.lifeworth.com/deepadaptation.pdf>

<https://www.independent.co.uk/news/business/news/bp-shell-oil-global-warming-5-degree-paris-climate-agreement-fossil-fuels-temperature-rise-a8022511.html>

⁶<https://www.fossilfreemit.org/wp-content/uploads/2014/08/FossilFreeMIT-Lobbying-Disinformation.pdf>

confuse the public, sabotage science, and slander scientists.

Disinformation from fossil fuel and tobacco industries

Here are some excerpts from a February 19 2019 article by Mat Hope entitled “**Revealed: How the Tobacco and Fossil Fuel Industries Fund Disinformation Campaigns Around the World**”⁷:

Fossil fuel companies have a long history of adopting public relations strategies straight from the tobacco industry’s playbook. But a new analysis shows the two industries’ relationship goes much deeper - right down to funding the same organizations to do their dirty work.

MIT Associate Professor David Hsu analyzed organizations in DeSmog’s disinformation database and the Guardian’s tobacco database and found 35 thinktanks based in the US, UK, Australia, and New Zealand that promote both the tobacco and fossil fuel industries’ interests.

Of these organizations, DeSmog can reveal that 32 have taken direct donations from the tobacco industry, 29 have taken donations from the fossil fuel industry, and 28 have received money from both. Two key networks, based around the Koch brothers and Atlas Network, are involved in coordinating or funding many of the thinktanks.

⁷<https://www.desmogblog.com/2019/02/19/how-tobacco-and-fossil-fuel-companies-fund-disinformation-campaigns-around-world>



Figure 8.2: Smoke destroys human health, regardless of whether it is from cigarettes or coal-fired power plants. Fossil fuel corporations and tobacco companies have exhibited an astonishing degree of cynicism and lack of social responsibility.

8.3 The divestment movement begins to hurt

In a December 16, 2018 article in *The Guardian*⁸, Bill McKibben wrote:

I remember well the first institution to announce it was divesting from fossil fuel. It was 2012 and I was on the second week of a gruelling tour across the US trying to spark a movement. Our roadshow had been playing to packed houses down the west coast, and we'd crossed the continent to Portland, Maine. As a raucous crowd jammed the biggest theatre in town, a physicist named Stephen Mulkey took the mic. He was at the time president of the tiny Unity College in the state's rural interior, and he announced that over the weekend its trustees had voted to sell their shares in coal, oil and gas companies. "The time is long overdue for all investors to take a hard look at the consequences of supporting an industry that persists in destructive practices," he said.

Six years later, we have marked the 1,000th divestment in what

⁸<https://www.theguardian.com/commentisfree/2018/dec/16/divestment-fossil-fuel-industry-trillions-dollars-investments-carbon>

has become by far the largest anti-corporate campaign of its kind. The latest to sell their shares - major French and Australian pension funds, and Brandeis University in Massachusetts - bring the total size of portfolios and endowments in the campaign to just under \$8 trillion.

The list of institutions that have cut their ties with this most destructive of industries encompasses religious institutions large and small (the World Council of Churches, the Unitarians, the Lutherans, the Islamic Society of North America, Japanese Buddhist temples, the diocese of Assisi); philanthropic foundations (even the Rockefeller family, heir to the first great oil fortune, divested its family charities); and colleges and universities from Edinburgh to Sydney to Honolulu are on board, with more joining each week. Forty big Catholic institutions have already divested; now a campaign is urging the Vatican bank itself to follow suit. Ditto with the Nobel Foundation, the world's great art museums, and every other iconic institution that works for a better world.

Thanks to the efforts of groups such as People & Planet (and to the Guardian, which ran an inspiring campaign), half the UK's higher education institutions are on the list. And so are harder-nosed players, from the Norwegian sovereign wealth fund (at a trillion dollars, the largest pool of investment capital on Earth) to European insurance giants such as Axa and Allianz. It has been endorsed by everyone from Leonardo DiCaprio to Barack Obama to Ban Ki-moon (and, crucially, by Desmond Tutu, who helped run the first such campaign a generation ago, when the target was apartheid).

And the momentum just keeps growing: 2018 began with New York City deciding to divest its \$189bn pension funds. Soon the London mayor Sadiq Khan was on board, joining the New York mayor Bill de Blasio to persuade the other financial capitals of the planet to sell. By midsummer Ireland became the first nation to divest its public funds. And this month, a cross-party group of 200 MPs and former MPs called on the their pension fund to phase out its substantial investment in fossil fuel giants.

Heavy hitters like that make it clear that the first line of objection to fossil fuel divestment has long since been laid to rest: this is one big action you can take against climate change without big cost. Indeed, early divesters have made out like green-tinged bandits: since the fossil fuel sector has badly underperformed on the market over recent years, moving money into other investments has dramatically increased returns. Pity, for instance, the New York state comptroller

Thomas DeNapoli - unlike his New York City counterpart, he refused to divest, and the cost has been about \$17,000 per pensioner.

The deeper question, though, is whether divestment is making a dent in the fossil fuel industry. And there the answer is even clearer: this has become the deepest challenge yet to the companies that have kept us on the path to climate destruction.

At first we thought our biggest effect would be to rob fossil fuel companies of their social licence. Since their political lobbying power is above all what prevents governments taking serious action on global warming, that would have been worth the fight. And indeed academic research makes it clear that's happened - one study concluded that "liberal policy ideas (such as a carbon tax), which had previously been marginalised in the US debate, gained increased attention and legitimacy". That makes sense: most people don't have a coal mine or gas pipeline in their backyard, but everyone has - through their alma mater, their church, their local government - some connection to a large pot of money.

As time went on, though, it became clear that divestment was also squeezing the industry. Peabody, the world's biggest coal company, announced plans for bankruptcy in 2016; on the list of reasons for its problems, it counted the divestment movement, which was making it hard to raise capital. Indeed, just a few weeks ago analysts at that radical collective Goldman Sachs said the "divestment movement has been a key driver of the coal sector's 60% de-rating over the past five years"...

8.4 Some hopeful signs of change

According to a 5 April 2019 article in *The Guardian*⁹, "Norway's \$1tn oil fund, the world's largest sovereign wealth fund, is to plunge billions of dollars into wind and solar power projects. The decision follows Saudi Arabia's oil fund selling off its last oil and gas assets.

"Other national funds built up from oil profits are also thought to be ramping up their investments in renewables. The moves show that countries that got rich on fossil fuels are diversifying their investments and seeking future profits in the clean energy needed to combat climate change. Analysts say the investments are likely to power faster growth of green energy.

According to IRENA, "Renewable energy now accounts for a third of global

⁹<https://www.theguardian.com/environment/2019/apr/05/historic-breakthrough-norways-giant-oil-fund-dives-into-renewables>

power capacity”. Here are some excerpts from the Danish government’s State of Green newsletter of April 3, 2019:

The decade-long trend of strong growth in renewable energy capacity continued in 2018 with global additions of 171 gigawatts (GW), according to new data released by the International Renewable Energy Agency (IRENA). The annual increase of 7.9 per cent was bolstered by new additions from solar and wind energy, which accounted for 84 per cent of the growth. A third of global power capacity is now based on renewable energy.

IRENA’s annual Renewable Capacity Statistics 2019,¹⁰ the most comprehensive, up-to-date and accessible figures on renewable energy capacity indicates growth in all regions of the world, although at varying speeds. While Asia accounted for 61 per cent of total new renewable energy installations and grew installed renewables capacity by 11.4 per cent, growth was fastest in Oceania that witnessed a 17.7 per cent rise in 2018. Africa’s 8.4 per cent growth put it in third place just behind Asia. Nearly two-thirds of all new power generation capacity added in 2018 was from renewables, led by emerging and developing economies.

“Through its compelling business case, renewable energy has established itself as the technology of choice for new power generation capacity,” said IRENA Director-General Adnan Z. Amin.

¹⁰<https://www.irena.org/publications/2019/Mar/Capacity-Statistics-2019>

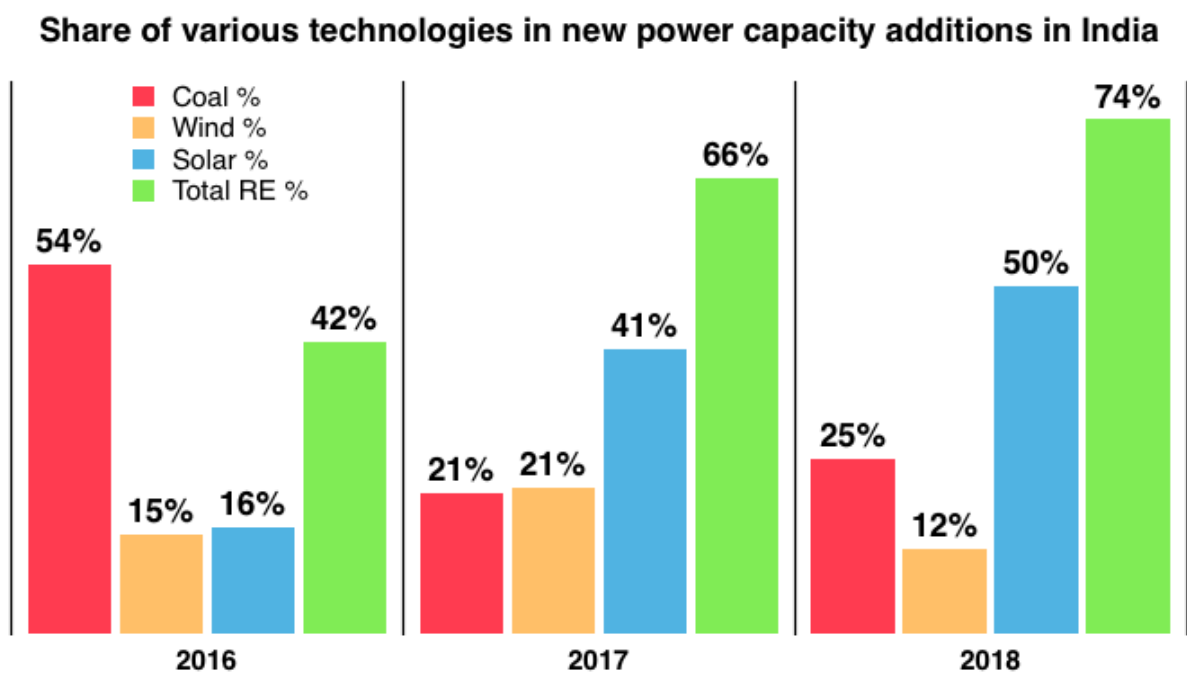


Figure 8.3: **74%** of India's new power capacity addition in 2018 was renewable.



Figure 8.4: Ukraine in the first quarter of 2019 commissioned 861.1 MW of renewable energy facilities, which is 5.4 times more than in the same period last year.

8.5 Greed is driving us towards disaster

Religions warn against excessive love of money. For example, in Christianity, Greed is listed among the seven deadly sins, and the Bible contains the admonition: “The love of money is the root of all evil.”

Today, with the future of our planet at stake, greed is driving us towards disaster. Economics and politics are far too closely linked. Decisions are made on the basis of short-term financial considerations, and these decisions are sacrificing hope for saving human civilization and the biosphere from catastrophic climate change.

What will happen if we fail (for the sake of money) to avoid a climate catastrophe? Rising temperatures will make most of the world uninhabitable. Large numbers of animals and plants that cannot move long distances will become extinct. Humans will not necessarily become extinct. but the global population of humans will be reduced to a small number. There is a danger that human solidarity will break down entirely, as everyone tries to save themselves.

8.6 Noam Chomsky on climate inaction

Here are some quotations from an article entitled *Chomsky and Pollin: COP26 Pledges Will Fail Unless Pushed by Mass Organizing*, Published by Truthout on October 28, 2021:

“...Survival is at stake. The basic facts are brutally clear, more so with each passing year. They are laid out clearly enough in the latest Intergovernmental Panel on Climate Change (IPCC) report, released on August 9. In brief, any hope of avoiding disaster requires taking significant steps right away to reduce fossil fuel use, continuing annually with the goal of effectively phasing out fossil fuel use by mid-century. We are approaching a precipice. A few steps more, and we fall over it, forever.

“Falling off the precipice does not imply that everyone will die soon; there’s a long way down. Rather, it means that irreversible tipping points will be reached, and barring some now-unforeseen technological miracle, the human species will be entering a new era: one of inexorable decline, with mounting horrors of the kind we can easily depict, extrapolating realistically from what already surrounds us - an optimistic estimate, since non-linear processes may begin to take off and dangers lurk that are only dimly perceived.

“It will be an era of ‘sauve qui peut’ - run for your lives, everyone for themselves, material catastrophe heightened by social collapse

and wholesale psychic trauma of a kind never before experienced. And on the side, an assault on nature of indescribable proportions.

“All of this is understood at a very high level of confidence. Even a relic of rationality tells us that it is ridiculous to take a chance on its being mistaken, considering the stakes...

“The evidence at hand is not encouraging. Let’s go back to August 9, 2021, with its clear warning that we must begin now to reduce fossil fuel use.

“Immediately on receipt of this grim warning, the president of the most powerful state in world history issued an appeal to the global oil cartel OPEC to increase production. Europe followed suit, joined by the rest of what is called ‘advanced society.’ The reason is an energy crunch. That’s doubtless a problem. One way to deal with it is to race towards the precipice. Another is for the rich in the rich societies, the major culprits, to tighten their belts while we sharply accelerate transition to sustainable energy...”

8.7 Greta Thunberg’s TED talk

Greta Thunberg was born in Sweden in 2003. Her father, Svante Thunberg, is related to Svante Arrhenius, one of the important pioneers of climate science, and is named after him. Greta’s mother was a successful opera singer. Greta Thunberg’s strong belief in the urgency of action to prevent catastrophic climate change converted her parents, so that they made changes in their lives. For example, Greta’s mother gave up her career as an opera singer because it involved air travel.

In November, 2018, Greta Thunberg gave an impressively clear TEDx talk in Stockholm, the video of which was recently released.¹¹ Here is a transcript of the talk.

When I was about 8 years old, I first heard about something called ‘climate change’ or ‘global warming’. Apparently, that was something humans had created by our way of living. I was told to turn off the lights to save energy and to recycle paper to save resources. I remember thinking that it was very strange that humans, who are an animal species among others, could be capable of changing the Earth’s climate. Because, if we were, and if it was really happening, we wouldn’t be talking about anything else. As soon as

¹¹<https://www.dailykos.com/stories/2018/12/16/1819508/-A-Call-to-Action-on-Climate-Change-by-15-year-Old-Greta-Thunberg>

you turn on the TV, everything would be about that. Headlines, radio, newspapers: You would never read or hear about anything else. As if there was a world war going on, but no one ever talked about it. If burning fossil fuels was so bad that it threatened our very existence, how could we just continue like before? Why were there no restrictions? Why wasn't it made illegal?

To me, that did not add up. It was too unreal.

So, when I was 11, I became ill, I fell into depression, I stopped talking, and I stopped eating. In two months, I lost about 10 kilos of weight. Later on, I was diagnosed with Asperger's syndrome, OCD and selective mutism. This basically means, I only speak, when I think it is necessary.

Now is one of those moments.

For those of us, who are on the spectrum, almost everything is black or white. We aren't very good at lying and we usually don't enjoy participating in the social games that the rest of you seem so fond of. I think, in many ways, that we autistic are the normal ones and the rest of the people are pretty strange. Especially when it comes to the sustainability crisis: Where everyone keeps saying that climate change is an existential threat and the most important issue of all. And yet, they just carry on like before.

I don't understand that. Because if the emissions have to stop, then we must stop the emissions. To me, that is black or white. There are no gray areas when it comes to survival. Either we go on as a civilization or we don't.

We have to change.

Rich countries like Sweden need to start reducing emissions by at least 15% every year. And that is so that we can stay below a 2 degrees warming target. Yet, as the IPCC has recently demonstrated, aiming instead for 1.5 degrees Celsius would significantly reduce the climate impacts. But we can only imagine what that means for reducing emissions.

You would think the media and every one of our leaders would be talking about nothing else. But they never even mention it.

Nor does anyone ever mentioned the greenhouse gases already locked in the system. Nor that air pollution is hiding some warming; so that, when we stop burning fossil fuels, we already have an extra level of warming - perhaps as high as 0.5 to 1.1 degrees Celsius.

Furthermore, does hardly anyone speak about the fact that we are in the midst of the sixth mass extinction: With up to 200 species going extinct every single day. That the extinction rate is today

between 1000 and 10,000 times higher than what is seen as normal.

Nor does hardly anyone ever speak about the aspect of equity or climate justice, clearly stated everywhere in the Paris agreement, which is absolutely necessary to make it work on a global scale. That means that rich countries need to get down to zero emissions within 6 to 12 years with today's emission speed. And that is so that people in poorer countries can have a chance to heighten their standard of living by building some of the infrastructures that we have already built, such as roads, schools, hospitals, clean drinking water, electricity, and so on. Because, how can we expect countries like India or Nigeria to care about the climate crisis if we, who already have everything, don't care even a second about it or our actual commitments to the Paris agreement?

So why are we not reducing our emissions? Why are they in fact still increasing? Are we knowingly causing a mass extinction? Are we evil?

No, of course, not. People keep doing what they do because the vast majority doesn't have a clue about the actual consequences for their everyday life. And they don't know that rapid change is required.

We all think we know and we all think everybody knows. But we don't.

Because, how could we? If there really was a crisis, and if this crisis was caused by our emissions, you would at least see some signs. Not just flooded cities. Tens of thousands of dead people and whole nations leveled to piles of torn down buildings. You would see some restrictions.

But no. And no one talks about it. There are no emergency meetings, no headlines, no breaking news. No one is acting as if we were in a crisis.

Even most climate scientists or green politicians keep on flying around the world, eating meat and dairy.

If I live to be 100, I will be alive in the year 2103. When you think about the future today, you don't think beyond the year 2050. By then I will, in the best case, not even have lived half of my life. What happens next? In the year 2078, I will celebrate my 75th birthday. If I have children or grandchildren, maybe they will spend that day with me. Maybe they will ask me about you, the people who were around back in 2018. Maybe they will ask why you didn't do anything while there still was time to act. What we do or don't do right now, will affect my entire life and the lives of my children

and grandchildren. What we do or don't do right now, me and my generation can't undo in the future.

So, when school started in August of this year, I decided that this was enough. I set myself down on the ground outside the Swedish parliament. I school-striking for the climate.

Some people say that I should be in school instead. Some people say that I should study, to become a climate scientist so that I can solve the climate crisis.

But the climate crisis has already been solved. We already have all the facts and solutions. All we have to do is to wake up and change.

And why should I be studying for a future that soon will be no more, when no one is doing anything whatsoever to save that future? And what is the point of learning facts in the school system, when the most important facts given by the finest science of that same school system clearly means nothing to our politicians and our society?

Some people say that Sweden is just a small country and that it doesn't matter what we do. But I think that if a few children can get headlines all over the world just by not coming to school for a few weeks, imagine what we could all do together if we wanted to?

Now we're almost at the end of my talk and this is where people usually people usually start talking about hope. Solar panels, wind power, circular economy, and so on. But I'm not going to do that. We've had 30 years of pep talking and selling positive ideas. And I'm sorry but it doesn't work because if it would have, the emissions would have gone down by now. They haven't.

And yes, we do need hope. Of course, we do. But the one thing we need more than hope is action. Once we start to act, hope is everywhere. So instead of looking for hope, look for action. Then and only then, hope will come today.

Today we use 100 million barrels of oil every single day. There are no politics to change that. There are no rules to keep that oil in the ground. So, we can't save the world by playing by the rules, because the rules have to be changed.

Everything needs to change and it has to start today.

Thank you.

8.8 Only immediate climate action can save the future

Immediate action to halt the extraction of fossil fuels and greatly reduce the emission of CO₂ and other greenhouse gasses is needed to save the long-term future of human civilization and the biosphere.

At the opening ceremony of United Nations-sponsored climate talks in Katowice, Poland, Sir David Attenborough said “Right now, we are facing a man-made disaster of global scale. Our greatest threat in thousands of years. Climate change. If we don’t take action, the collapse of our civilizations and the extinction of much of the natural world is on the horizon. The world’s people have spoken. Their message is clear. Time is running out. They want you, the decision-makers, to act now.”

Antonio Guterres, UN Secretary-General, said climate change was already “a matter of life and death” for many countries. He added that the world is “nowhere near where it needs to be” on the transition to a low-carbon economy.

Swedish student Greta Thunberg, is a 16-year-old who has launched a climate protest movement in her country. She said, in a short but very clear speech after that of UN leader Antonio Guterres: “Some people say that I should be in school instead. Some people say that I should study to become a climate scientist so that I can ‘solve the climate crisis’. But the climate crisis has already been solved. We already have all the facts and solutions.”

She added: “Why should I be studying for a future that soon may be no more, when no one is doing anything to save that future? And what is the point of learning facts when the most important facts clearly mean nothing to our society?”

Thunberg continued: “Today we use 100 million barrels of oil every single day. There are no politics to change that. There are no rules to keep that oil in the ground. So we can’t save the world by playing by the rules. Because the rules have to be changed.”

She concluded by saying that “since our leaders are behaving like children, we will have to take the responsibility they should have taken long ago.”

Appearing among billionaires, corporate CEO’s and heads of state at the Davos Economic Forum in Switzerland, like a new Joan of Arc, 16-year-old Swedish climate activist Greta Thunberg called on decision-makers to fulfil their responsibilities towards future generations. Here are some excerpts from her speech:

8.8. ONLY IMMEDIATE CLIMATE ACTION CAN SAVE THE FUTURE79



Greta's speech at Davos

Our house is on fire. I am here to say, our house is on fire. According to the IPCC, we are less than 12 years away from not being able to undo our mistakes. In that time, unprecedented changes in all aspects of society need to have taken place, including a reduction of our CO₂ emissions by at least 50%...

Here in Davos - just like everywhere else - everyone is talking about money. It seems money and growth are our only main concerns.

And since the climate crisis has never once been treated as a crisis, people are simply not aware of the full consequences on our everyday life. People are not aware that there is such a thing as a carbon budget, and just how incredibly small that remaining carbon budget is. That needs to change today.

No other current challenge can match the importance of establishing a wide, public awareness and understanding of our rapidly disappearing carbon budget, that should and must become our new global currency and the very heart of our future and present economics.

We are at a time in history where everyone with any insight of the climate crisis that threatens our civilization - and the entire biosphere - must speak out in clear language, no matter how uncomfortable and unprofitable that may be.

We must change almost everything in our current societies. The bigger your carbon footprint, the bigger your moral duty. The bigger your platform, the bigger your responsibility.

8.8. ONLY IMMEDIATE CLIMATE ACTION CAN SAVE THE FUTURE81



Figure 8.5: Greta Thunberg on the cover of Time Magazine, The Intergovernmental Panel on Climate Change, in their October 2018 report, used strong enough language to wake up at least part of the public: the children whose future is at stake. Here is an excerpt from a speech which 16-year-old Swedish climate activist Greta Thunberg made at the Davos Economic Forum in January, 2019: “Our house is on fire. I am here to say, our house is on fire. According to the IPCC, we are less than 12 years away from not being able to undo our mistakes. In that time, unprecedented changes in all aspects of society need to have taken place, including a reduction of our CO₂ emissions by at least 50%...”

8.9 Worldwide school strike, 15 March, 2019

Over 1.4 million young students across all continents took to the streets on Friday March 15th for the first ever global climate strike. Messages in more than 40 languages were loud and clear: world leaders must act now to address the climate crisis and save our future. The school strike was the largest climate action in history. Nevertheless it went almost unmentioned in the media,

Here are some of the statements by the students explaining why they took part in the strikes:

In India, no one talks about climate change. You don't see it on the news or in the papers or hear about it from government. We want global leaders to declare a climate emergency. If we don't act today, then we will have no tomorrow. - Vidit Baya, 17, Udaipur, India.

We face heartbreaking loss due to increasingly extreme weather events. We urge the Taiwanese government to implement mitigation measures and face up to the vulnerability of indigenous people, halt construction projects in the indigenous traditional realm, and recognize the legal status of Plains Indigenous People, in order to implement environmental protection as a bottom-up approach - Kaisanan Ahuan, Puli City, Taiwan.

We have reached a point in history when we have the technical capacities to solve poverty, malnutrition, inequality and of course global warming. The deciding factors for whether we take advantage of our potential will be our activism, our international unity and our ability to develop the art of making the impossible possible. Whether we succeed or not depends on our political will - Eyal Weintraub, 18, and Bruno Rodriguez, 18, Argentina.

The damage done by multinationals is enormous: the lack of transparency, dubious contracts, the weakening of the soil, the destruction of flora and fauna, the lack of respect for mining codes, the contamination of groundwater. In Mali, the state exercises insufficient control over the practices of the multinationals, and it is us, the citizens, who suffer the consequences. The climate alarm has sounded, and the time has come for us all to realize that there is still time to act locally, in our homes, our villages, our cities - Mone Fousseny, 22, Mali.







Figure 8.6: Eve White and her children join climate protesters in Tasmania. According to an article in *The Guardian*, parents and grandparents around the world are mobilizing in support of the youth climate movement that has swept the globe.

Concerns of young protesters are justified

In an article in the journal *Science* dated 12 April, 2019,¹³ 20 prominent climate scientists stated that the concerns of student protesters around the world are fully justified. Here are some quotations from the article:

The world's youth have begun to persistently demonstrate for the protection of the climate and other foundations of human well-being. As scientists and scholars who have recently initiated similar letters of support in our countries, we call for our colleagues across all disciplines and from the entire world to support these young climate protesters. We declare: Their concerns are justified and supported by the best available science. The current measures for protecting the climate and biosphere are deeply inadequate.

Nearly every country has signed and ratified the Paris Agreement of 2015, committing under international law to hold global warming well below 2°C above preindustrial levels and to pursue efforts to limit the temperature increase to 1.5°C. The scientific community has clearly concluded that a global warming of 2°C instead of 1.5°C would substantially increase climate-related impacts and the risk of some becoming irreversible. Moreover, given the uneven distribution of most impacts, 2°C of warming would further exacerbate existing global inequalities.

It is critical to immediately begin a rapid reduction in CO₂ and other greenhouse gas emissions. The degree of climate crisis that humanity will experience in the future will be determined by our cumulative emissions; rapid reduction now will limit the damage. For example, the Intergovernmental Panel on Climate Change (IPCC) has recently assessed that halving CO₂ emissions by 2030 (relative to 2010 levels) and globally achieving net-zero CO₂ emissions by 2050 (as well as strong reductions in other greenhouse gases) would allow a 50% chance of staying below 1.5°C of warming. Considering that industrialized countries produced more of and benefited more from previous emissions, they have an ethical responsibility to achieve this transition more quickly than the world as a whole.

Many social, technological, and nature-based solutions already

¹²<https://www.theguardian.com/environment/2019/apr/03/parents-around-the-world-mobilise-behind-youth-climate-strikes>

¹³<https://science.sciencemag.org/content/364/6436/139.2>



exist. The young protesters rightfully demand that these solutions be used to achieve a sustainable society. Without bold and focused action, their future is in critical danger. There is no time to wait until they are in power...

The enormous grassroots mobilization of the youth climate movement -including Fridays for Future, School (or Youth) Strike 4 Climate, Youth for (or 4) Climate, and Youth Climate Strike - shows that young people understand the situation. We approve and support their demand for rapid and forceful action. We see it as our social, ethical, and scholarly responsibility to state in no uncertain terms: Only if humanity acts quickly and resolutely can we limit global warming, halt the ongoing mass extinction of animal and plant species, and preserve the natural basis for the food supply and well-being of present and future generations. This is what the young people want to achieve. They deserve our respect and full support.



Figure 8.7: Greta Thunberg addressing a meeting of the European Parliament in April, 2019. She complained that Brexit was treated as an emergency by the European Union, but climate change, which is a far greater emergency has been almost neglected. The 16-year-old, who is due to meet the Pope on Wednesday, said, “We face an end to civilization as we know it unless permanent changes take place in our society...European elections are coming soon and many like me who are affected most by this crisis, are not allowed to vote. That is why millions of children are taking to the street to draw attention to the climate crisis... It is not too late to act but it will take far-reaching vision and fierce determination... My plea is: Please wake up and do the seemingly impossible.”

8.10 The World Meteorological Organization's report

According to a recent United Nations report, extreme weather events displaced 2 million people during 2018. While no single event can be unambiguously attributed to anthropogenic climate change, scientists believe the the increasing frequency of extreme weather events is definitely linked to global warming. The same is true of their increasing severity.

The report states that during 2018, extreme weather events impacted roughly 62 million people, of whom 2 million were displaced from their homes. In the words of the WMO report, "The physical signs and socio-economic impacts of climate change are accelerating, as record greenhouse gas concentrations drive global temperatures towards increasingly dangerous levels."

UN Secretary General Antonio Guterres, speaking at the launching of the WMO report, used the occasion to remind global leaders of the urgency of the climate emergency. Guterres has convened a climate summit meeting scheduled for September 23, 2019, and referring to the meeting, he said: "Don't come with a speech, come with a plan. This is what science says is needed. It is what young people around the globe are rightfully demanding." Two weeks previously, on March 15, one and a half million students from more than 130 countries had skipped school to participate in the largest climate demonstration in history, demanding action to save the future from the threat of catastrophic climate change.

8.11 Only 12 years left to limit climate change catastrophe

The world's leading scientists met at the Forty-Eighth Session of the IPCC and First Joint Session of Working Groups I, II, and III, 1-5 October 2018 in Incheon, Republic of Korea and openly declared that civilization is on track for collapse because of reckless use of fossil fuels, unless immediate action is taken to drastically cut the extraction and use of fossil fuels.

The report finds that limiting global warming to 1.5°C would require "rapid and far-reaching" transitions in land, energy, industry, buildings, transport, and cities. Global net human-caused emissions of carbon dioxide would need to fall by about 45 percent from 2010 levels by 2030, reaching 'net zero' around 2050.

"It's a line in the sand and what it says to our species is that this is the moment and we must act now," said Debra Roberts, a co-chair of the working



Figure 8.8: A firefighter battles fire in California. The world is currently 1 degree Centigrade warmer than preindustrial levels.

group on impacts. “This is the largest clarion bell from the science community and I hope it mobilizes people and dents the mood of complacency.”

“We have presented governments with pretty hard choices. We have pointed out the enormous benefits of keeping to 1.5C, and also the unprecedented shift in energy systems and transport that would be needed to achieve that,” said Jim Skea, a co-chair of the working group on mitigation. “We show it can be done within laws of physics and chemistry. Then the final tick box is political will. We cannot answer that. Only our audience can - and that is the governments that receive it.”

Bob Ward, of the Grantham Research Institute on Climate Change, said the final document was “incredibly conservative” because it did not mention the likely rise in climate-driven refugees or the danger of tipping points that could push the world on to an irreversible path of extreme warming.

Policymakers commissioned the report at the Paris climate talks in 2016, but since then the gap between science and politics has widened. Donald Trump has promised to withdraw the US - the world’s biggest source of historical emissions - from the accord. Brazil’s president, Jair Bolsonaro, threatens to do the same and also open the Amazon rainforest to agribusiness.



Figure 8.9: UN Secretary-General Antonio Guterres: “It is hard to overstate the urgency of our situation. Even as we witness devastating climate impacts causing havoc across the world, we are still not doing enough, nor moving fast enough, to prevent irreversible and catastrophic climate disruption. Nor are we doing enough to capitalize on the enormous social, economic and environmental opportunities of climate action.”

8.12 COP24, the climate summit in Poland

The UN Secretary General's address to the opening session

Welcome to COP 24.

I thank President Duda, Minister Kowalczyk and COP President Designate Mijal Kurtyka for their warm welcome.

We are in trouble. We are in deep trouble with climate change.

Climate change is running faster than we are and we must catch up sooner rather than later before it is too late.

For many, people, regions even countries this is already a matter of life and death.

This meeting is the most important gathering on climate change since the Paris Agreement was signed.

It is hard to overstate the urgency of our situation.

Even as we witness devastating climate impacts causing havoc across the world, we are still not doing enough, nor moving fast enough, to prevent irreversible and catastrophic climate disruption.

Nor are we doing enough to capitalize on the enormous social, economic and environmental opportunities of climate action.

And so, I want to deliver four simple messages.

First: science demands a significantly more ambitious response.

Second: the Paris Agreement provides the framework for action, so we must operationalize it.

Third: we have a collective responsibility to invest in averting global climate chaos, to consolidate the financial commitments made in Paris and to assist the most vulnerable communities and nations.

Fourth: climate action offers a compelling path to transform our world for the better.

Let me turn first to science.

According to the World Meteorological Organization, the 20 warmest years on record have been in the past 22 years, with the top four in the past four years.

The concentration of carbon dioxide is the highest it has been in 3 million years.

Emissions are now growing again.

The recent special report from the Intergovernmental Panel on Climate Change finds that warming could reach 1.5 degrees as soon as 2030, with devastating impacts.

The latest UN Environment Programme Emissions Gap Report tells us that the current Nationally Determined Contributions under the Paris Agreement will lead to global warming of about 3 degrees by the end of the century.

Furthermore, the majority of countries most responsible for greenhouse gas emissions are behind in their efforts to meet their Paris pledges.

So, it is plain we are way off course.

We need more action and more ambition.

We absolutely have to close this emissions gap.

If we fail, the Arctic and Antarctic will continue to melt, corals will bleach and then die, the oceans will rise, more people will die from air pollution, water scarcity will plague a significant proportion of humanity, and the cost of disasters will skyrocket.

Last year I visited Barbuda and Dominica, which were devastated by hurricanes. The destruction and suffering I saw was heart-breaking. That story is repeated almost daily somewhere in the world.

These emergencies are preventable.

Emissions must decline by 45 per cent from 2010 levels by 2030 and be net zero by 2050.

Renewable energy will need to supply half to two-thirds of the world's primary energy by 2050 with a corresponding reduction in fossil fuels.

In short, we need a complete transformation of our global energy economy, as well as how we manage land and forest resources.

We need to embrace low-carbon, climate-resilient sustainable development.

I am hopeful that the Talanoa Dialogue will provide a very strong impulse for increased ambition in the commitments for climate action.

Excellencies,

This brings me to my second point.

The Paris Agreement provides a framework for the transformation we need.

It is our job here in Katowice is to finalize the Paris Agreement Work Programme – the rule book for implementation.

I remind all Parties that this is a deadline you set for yourselves and it is vital you meet it.

We need a unifying implementation vision that sets out clear rules, inspires action and promotes raised ambition, based on the

principle of equity and common but differentiated responsibilities and respective capabilities, in light of different national circumstances.

We have no time for limitless negotiations.

A completed Work Programme will unleash the potential of the Paris Agreement.

It will build trust and make clear that countries are serious about addressing climate change.

Dear Friends,

This brings me to my third point: the central importance of finance.

We need concerted resource mobilization and investment to successfully combat climate change.

We need transformative climate action in five key economic areas - energy, cities, land use, water and industry.

Some 75 per cent of the infrastructure needed by 2050 still remains to be built.

How this is done will either lock us in to a high-emissions future or steer us towards truly sustainable low-emissions development.

Governments and investors need to bet on the green economy, not the grey.

That means embracing carbon pricing, eliminating harmful fossil fuel subsidies and investing in clean technologies.

It also means providing a fair transition for those workers in traditional sectors that face disruption, including through retraining and social safety nets.

We also have a collective responsibility to assist the most vulnerable communities and countries - such as small island nations and the least developed countries - by supporting adaptation and resilience.

Making clear progress to mobilize the pledged \$100 billion dollars a year will provide a much-needed positive political signal.

I have appointed the President of France and Prime Minister of Jamaica to lead the mobilization of the international community, both public and private, to reach that target in the context of preparation of the Climate Summit I have convened in September of next year.

I also urge Member States to swiftly implement the replenishment of the Green Climate Fund.

It is an investment in a safer, less costly future.

Dear Friends,

All too often, climate action is seen as a burden. My fourth point is this: decisive climate action today is our chance to right our ship and set a course for a better future for all.

We have the knowledge.

Many technological solutions are already viable and affordable.

Cities, regions, civil society and the business community around the world are moving ahead.

What we need is political more will and more far-sighted leadership.

This is the challenge on which this generation's leaders will be judged.

Climate action is not just the right thing to do - it makes social and economic sense.

Meeting the goals of the Paris Agreement would reduce air pollution - saving more than a million lives each year by 2030, according to the World Health Organization.

According to the recent New Climate Economy report, ambitious climate action could yield 65 million jobs and a direct economic gain of \$26 trillion US dollars compared to business as usual over the next 12 years.

We are seeing early signs of this economic transformation, but we are nowhere near where we need to be.

The transition to a low-carbon economy needs political impetus from the highest levels.

And it requires inclusivity, because everyone is affected by climate change.

That is the message of the Talanoa Dialogue.

We need a full-scale mobilization of young people.

And we need a global commitment to gender equality, because women's leadership is central to durable climate solutions.

A successful conference here in Katowice can provide the catalyst.

There is now significant global momentum for climate action.

It has galvanized private business and investors around the world, while cities and regional governments are also showing that ambitious climate action is possible and desirable.

Let us build on this momentum.

I am convening a Climate Summit in September next year to raise ambition and mobilize the necessary resources.

But that ambition needs to begin here, right now, in Katowice, driven by governments and leaders who understand that their legacies and the well-being of future generations are at stake.

We cannot afford to fail in Katowice.

Some might say that it will be a difficult negotiation. I know it is not easy. It requires a firm political will for compromise. But, for me, what is really difficult is to be a fisherman in Kiribati seeing his country in risk of disappearing or a farmer or herder in the Sahel losing livelihoods and losing peace. Or being a woman in Dominica or any other Caribbean nation enduring hurricane after hurricane destroying everything in its path.

Ladies and gentlemen,

Climate change is the single most important issue we face.

It affects all our plans for sustainable development and a safe, secure and prosperous world.

So, it is hard to comprehend why we are collectively still moving too slowly - and even in the wrong direction.

The IPCC's Special Report tells us that we still have time to limit temperature rise.

But that time is running out.

We achieved success in Paris because negotiators were working towards a common goal.

I implore you to maintain the same spirit of urgent collaboration here in Katowice with a dynamic Polish leadership in the negotiations.

Katowice must ensure that the bonds of trust established in Paris will endure.

Incredible opportunity exists if we embrace a low-carbon future and unleash the power of the Paris Agreement.

But we must start today building the tomorrow we want.

Let us rise to the challenge and finish the work the world demands of us.

Thank you.

Greta Thunberg's address to the opening session

Greta Thunberg (born 3 January 2003) is a Swedish climate activist. She is known for protesting outside the Swedish parliament building to raise climate change activism.

On 20 August 2018, Thunberg, then in 9th grade, decided to not attend school until the 2018 Sweden general election on 9 September after heat waves and wildfires in Sweden. Her demands were that the Sweden government reduce carbon emissions as per the Paris Agreement, and she protested via sitting outside the Riksdag every day during school hours with the sign "Skolstrejk



Figure 8.10: Greta: “Many people say that Sweden is just a small country, and it doesn’t matter what we do. But I’ve learned that you are never too small to make a difference. And if a few children can get headlines all over the world just by not going to school, then imagine what we could all do together if we really wanted to.”



Figure 8.11: Greta: “You only talk about moving forward with the same bad ideas that got us into this mess, even when the only sensible thing to do is pull the emergency brake. You are not mature enough to tell it like it is. Even that burden you leave to us children.”

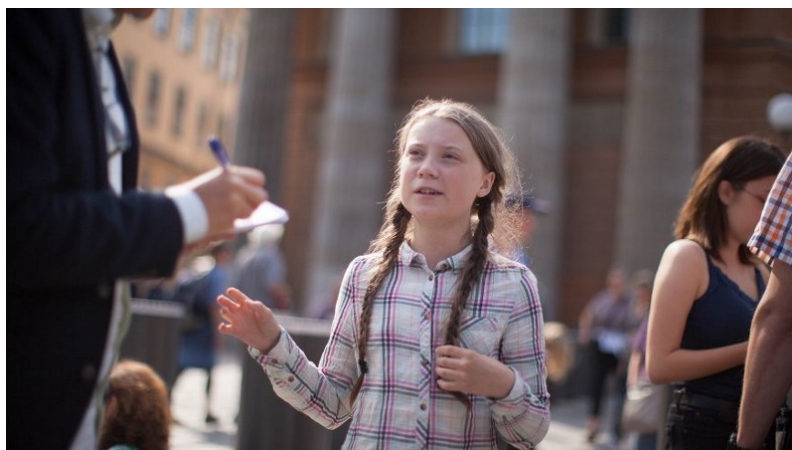


Figure 8.12: Greta: “Until you start focusing on what needs to be done, rather than what is politically possible, there is no hope. We cannot solve a crisis without treating it as a crisis. We need to keep the fossil fuels in the ground, and we need to focus on equity. And if solutions within the system are so impossible to find, then maybe we should change the system itself.”

för klimatet” (school strike for the climate). After the general elections, she continued to strike only on Fridays. The strike is now in its 17th week. The transcript of her address to the opening session of COP24^{1415 16 17} is given below,

My name is Greta Thunberg. I am 15 years old, and I’m from Sweden. I speak on behalf of Climate Justice Now!

Many people say that Sweden is just a small country, and it doesn’t matter what we do. But I’ve learned that you are never too small to make a difference. And if a few children can get headlines all over the world just by not going to school, then imagine what we could all do together if we really wanted to.

But to do that, we have to speak clearly, no matter how uncomfortable that may be. You only speak of green eternal economic growth because you are too scared of being unpopular. You only talk about moving forward with the same bad ideas that got us into this mess, even when the only sensible thing to do is pull the emer-

¹⁴<https://www.youtube.com/watch?v=VFkQSGyeCWg>

¹⁵<https://www.youtube.com/watch?v=0TYyBtb1PH4>

¹⁶<https://www.youtube.com/watch?v=DdAOgNTxxt0>

¹⁷<https://www.youtube.com/watch?v=pJ1HRGA8g10>

gency brake. You are not mature enough to tell it like it is. Even that burden you leave to us children.

But I don't care about being popular. I care about climate justice and the living planet. Our civilization is being sacrificed for the opportunity of a very small number of people to continue making enormous amounts of money. Our biosphere is being sacrificed so that rich people in countries like mine can live in luxury. It is the sufferings of the many which pay for the luxuries of the few.

The year 2078, I will celebrate my 75th birthday. If I have children, maybe they will spend that day with me. Maybe they will ask me about you. Maybe they will ask why you didn't do anything while there still was time to act. You say you love your children above all else, and yet you are stealing their future in front of their very eyes.

Until you start focusing on what needs to be done, rather than what is politically possible, there is no hope. We cannot solve a crisis without treating it as a crisis. We need to keep the fossil fuels in the ground, and we need to focus on equity. And if solutions within the system are so impossible to find, then maybe we should change the system itself.

We have not come here to beg world leaders to care. You have ignored us in the past, and you will ignore us again. We have run out of excuses, and we are running out of time. We have come here to let you know that change is coming, whether you like it or not. The real power belongs to the people. Thank you.

An appeal by Greta Thunberg, October 30, 2021

Dear friends,

Humanity is failing to stop the climate crisis. It's now beyond urgent – the planet is screaming for help.

Right now world leaders are meeting for historic climate talks – but pledges without real action won't cut it anymore. We need bold, visionary leaders to finally do what's needed to pull us back from the abyss.

I'll be at the talks with inspiring youth leaders like Vanessa Nakate and Dominika Lasota. We'll personally meet dozens of governments – it's the perfect opportunity to deliver a giant call for urgent action. Join us now: add your name with one click and pass this on.



Figure 8.13: Greta Thunberg addresses the National Assembly In Paris on July 23, 2019 in Paris, France.



Figure 8.14: Greta Thunberg crossing the Atlantic on a small emission-free boat.

To world leaders,

“Betrayal”. That’s how young people around the world describe our governments’ failure to cut carbon emissions. And it’s no surprise.

We are catastrophically far from the crucial goal of 1.5 degrees C, and yet governments everywhere are still accelerating the crisis, spending billions on fossil fuels.

This is not a drill. It’s code red for the Earth. Millions will suffer as our planet is devastated – a terrifying future that will be created, or avoided, by the decisions you make. You have the power to decide.

As citizens across the planet, we urge you to face up to the climate emergency. Not next year. Not next month. Now:

As citizens across the planet, we urge you to face up to the climate emergency. Not next year. Not next month. Now:As citizens across the planet, we urge you to face up to the climate emergency. Not next year. Not next month. Now:

- Keep the precious goal of 1.5 degrees C alive with immediate, drastic, annual emission reductions unlike anything the world has ever seen.
- End all fossil fuel investments, subsidies, and new projects immediately, and stop new exploration and extraction.
- End ‘creative’ carbon accounting by publishing total emissions for all consumption indices, supply chains, international aviation and shipping, and the burning of biomass.
- Deliver the \$100bn promised to the most vulnerable countries, with additional funds for climate disasters.
- Enact climate policies to protect workers and the most vulnerable, and reduce all forms of inequality.

We can still do this. There is still time to avoid the worst consequences if we are prepared to change. It will take determined, visionary leadership. And it will take immense courage – but know that when you rise, billions will be right behind you.

It can feel incredibly hard to keep hope alive in the face of inaction. But my hope lies in people – in the millions of us who are

rising to save the future. It lies in our marches, in our dogged determination to keep fighting, and in our trembling voices as we speak truth to power. My hope is rooted in action and fuelled by a love for humanity and our most beautiful earth. It's what keeps me absolutely convinced that we can do this. And we must do this. Together.

With fierce hope,

Greta +...

Cop26: 'Greta Mania' hits Glasgow as Swedish teenager is mobbed

Here are some quotations from an article by Karla Adam, published on November 1, 2021 in Stuff¹⁸:

“Greta Thunberg may not have been officially invited to the landmark COP26 climate summit in Glasgow, but on the first day of the conference, she was making her presence known.

“The Swedish teenager, who is something of a rock star for climate activists around the world, is among the thousands of activists who are descending on Glasgow for the UN Climate Change Conference, known as COP26, which kicked off on Sunday (local time).

“They are calling on world leaders take bold action to prevent global temperatures from rising by more than 1.5 Celsius above preindustrial levels.

“Speaking to the BBC's Andrew Marr, Thunberg said that the 1.5C goal was ‘possible in theory’ but ‘it's up to us if we want that to happen.’...

8.13 The UK declares a climate emergency

Introducing the motion in the House of Commons, Labour leader Jeremy Corbyn said: “We have no time to waste. We are living in a climate crisis that will spiral dangerously out of control unless we take rapid and dramatic action now. This is no longer about a distant future. We're talking about nothing less than the irreversible destruction of the environment within our lifetimes of members of this house.”

¹⁸<https://www.stuff.co.nz/environment/climate-news/300442754/cop26-greta-mania-hits-glasgow-as-swedish-teenager-is-mobbed>

Here are some excerpts from an article by Amy Goodman and Nermeen Shaikh of Democracy now published in Truthout on May 2, 2019.¹⁹:

On Wednesday, the House of Commons became the first parliament in the world to declare a climate emergency. The resolution came on the heels of the recent Extinction Rebellion mass uprising that shut down Central London last month in a series of direct actions. Activists closed bridges, occupied public landmarks and even superglued themselves to buildings, sidewalks and trains to demand urgent action to combat climate change. Police arrested more than 1,000 protesters. Labour Party Leader Jeremy Corbyn told Parliament, “We are witnessing an unprecedented upsurge of climate activism, with groups like Extinction Rebellion forcing the politicians in this building to listen. For all the dismissive and defensive column inches the processes have provoked, they are a massive and, I believe, very necessary wake-up call. Today we have the opportunity to say, ‘We hear you.’” We speak with George Monbiot, British journalist, author and columnist with The Guardian. His recent piece for The Guardian is headlined “Only rebellion will prevent an ecological apocalypse.” Monbiot says capitalism “is like a gun pointed at the heart of the planet. It will essentially, necessarily destroy our life-support systems. Among those characteristics is the drive for perpetual economic growth on a finite planet.”

¹⁹<https://truthout.org/video/george-monbiot-on-the-uk-climate-emergency/>



8.14 Understatement of existential climate risk

Here are some excerpts from a 44-page report entitled *What Lies Beneath: The Understanding of Existential Climate Risk*, by David Spratt and Ian Dunlop²⁰:

Three decades ago, when serious debate on human-induced climate change began at the global level, a great deal of statesmanship was on display. There was a preparedness to recognize that this was an issue transcending nation states, ideologies and political parties which had to be addressed pro-actively in the long-term interests of humanity as a whole. This was the case even though the existential nature of the risk it posed was far less clear cut than it is today.

As global institutions, such as the United Nations Framework Convention on Climate Change (UNFCCC) which was established at the Rio Earth Summit in 1992, were developed to take up this challenge, and the extent of change this would demand of the fossil-fuel-dominated world order became clearer, the forces of resistance began to mobilize. Today, as a consequence, and despite the diplomatic triumph of the 2015 Paris Agreement, the debate around climate change policy has never been more dysfunctional, indeed Orwellian.

²⁰<https://www.breakthroughonline.org.au/>

In his book 1984, George Orwell describes a double-think totalitarian state where most of the population accepts “the most flagrant violations of reality, because they never fully grasped the enormity of what was demanded of them, and were not sufficiently interested in public events to notice what was happening. By lack of understanding they remained sane.”

Orwell could have been writing about climate change and policymaking. International agreements talk of limiting global warming to 1.5-2 degrees Celsius ($^{\circ}\text{C}$), but in reality they set the world on a path of 3-5 $^{\circ}\text{C}$ of warming. Goals are reaffirmed, only to be abandoned. Coal is “clean”. Just 1 $^{\circ}\text{C}$ of warming is already dangerous, but this cannot be admitted. The planetary future is hostage to myopic national self-interest. Action is delayed on the assumption that as yet unproven technologies will save the day, decades hence. The risks are existential, but it is “alarmist” to say so.

A one-in-two or one-in-three chance of missing a goal is normalized as reasonable. Moral hazard permeates official thinking, in that there is an incentive to ignore the risks in the interests of political expediency.

Climate policymaking for years has been cognitively dissonant, “a flagrant violation of reality”. So it is unsurprising that there is a lack of understanding amongst the public and elites of the full measure of the climate challenge. Yet most Australians sense where we are heading: three-quarters of Australians see climate change as catastrophic risk, and half see our way of life ending within the next 100 years.

Politics and policymaking have norms: rules and practices, assumptions and boundaries, that constrain and shape them. In recent years, the previous norms of statesmanship and long-term thinking have disappeared, replaced by an obsession with short-term political and commercial advantage. Climate policymaking is no exception. Since 1992, short-term economic interest has trumped environmental and future human needs.

The world today emits 50% more carbon dioxide (CO_2) from the consumption of energy than it did 25 years ago, and the global economy has more than doubled in size. The UNFCCC strives “to enable economic development to proceed in a sustainable manner”, but every year humanity’s ecological footprint becomes larger and less sustainable. Humanity now requires the biophysical capacity of 1.7 Earths annually as it rapidly chews up natural capital.

A fast, emergency-scale transition to a post-fossil fuel world is ab-

solutely necessary to address climate change. But this is excluded from consideration by policymakers because it is considered to be too disruptive. The orthodoxy is that there is time for an orderly economic transition within the current short-termist political paradigm. Discussion of what would be safe - less warming than we presently experience - is non-existent. And so we have a policy failure of epic proportions.

Policymakers, in their magical thinking, imagine a mitigation path of gradual change to be constructed over many decades in a growing, prosperous world. The world not imagined is the one that now exists: of looming financial instability; of a global crisis of political legitimacy and “fake news”; of a sustainability crisis that extends far beyond climate change to include all the fundamentals of human existence and most significant planetary boundaries (soils, potable water, oceans, the atmosphere, biodiversity, and so on); and of severe global energy-sector dislocation.

In anticipation of the upheaval that climate change would impose upon the global order, the IPCC was established by the United Nations (UN) in 1988, charged with regularly assessing the global consensus on climate science as a basis for policymaking. The IPCC Assessment Reports (AR), produced every five-to-eight years, play a large part in the public framing of the climate narrative: new reports are a global media event.

AR5 was produced in 2013-14, with AR6 due in 2022. The IPCC has done critical, indispensable work of the highest standard in pulling together a periodic consensus of what must be the most exhaustive scientific investigation in world history.

It does not carry out its own research, but reviews and collates peer-reviewed material from across the spectrum of this incredibly complex area, identifying key issues and trends for policymaker consideration. However, the IPCC process suffers from all the dangers of consensus-building in such a wide-ranging and complex arena. For example, IPCC reports, of necessity, do not always contain the latest available information. Consensus-building can lead to “least drama”, lowest-common-denominator outcomes, which overlook critical issues. This is particularly the case with the “fat-tails” of probability distributions, that is, the high-impact but lower-probability events where scientific knowledge is more limited.

Vested-interest pressure is acute in all directions; climate denialists accuse the IPCC of alarmism, whereas many climate action proponents consider the IPCC to be far too conservative. To cap it all,

the IPCC conclusions are subject to intense political oversight before being released, which historically has had the effect of substantially watering-down sound scientific findings.

These limitations are understandable, and arguably were not of overriding importance in the early period of the IPCC. However, as time has progressed, it is now clear that the risks posed by climate change are far greater than previously anticipated. We have moved out of the twilight period of much talk, but relatively limited climate impacts, into the harsh light of physically-evident existential threats. Climate change is now turning nasty, as we have witnessed recently in the North America, East and South Asia, the Middle East and Europe, with record-breaking heatwaves and wildfires, more intense flooding and more damaging hurricanes.

The distinction between climate science and risk is the critical issue, for the two are not the same. Scientific reticence - a reluctance to spell out the full risk implications of climate science in the absence of perfect information - has become a major problem. Whilst this is understandable, particularly when scientists are continually criticized by denialists and political apparatchiks for speaking out, it is extremely dangerous given the fat-tail risks of climate change. Waiting for perfect information, as we are continually urged to do by political and economic elites, means it will be too late to act. Time is not on our side. Sensible risk management addresses risk in time to prevent it happening, and that time is now.

Irreversible, adverse climate change on the global scale now occurring is an existential risk to human civilization. Many of the world's top climate scientists - Kevin Anderson, James Hansen, Michael E. Mann, Michael Oppenheimer, Naomi Oreskes, Stefan Rahmstorf, Eric Rignot, Hans Joachim Schellnhuber, Kevin Trenberth and others - who are quoted in this report well understand these implications and are forthright about their findings, where we are heading, and the limitations of IPCC reports.

This report seeks to alert the wider community and business and political leaders to these limitations and urges changes to the IPCC approach, to the wider UNFCCC negotiations, and to national policymaking. It is clear that existing processes will not deliver the transformation to a carbon-negative world in the limited time now available. We urgently require a re-framing of scientific research within an existential risk-management framework. This requires special precautions that go well beyond conventional risk management. Like an iceberg, there is great danger in "what lies beneath".

Existential Risk to Human Civilization

In 2016, the World Economic Forum survey of the most impactful risks for the years ahead elevated the failure of climate change mitigation and adaptation to the top of the list, ahead of weapons of mass destruction, ranking second, and water crises, ranking third. By 2018, following a year characterized by high-impact hurricanes and extreme temperatures, extreme-weather events were seen as the single most prominent risk. As the survey noted: “We have been pushing our planet to the brink and the damage is becoming increasingly clear.”

Climate change is an existential risk to human civilization: that is, an adverse outcome that would either annihilate intelligent life or permanently and drastically curtail its potential.

Temperature rises that are now in prospect, after the Paris Agreement, are in the range of 3-5 °C. At present, the Paris Agreement voluntary emission reduction commitments, if implemented, would result in planetary warming of 3.4 °C by 2100, without taking into account “long-term” carbon- cycle feedbacks. With a higher climate sensitivity figure of 4.5 °C, for example, which would account for such feedbacks, the Paris path would result in around 5 °C of warming, according to a MIT study.

A study by Schroeder Investment Management published in June 2017 found - after taking into account indicators across a wide range of the political, financial, energy and regulatory sectors - the average temperature increase implied for the Paris Agreement across all sectors was 4.1 °C.

Yet 3 °C of warming already constitutes an existential risk. A 2007 study by two US national security think-tanks concluded that 3 °C of warming and a 0.5 meter sea-level rise would likely lead to “outright chaos” and “nuclear war is possible”, emphasizing how “massive non-linear events in the global environment give rise to massive nonlinear societal event”.

The Global Challenges Foundation (GCF) explains what could happen: “If climate change was to reach 3 °C, most of Bangladesh and Florida would drown, while major coastal cities - Shanghai, Lagos, Mumbai - would be swamped, likely creating large flows of climate refugees. Most regions in the world would see a significant drop in food production and increasing numbers of extreme weather

events, whether heat waves, floods or storms. This likely scenario for a 3 °C rise does not take into account the considerable risk that self-reinforcing feedback loops set in when a certain threshold is reached, leading to an ever increasing rise in temperature. Potential thresholds include the melting of the Arctic permafrost releasing methane into the atmosphere, forest die-back releasing the carbon currently stored in the Amazon and boreal forests, or the melting of polar ice caps that would no longer reflect away light and heat from the sun.”

Warming of 4 °C or more could reduce the global human population by 80% or 90%, and the World Bank reports “there is no certainty that adaptation to a 4 °C world is possible.”

Prof. Kevin Anderson says a 4 °C future “is incompatible with an organized global community, is likely to be beyond ‘adaptation’, is devastating to the majority of ecosystems, and has a high probability of not being stable”.

This is a commonly-held sentiment amongst climate scientists. A recent study by the European Commission’s Joint Research Centre found that if the global temperature rose 4 °C, then extreme heatwaves with “apparent temperatures” peaking at over 55 °C will begin to regularly affect many densely populated parts of the world, forcing much activity in the modern industrial world to stop. (“Apparent temperatures” refers to the Heat Index, which quantifies the combined effect of heat and humidity to provide people with a means of avoiding dangerous conditions.)

In 2017, one of the first research papers to focus explicitly on existential climate risks proposed that “mitigation goals be set in terms of climate risk category instead of a temperature threshold”, and established a “dangerous” risk category of warming greater than 1.5 °C, and a “catastrophic” category for warming of 3 °C or more. The authors focussed on the impacts on the world’s poorest three billion people, on health and heat stress, and the impacts of climate extremes on such people with limited adaptation resources. They found that a 2 °C warming “would double the land area subject to deadly heat and expose 48% of the population (to deadly heat). A 4 °C warming by 2100 would subject 47% of the land area and almost 74% of the world population to deadly heat, which could pose existential risks to humans and mammals alike unless massive adaptation measures are implemented.”

A 2017 survey of global catastrophic risks by the Global Challenges Foundation found that: “In high-end [climate] scenarios, the

scale of destruction is beyond our capacity to model, with a high likelihood of human civilization coming to an end.”

84% of 8000 people in eight countries surveyed for the Foundation considered climate change a “global catastrophic risk”.

Existential risk may arise from a fast rate of system change, since the capacity to adapt, in both the natural and human worlds, is inversely proportional to the pace of change, amongst other factors. In 2004, researchers reported on the rate of warming as a driver of extinction...

At 4 °C of warming “the limits for adaptation for natural systems would largely be exceeded throughout the world”.

Ecological breakdown of this scale would ensure an existential human crisis. By slow degrees, these existential risks are being recognized. In May 2018, an inquiry by the Australian Senate into national security and global warming recognized “climate change as a current and existential national security risk... defined as ‘one that threatens the premature extinction of Earth-originating intelligent life or the permanent and drastic destruction of its potential for desirable future development’”.

In April 2018, the Intelligence on European Pensions and Institutional Investment think-tank warned business leaders that “climate change is an existential risk whose elimination must become a corporate objective”.

However the most recent IPCC Assessment Report did not consider the issue. Whilst the term “risk management” appears in the 2014 IPCC Synthesis Report fourteen times, the terms “existential” and “catastrophic” do not appear...

8.15 Scientists leaked the newest IPCC Report

Here are excerpts from an article entitled **Leak of IPCC Report!** by Scientist’s Rebellion.²¹:

“We have leaked part III of the upcoming IPCC report. There’s no time to wait around, there’s no time for continued inaction - the people deserve to know NOW what our corporate owned politicians have done to them.

²¹<https://scientistrebillion.com/we-leaked-the-upcoming-ipcc-report/>

“The greatest crime ever has already been carried out - the perpetrators are still at liberty, but the victims are starting to pile up.

“We leaked the report because governments - pressured and bribed by fossil fuel and other industries, protecting their failed ideology and avoiding accountability - have edited the conclusions before official reports were released in the past. We leaked it to show that scientists are willing to disobey and take personal risk to inform the public.

“The report explicitly states that incremental change is not a viable option. It states that individual behavioral changes alone are insignificant. It states that justice, equity and redistribution are essential to climate policy.

“It says that we need massive investment - to transform energy systems, transport, industry, land use and agriculture, housing, and to prepare for the accelerating effects of climate breakdown - not the death cult of conservative economics.

“It shows that we must abandon economic growth, which is the basis of capitalism.

“For thousands of scientists - mostly older, privileged, moderate - to agree on something so apparently radical demonstrates the severity of the present moment. But the real radicals are in power. They will plunder the Earth until it is but fire and ash, unless we stop them.

“We plead with people to go into serious nonviolent resistance. To join us in the streets to apply unbearable pressure on this genocidal system - to take it down before it takes us all down with it.”

Only immediate climate action can save the future

Immediate action to halt the extraction of fossil fuels and greatly reduce the emission of CO₂ and other greenhouse gasses is needed to save the long-term future of human civilization and the biosphere.

At the opening ceremony of United Nations-sponsored climate talks in Katowice, Poland, Sir David Attenborough said “Right now, we are facing a man-made disaster of global scale. Our greatest threat in thousands of years. Climate change. If we don’t take action, the collapse of our civilizations and the extinction of much of the natural world is on the horizon. The world’s people have spoken. Their message is clear. Time is running out. They want you, the decision-makers, to act now.”

Antonio Guterres, UN Secretary-General, said climate change was already “a matter of life and death” for many countries. He added that the world is

“nowhere near where it needs to be” on the transition to a low-carbon economy.

Swedish student Greta Thunberg, is a 16-year-old who has launched a climate protest movement in her country. She said, in a short but very clear speech after that of UN leader Antonio Guterres: “Some people say that I should be in school instead. Some people say that I should study to become a climate scientist so that I can ‘solve the climate crisis’. But the climate crisis has already been solved. We already have all the facts and solutions.”

She added: “Why should I be studying for a future that soon may be no more, when no one is doing anything to save that future? And what is the point of learning facts when the most important facts clearly mean nothing to our society?”

Thunberg continued: “Today we use 100 million barrels of oil every single day. There are no politics to change that. There are no rules to keep that oil in the ground. So we can’t save the world by playing by the rules. Because the rules have to be changed.”

She concluded by saying that “since our leaders are behaving like children, we will have to take the responsibility they should have taken long ago.”

Institutional inertia

Our collective failure to respond adequately to the current crisis is very largely due to institutional inertia. Our financial system is deeply embedded and resistant to change. Our entire industrial infrastructure is based on fossil fuels; but if the future is to be saved, the use of fossil fuels must stop. International relations are still based on the concept of absolutely sovereign nation states, even though this concept has become a dangerous anachronism in an era of instantaneous global communication and economic interdependence. Within nations, systems of law and education change very slowly, although present dangers demand rapid revolutions in outlook and lifestyle.

The failure of the recent climate conferences to produce strong final documents can be attributed to the fact that the nations attending the conferences felt themselves to be in competition with each other, when in fact they ought to have cooperated in response to a common danger. The heavy hand of the fossil fuel industry also made itself felt at the conferences.

Until the development of coal-driven steam engines in the 19th century humans lived more or less in harmony with their environment. Then, fossil fuels, representing many millions of years of stored sunlight, were extracted and burned in two centuries, driving a frenzy of growth of population and industry that has lasted until the present. But today, the party is over. Coal, oil and gas are nearly exhausted, and what remains of them must be left in the

ground to avoid existential threats to humans and the biosphere. Big coal and oil corporations base the value of their stocks on ownership of the remaining resources that are still buried, and they can be counted on to use every trick, fair or unfair, to turn those resources into money.

In general corporations represent a strong force resisting change. By law, the directors of corporations are obliged to put the profits of stockholders above every other consideration. No room whatever is left for an ecological or social conscience. Increasingly, corporations have taken control of our mass media and our political system. They intervene in such a way as to make themselves richer, and thus to increase their control of the system.

Polite conversation and cultural inertia

Each day, the conventions of polite conversation contribute to our sense that everything is as it always was. Politeness requires that we do not talk about issues that might be contrary to another person's beliefs. Thus polite conversation is dominated by trivia, entertainment, sports, the weather, gossip, food, and so on. Worries about the distant future, the danger of nuclear war, the danger of uncontrollable climate change, or the danger of widespread famine seldom appear in conversations at the dinner table, over coffee or at the pub. In conversations between polite people, we obtain the false impression that all is well with the world. But in fact, all is not well. We have to act promptly and adequately to save the future.

The situation is exactly the same in the mass media. The programs and articles are dominated by trivia and entertainment. Serious discussions of the sudden crisis which civilization now faces are almost entirely absent, because the focus is on popularity and ratings. As Neil Postman remarked, we are entertaining ourselves to death.

Further growth implies future collapse

We have to face the fact that endless economic growth on a finite planet is a logical impossibility, and that we have reached or passed the sustainable limits to growth.

In today's world, we are pressing against the absolute limits of the earth's carrying capacity, and further growth carries with it the danger of future collapse. In the long run, neither the growth of industry nor that of population is sustainable; and we have now reached or exceeded the sustainable limits.

The size of the human economy is, of course, the product of two factors: the total number of humans, and the consumption per capita. Let us first consider the problem of reducing the per-capita consumption in the industrialized

countries. The whole structure of western society seems designed to push its citizens in the opposite direction, towards ever-increasing levels of consumption. The mass media hold before us continually the ideal of a personal utopia, filled with material goods.

Every young man in a modern industrial society feels that he is a failure unless he fights his way to the “top”; and in recent years, women too have been drawn into the competition. Of course, not everyone can reach the top; there would not be room for everyone; but society urges us all to try, and we feel a sense of failure if we do not reach the goal. Thus, modern life has become a competition of all against all for power and possessions.

When possessions are used for the purpose of social competition, demand has no natural upper limit; it is then limited only by the size of the human ego, which, as we know, is boundless. This would be all to the good if unlimited industrial growth were desirable; but today, when further industrial growth implies future collapse, western society urgently needs to find new values to replace our worship of power, our restless chase after excitement, and our admiration of excessive consumption.

If you turn on your television set, the vast majority of the programs that you will be offered give no hint at all of the true state of the world or of the dangers which we will face in the future. Part of the reason for this willful blindness is that no one wants to damage consumer confidence. No one wants to bring on a recession. No one wants to shoot Santa Claus.

But sooner or later a severe recession will come, despite our unwillingness to recognize this fact. Perhaps we should prepare for it by reordering the world’s economy and infrastructure to achieve long-term sustainability, i.e. steady-state economics, population stabilization, and renewable energy.

Our responsibility to future generations and to the biosphere

All of the technology needed for the replacement of fossil fuels by renewable energy is already in place. Although renewable sources currently supply only 19 percent of the world’s energy requirements, they are growing rapidly. For example, wind energy is growing at the rate of 30 percent per year. Because of the remarkable properties of exponential growth, this will mean that wind will soon become a major supplier of the world’s energy requirements, despite bitter opposition from the fossil fuel industry.

Both wind and solar energy can now compete economically with fossil fuels, and this situation will become even more pronounced if more countries put a tax on carbon emissions, as Finland, the Netherlands, Norway, Costa Rica,

the United Kingdom and Ireland already have done.²²

Much research and thought have also been devoted to the concept of a steady-state economy. The only thing that is lacking is political will. It is up to the people of the world to make their collective will felt.²³

History has given to our generation an enormous responsibility towards future generations. We must achieve a new kind of economy, a steady-state economy. We must stabilize global population. We must replace fossil fuels by renewable energy. We must abolish nuclear weapons. We must end the institution of war. We must reclaim democracy in our own countries when it has been lost. We must replace nationalism by a just system of international law. We must prevent degradation of the earth's environment. We must act with dedication and fearlessness to save the future of the earth for human civilization and for the plants and animals with which we share the gift of life.

“And yes, we do need hope. Of course, we do. But the one thing we need more than hope is action. Once we start to act, hope is everywhere. So instead of looking for hope, look for action. Then and only then, hope will come today.” Greta Thunberg

Why do we not respond to the crisis?

Today we are faced with multiple interrelated crises, for example the threat of catastrophic climate change or equally catastrophic thermonuclear war, and the threat of widespread famine. These threats to human existence and to the biosphere demand a prompt and rational response; but because of institutional and cultural inertia, we are failing to take the steps that are necessary to avoid disaster.

²²<http://eruditio.worldacademy.org/issue-5/article/urgent-need-renewable-energy>

²³<http://steadystate.org/category/herman-daly/>

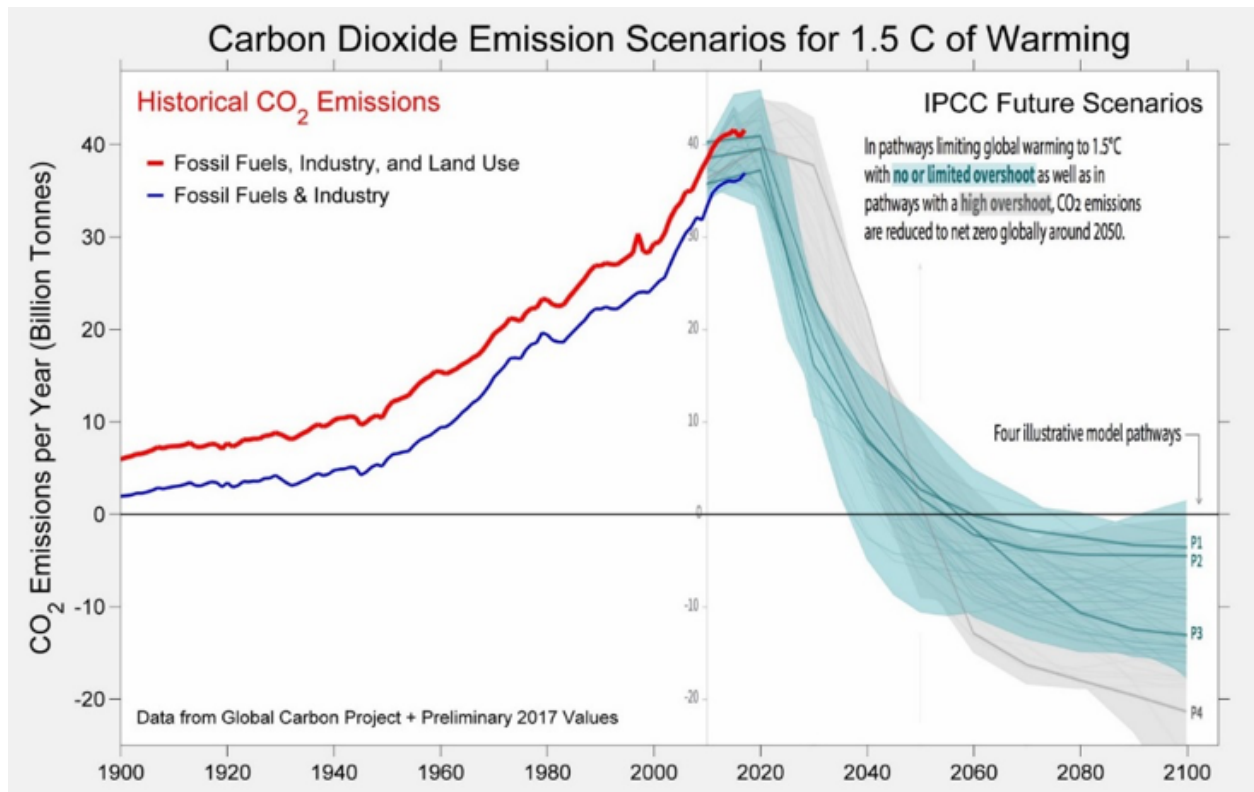
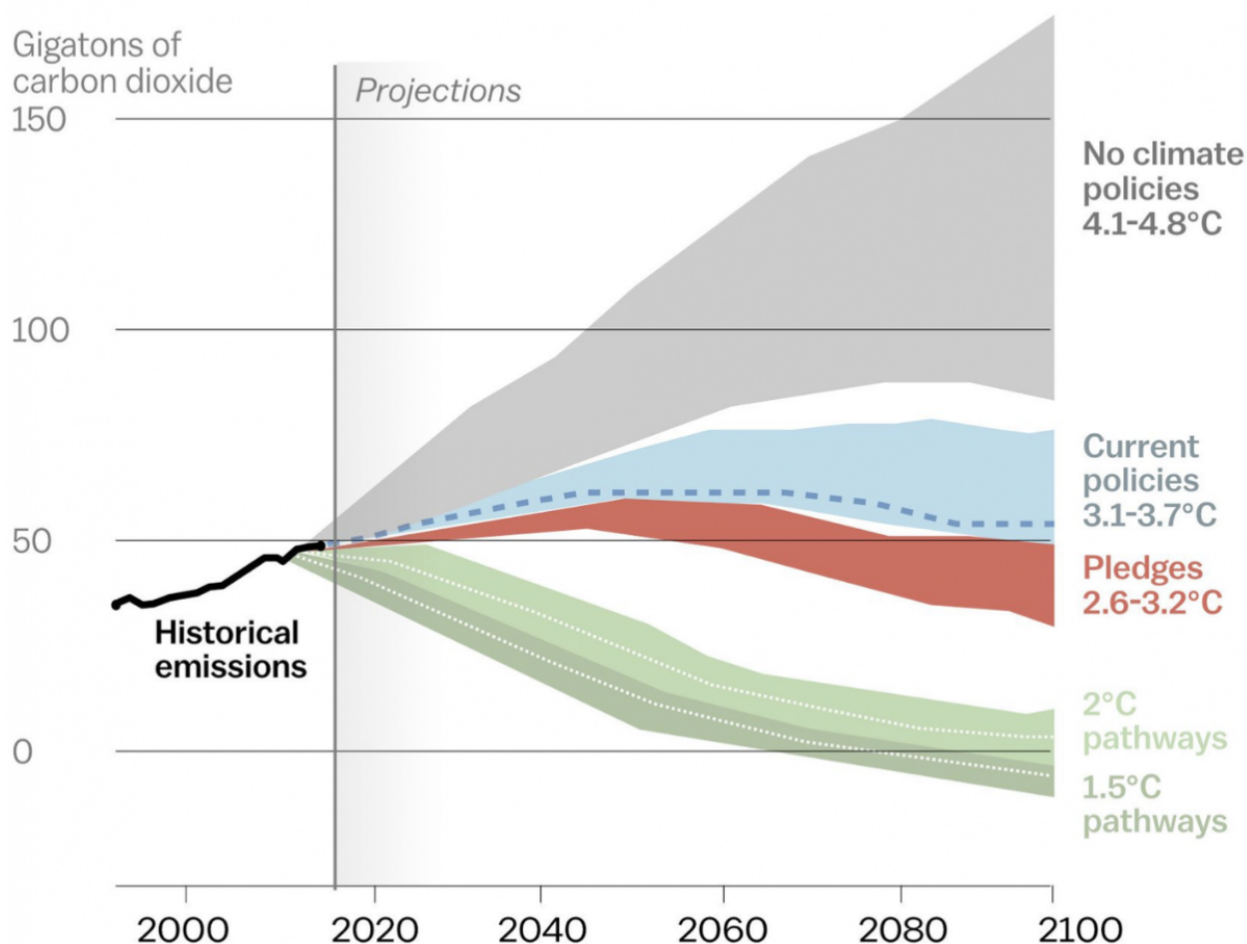


Figure 8.15: Our carbon budget. If global warming is to be limited to 1.5°C, CO₂ emissions must fall extremely rapidly. This means radical and fundamental changes for economies and lifestyles.

Effect of current pledges and policies

Global greenhouse gas emissions



Source: Climate Action Tracker

Vox

Figure 8.16: Predicted gigatons of carbon emitted during the present century under various policies. Under current policies, temperatures at the end of the century are predicted to be 3.1-3.7°C higher than normal, which would be disastrous. This implies that quick action must be taken to change current policies.

8.16 Media in the service of powerholders

Throughout history, art was commissioned by rulers to communicate, and exaggerate, their power, glory, absolute rightness etc, to the populace. The pyramids gave visual support to the power of the Pharaoh; portraits of rulers are a traditional form of propaganda supporting monarchies; and palaces were built as symbols of power.

Modern powerholders are also aware of the importance of propaganda. Thus the media are a battleground where reformers struggle for attention, but are defeated with great regularity by the wealth and power of the establishment. This is a tragedy because today there is an urgent need to make public opinion aware of the serious problems facing civilization, and the steps that are needed to solve these problems. The mass media could potentially be a great force for public education, but often their role is not only unhelpful - it is negative.

It is certainly possible to find a few television programs and newspaper articles that present the facts about climate change in a realistic way. For example *The Guardian* gives outstanding climate change coverage. However, the mass media could do very much more. One has to conclude that the media are neglecting their great responsibilities at a time of acute crisis for human civilization and the biosphere. The same can be said of our educational systems at both the primary and advanced levels. We urgently need much more public education about the severe dangers that we face today.

8.17 Television as a part of our educational system

In the mid-1950's, television became cheap enough so that ordinary people in the industrialized countries could afford to own sets. During the infancy of television, its power was underestimated. The great power of television is due to the fact that it grips two senses simultaneously, both vision and hearing. The viewer becomes an almost-hypnotized captive of the broadcast.

In the 1950's, this enormous power, which can be used both for good and for ill, was not yet fully apparent. Thus insufficient attention was given to the role of television in education, in setting norms, and in establishing values. Television was not seen as an integral part of the total educational system. It is interesting to compare the educational systems of traditional cultures with those of modern industrial societies.

In traditional societies, multigenerational families often live together in the same dwelling. In general, there is a great deal of contact between grandpar-

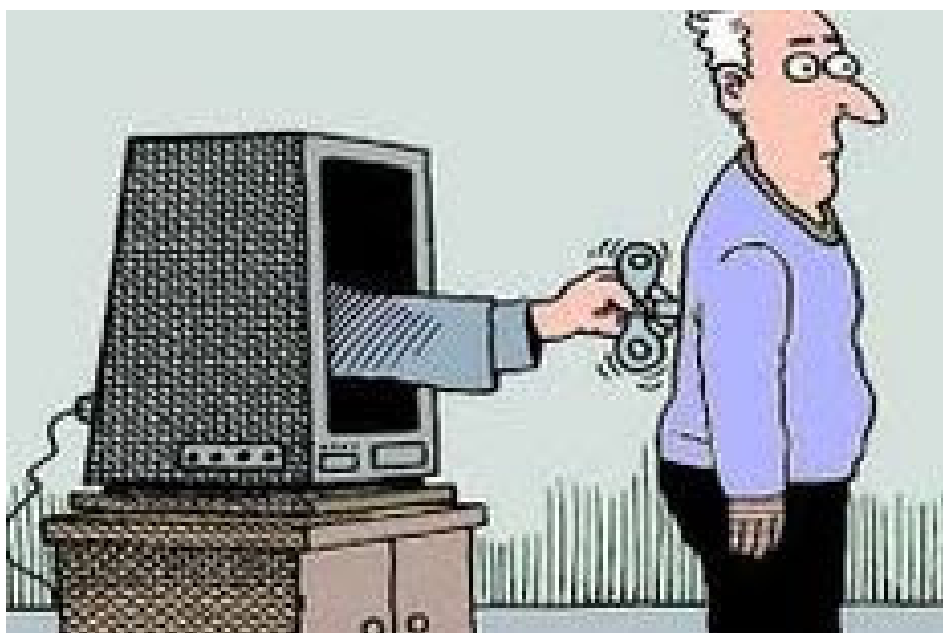


Figure 8.17: **The role of the media.**

ents and grandchildren, with much transmission of values and norms between generations. Old people are regarded with great respect, since they are considered to be repositories of wisdom, knowledge, and culture.

By contrast, modern societies usually favor nuclear families, consisting of only parents and children. Old people are marginalized. They live by themselves in communities or homes especially for the old. Their cultural education knowledge and norms are not valued because they are “out of date”. In fact, during the life of a young person in one of the rapidly-changing industrial societies of the modern world, there is often a period when they rebel against the authority of their parents and are acutely embarrassed by their parents, who are “so old-fashioned that they don’t understand anything”.

Although the intergenerational transmission of values, norms, and culture is much less important in industrial societies than it is in traditional ones, modern young people of the West and North are by no means at a loss over where to find their values, fashions and role models. With every breath, they inhale the values and norms of the mass media. Totally surrounded by a world of television and film images, they accept this world as their own.

Figure 8.18: **Liberty?**

8.18 Neglect of climate change in the mass media

The predicament of humanity today has been called “a race between education and catastrophe”: How do the media fulfil this life-or-death responsibility? Do they give us insight? No, they give us pop music. Do they give us an understanding of the sweep of evolution and history? No, they give us sport. Do they give us an understanding of the ecological catastrophes that threaten our planet because of unrestricted growth of population and industries? No, they give us sit-coms and soap operas. Do they give us unbiased news? No, they give us news that has been edited to conform with the interests of powerful lobbys. Do they present us with the urgent need to leave fossil fuels in the ground? No, they do not, because this would offend the powerholders. Do they tell of the danger of passing tipping points after which human efforts to prevent catastrophic climate change will be useless? No, they give us programs about gardening and making food.

A consumer who subscribes to the “package” of broadcasts sold by a cable company can often search through all 95 channels without finding a single program that offers insight into the various problems that are facing the world today. What the viewer finds instead is a mixture of pro-establishment propaganda and entertainment. Meanwhile the neglected global problems are becoming progressively more severe.

In general, the mass media behave as though their role is to prevent the

peoples of the world from joining hands and working to change the world and to save it from thermonuclear war, environmental catastrophes and threatened global famine. The television viewer sits slumped in a chair, passive, isolated, disempowered and stupefied. The future of the world hangs in the balance, the fate of children and grandchildren hangs in the balance, but the television viewer feels no impulse to work actively to change the world or to save it. The Roman emperors gave their people bread and circuses to numb them into political inactivity. The modern mass media seem to be playing a similar role.

8.19 Climate change denial in mass media

The Wikipedia article on climate change denial describes it with the following words: “Although scientific opinion on climate change is that human activity is extremely likely to be the primary driver of climate change, the politics of global warming have been affected by climate change denial, hindering efforts to prevent climate change and adapt to the warming climate. Those promoting denial commonly use rhetorical tactics to give the appearance of a scientific controversy where there is none.”

It is not surprising that the fossil fuel industry supports, on a vast scale, politicians and mass media that deny the reality of climate change. The amounts of money at stake are vast. If catastrophic climate change is to be avoided, coal, oil and natural gas “assets” worth trillions of dollars must be left in the ground. Giant fossil fuel corporations are desperately attempting to turn these “assets” into cash.

Preventing an ecological apocalypse

Here are some excerpts from an article entitled “**Only Rebellion will prevent an ecological apocalypse**” by George Monbiot, which was published on April 15 2019 in The Guardian²⁴:

No one is coming to save us. Mass civil disobedience is essential to force a political response.

Had we put as much effort into preventing environmental catastrophe as we’ve spent on making excuses for inaction, we would have solved it by now. Everywhere I look, I see people engaged in furious attempts to fend off the moral challenge it presents...

²⁴<https://www.theguardian.com/commentisfree/2019/apr/15/rebellion-prevent-ecological-apocalypse-civil-disobedience>



Figure 8.19: Network administrators have noticed that programs about climate change often have low viewer ratings. Since they see delivering high viewer ratings to their advertisers as their primary duty, these executives seldom allow programs dealing with the danger of catastrophic climate change. The duty to save the earth from environmental catastrophe is neglected for the sake of money. As Al Gore said, “Instead of having a well-informed electorate, we have a well-amused audience”.



As the environmental crisis accelerates, and as protest movements like YouthStrike4Climate and Extinction Rebellion make it harder not to see what we face, people discover more inventive means of shutting their eyes and shedding responsibility. Underlying these excuses is a deep-rooted belief that if we really are in trouble, someone somewhere will come to our rescue: “they” won’t let it happen. But there is no they, just us.

The political class, as anyone who has followed its progress over the past three years can surely now see, is chaotic, unwilling and, in isolation, strategically incapable of addressing even short-term crises, let alone a vast existential predicament. Yet a widespread and wilful naivety prevails: the belief that voting is the only political action required to change a system. Unless it is accompanied by the concentrated power of protest - articulating precise demands and creating space in which new political factions can grow - voting, while essential, remains a blunt and feeble instrument.

The media, with a few exceptions, is actively hostile. Even when broadcasters cover these issues, they carefully avoid any mention of power, talking about environmental collapse as if it is driven by mysterious, passive forces, and proposing microscopic fixes for vast structural problems. The BBC’s Blue Planet Live series exemplified this tendency.

Those who govern the nation and shape public discourse cannot be trusted with the preservation of life on Earth. There is no benign authority preserving us from harm. No one is coming to save us.

None of us can justifiably avoid the call to come together to save ourselves...

Predatory delay

Here are some excerpts from a May 3 2019 article by Bill Henderson entitled “Neoliberalism, Solution Aversion, Implicatory Denial and Predatory Delay”²⁵:

Looking back at the history, that it’s not really a failure of human beings and human nature that’s the problem here. It’s a hijacking of our political and economic system by the fossil fuel industry and a small number of like-minded people. It was our bad luck that this idea that markets solve all problems and that government should be left to wither away crested just at the moment when it could do the most damage.

Despite the urgent need to reduce greenhouse gas emissions globally if we are to lower the risks of catastrophic climate change, wealthy industrialized nations persist with a widespread public silence on the issue and fail to address climate change. This is despite there being ever more conclusive evidence of its severity. Why is there an undercurrent of inaction, despite the challenge of climate change being ever more daunting? One element is denial.

George Marshall discovered that there has not been a single proposal, debate or even position paper on limiting fossil fuel production put forward during international climate negotiations. From the very outset fossil fuel production lay outside the frame of the discussions and, as with other forms of socially constructed silence, the social norms among the negotiators and policy specialists kept it that way.

Global climate leadership is being redefined. There is a growing recognition that you cannot be a climate leader if you continue to enable new fossil fuel production, which is inconsistent with climate limits. If no major producers step up to stop the expansion of extraction and begin phasing out existing fields and mines, the Paris goals will become increasingly difficult to achieve. Wealthy fossil fuel producers have a responsibility to lead, and this must include planning for a just and equitable managed decline of existing production.

²⁵<https://countercurrents.org/2019/05/03/neoliberalism-solution-aversion-implicatory-denial-and-predatory-delay-bill-henderson/>

The (emissions reduction) curve we've been forced onto bends so steeply, that the pace of victory is part of victory itself. Winning slowly is basically the same thing as losing outright. We cannot afford to pursue past strategies, aimed at limited gains towards distant goals. In the face of both triumphant denialism and predatory delay, trying to achieve climate action by doing the same things, the same old ways, means defeat. It guarantees defeat.

A fast, emergency-scale transition to a post-fossil fuel world is absolutely necessary to address climate change. But this is excluded from consideration by policymakers because it is considered to be too disruptive. The orthodoxy is that there is time for an orderly economic transition within the current short-termist political paradigm. Discussion of what would be safe - less warming than we presently experience - is non-existent. And so we have a policy failure of epic proportions. Policymakers, in their magical thinking, imagine a mitigation path of gradual change, to be constructed over many decades in a growing, prosperous world...

8.20 Showing unsustainable lifestyles in mass media

Television and other mass media contribute indirectly to climate change denial by showing unsustainable lifestyles. Television dramas show the ubiquitous use of gasoline-powered automobiles and highways crowded with them. Just as though there did not exist an urgent need to transform our transportation systems. Motor racing is shown. A program called "Top Gear" tells viewers about the desirability of various automobiles. In general, cyclists are not shown. In television dramas, the protagonists fly to various parts of the world for their holidays. The need for small local self-sustaining communities is not shown.

Advertisements in the mass media urge us to consume more, to fly, to purchase large houses, and to buy gasoline-driven automobiles, just as though such behavior ought to be the norm. Such norms are leading us towards environmental disaster.

8.21 Alternative media

Luckily, the mass media do not have a complete monopoly on public information. With a little effort, citizens who are concerned about the future can find



alternative media. These include a large number of independent on-line news services that are supported by subscriber donations rather than by corporate sponsors. *YouTube* videos also represent an extremely important source of public information.

8.22 Outstanding voices calling for climate action

The Guardian

There are exceptions to the general rule that the mass media downplay or completely ignore the climate emergency. The Guardian is a newspaper with absolutely outstanding coverage of all issues related to climate change. No praise can be strong enough for the courageous environmental editorial policy of this famous old British newspaper.

Al Gore

Albert Arnold Gore Jr. served as the 45th Vice President of the United States from January 1985 to January 1993. He then ran for the office of President, but was defeated by George W. Bush in a controversial election whose outcome

was finally decided by the US Supreme Court²⁶.

Al Gore is the founder and current Chairman of the Alliance for Climate Protection. He was one of the first important political figures to call attention to the problem of steadily increasing CO₂ levels in the atmosphere and the threat of catastrophic climate change. He produced the highly influential documentary film *An Inconvenient Truth*²⁷. Because of his important efforts to save the global environment, Al Gore shared the 2007 Nobel Peace Prize with the Intergovernmental Panel on Climate Change.

Al Gore's TED talk: The Case for Optimism on Climate Change

In 2016, Al Gore gave an important talk to a TED audience²⁸. In which he pointed out that an economic tipping point has just been passed. Solar energy and wind energy are now cheaper than energy from fossil fuels. This means that economic forces alone can drive a rapid transition to 100% renewable energy. Investors will realize that renewables represent an unparalleled investment opportunity.

Sir David Attenborough

In a 2011 interview in *The Guardian*, Sir David Attenborough was asked: "What will it take to wake people up about climate change?". He replied "Disaster. It's a terrible thing to say, isn't it? And even disaster doesn't always do it. I mean, goodness me, there have been disasters in North America, with hurricanes, and one thing and another, and floods; and still a lot of people would deny it, and say it's nothing to do with climate change. Well it visibly has to do with climate change!"

Sir David Attenborough's almost unbelievably enormous and impressive opus of television programs about the natural world have helped to raise public awareness of the importance of the natural environment. He also has made a number of television programs specifically related to questions such as saving threatened species, the dangers of exploding global human populations, and the destruction of forests for the sake of palm oil plantations.

Let us return to *The Guardian*'s 2011 interview with Sir David. Had it been made in the autumn of 2017, the interview would certainly have included a discussion of recent hurricanes of unprecedented power and destructiveness, such as Harvey, Irma and Maria, as well as 2017's wildfires and Asian floods. It is possible that such events, which will certainly become more frequent

²⁶Many people believe that Al Gore won the election.

²⁷<https://www.youtube.com/watch?v=I-SV13UQXdk>

²⁸<https://www.youtube.com/watch?v=I-SV13UQXdk>

and severe during the next few years, will provide the political will needed to silence climate change denial, to stop fossil fuel extraction, and to promote governmental policies favoring renewable energy.

Although the mass media almost have entirely neglected the link between climate change and recent disastrous hurricanes, floods droughts and wild-fires, many individuals and organizations emphasized the cause and effect relationship. For example, UK airline billionaire Sir Richard Branson, whose Caribbean summer residence was destroyed by Hurricane Irma said:

“Look, you can never be 100 percent sure about links, But scientists have said the storms are going to get more and more and more intense and more and more often. We’ve had four storms within a month, all far greater than that have ever, ever, ever happened in history, Sadly, I think this is the start of things to come. Climate change is real. Ninety-nine percent of scientists know it’s real. The whole world knows it’s real except for maybe one person in the White House.”

May Boeve, executive director of the NGO 350.org, said “With a few exceptions, the major TV networks completely failed to cover the scientifically proven ways that climate change is intensifying extreme weather events like hurricanes Harvey and Irma. That’s not just disappointing, it’s dangerous. We won’t be able to turn this crisis around if our media is asleep at the wheel.”

Commenting on the destruction of Puerto Rico by Hurricane Maria, historian Juan Cole wrote: “When you vote for denialist politicians, you are selecting people who make policy. The policy they make will be clueless and will actively endanger the public. Climate change is real. We are causing it by our emissions. If you don’t believe that, you are not a responsible steward of our infrastructure and of our lives.”

When interviewed by Amy Goodman of *Democracy Now*, musician Stevie Wonder said: “... we should begin to love and value our planet, and anyone who believes that there is no such thing as global warming must be blind or unintelligent.”

Another well-known musician, Beyoncé, added: “The effects of climate change are playing out around the world every day. Just this past week, we’ve seen devastation from the monsoon in India...and multiple catastrophic hurricanes. Irma alone has left a trail of death and destruction from the Caribbean to Florida to Southern United States. We have to be prepared for what comes next...”

In her September 2017 publication *Season of Smoke*²⁹, prizewinning author Naomi Klein wrote:

“We hear about the record-setting amounts of water that Hurricane Harvey

²⁹<https://theintercept.com/2017/09/09/in-a-summer-of-wildfires-and-hurricanes-my-son-asks-why-is-everything-going-wrong/>

dumped on Houston and other Gulf cities and towns, mixing with petrochemicals to pollute and poison on an unfathomable scale. We hear too about the epic floods that have displaced hundreds of thousands of people from Bangladesh to Nigeria (though we don't hear enough). And we are witnessing, yet again, the fearsome force of water and wind as Hurricane Irma, one of the most powerful storms ever recorded, leaves devastation behind in the Caribbean, with Florida now in its sights.

"Yet for large parts of North America, Europe, and Africa, this summer has not been about water at all. In fact it has been about its absence; it's been about land so dry and heat so oppressive that forested mountains exploded into smoke like volcanoes. It's been about fires fierce enough to jump the Columbia River; fast enough to light up the outskirts of Los Angeles like an invading army; and pervasive enough to threaten natural treasures, like the tallest and most ancient sequoia trees and Glacier National Park.

"For millions of people from California to Greenland, Oregon to Portugal, British Columbia to Montana, Siberia to South Africa, the summer of 2017 has been the summer of fire. And more than anything else, it's been the summer of ubiquitous, inescapable smoke.

"For years, climate scientists have warned us that a warming world is an extreme world, in which humanity is buffeted by both brutalizing excesses and stifling absences of the core elements that have kept fragile life in equilibrium for millennia. At the end of the summer of 2017, with major cities submerged in water and others licked by flames, we are currently living through Exhibit A of this extreme world, one in which natural extremes come head-to-head with social, racial, and economic ones."

It seems likely that the climate-linked disasters of 2019 and 2020 will be even more severe than those that we have witnessed during 2017 and 2018. But will such disasters be enough to wake us up?

The BBC has recently announced that Sir David Attenborough is currently producing a new series, *Blue Planet II*, which will focus on environmental issues.³⁰

"My hope is that the world is coming to its senses ... I'm so old I remember a time when ... we didn't talk about climate change, we talked about animals and species extermination," Sir David told Greenpeace in an interview, "For the first time I'm beginning to think there is actually a groundswell, there is a change in the public view. I feel many more people are concerned and more aware of what the problems are. Young people - people who've got 50 years of their life ahead of them - they are thinking they ought to be doing something about this. That's a huge change."

³⁰<http://www.bbcearth.com/blueplanet2/>



Figure 8.20: Sir David Attenborough: “Disaster. It’s a terrible thing to say, isn’t it?”



Figure 8.21: Speaking at the opening ceremony of COP24, the universally loved and respected naturalist Sir David Attenborough said: “If we don’t take action, the collapse of our civilizations and the extinction of much of the natural world is on the horizon.”

Climate Change, The Facts

Now Sir David Attenborough has completed a new one-hour BBC program on the danger of catastrophic climate change. Here are some excerpts from an April 18 2019 review of the program by Rebecca Nicholson in *The Guardian*:

The Facts is a rousing call to arms. It is an alarm clock set at a horrifying volume. The first 40 minutes are given over to what Attenborough calls, without hyperbole, “our greatest threat in thousands of years”. Expert after expert explains the consequences of rising CO₂ levels, on the ice caps, on coastal regions, on weather and wildlife and society itself. The most powerful moments are in footage shot not by expert crews who have spent years on location, but on shaky cameras, capturing the very moment at which the reality of our warming planet struck the person holding the phone. In Cairns, Australia, flying foxes are unable to survive the extreme temperatures; rescuers survey the terrible massacre, and we learn that while 350 were saved, 11,000 died. A man and his son talk through their escape from raging wildfires, over the film they took while attempting to drive through a cavern of blazing red trees. These are horror movies playing out in miniature. It is difficult to watch even five minutes of this and remain somehow neutral, or unconvinced.

Yet as I kept on, scribbling down an increasingly grim list of statistics, most of which I knew, vaguely, though compiled like this they finally sound as dreadful as they truly are - 20 of the warmest years on record happened in the last 22 years; Greenland’s ice sheet is melting five times faster than it was 25 years ago - I started to wonder about responsibility, and if and where it would be placed. This would be a toothless film, in the end, if it were hamstrung by political neutrality, and if its inevitable “it’s not too late” message rested solely on individuals and what relatively little tweaks we might make as consumers. What about corporations? What about governments?

Then, at that exact moment, having played the despair through to its crescendo, the experts served up unvarnished honesty. They lined up to lay out the facts, plain and simple. Fossil fuel companies are the most profitable businesses man has ever known, and they engage in PR offensives, using the same consultants as tobacco companies, and the resulting uncertainty and denial, designed to safeguard profits, has narrowed our window for action. It is unforgivable. I find it hard to believe that anyone, regardless of political affiliation,

can watch footage of Trump calling climate change “a hoax ... a money-making industry” and not be left winded by such staggering ignorance or astonishing deceit, though it is, more likely, more bleakly, a catastrophic combination of the two. At least Nigel Lawson only appears here in archive footage, and his argument sounds limp, to put it kindly.

Climate Change: The Facts should not have to change minds, but perhaps it will change them anyway, or at least make this seem as pressing as it needs to be. With the Extinction Rebellion protests across London this week, disrupting day-to-day business, and this, on primetime BBC One, maybe the message will filter through. At the very least, it should incite indignation that more was not done, sooner, and then urgency and a decision to both change and push for change at a much higher level. Because there is, for a brief moment, just possibly, still time.

Greta Thunberg meets Pope Francis

On 19 April 2019, Greta Thunberg met briefly with Pope Francis at the end of his general audience. “Continue, continue!” the Pope told her, “Go on, go ahead!” Greta answered Pope Francis with the words: “Thank you for standing up for the climate, for speaking the truth. It means a lot.” Greta’s father, Svante Thunberg, expressed his gratitude to the pope: “Thank you so much for what you are doing. It means everything. Everything.”

The Pope has made fighting climate change and caring for God’s creation a pillar of his papacy. He wrote an entire encyclical about it, blaming a thirst for money for turning the Earth into a wasteland and demanding immediate action to curb global warming.

While in Rome, Greta Thunberg will also address the Italian Parliament and participate in a school strike for action to avoid catastrophic climate change.

In June, 2015, His Holiness Pope Francis I addressed the climate crisis in an encyclical entitled “*Laudato Si’*”³¹. Here are a few excerpts from this enormously important encyclical, which is addressed not only to the world’s 1.2 billion Catholics, but also to concerned people of all faiths. After reviewing the contributions of his predecessors, Pope Francis makes the following points:

23. The climate is a common good, belonging to all and meant for all. At the global level, it is a complex system linked to many of the essential conditions for human life. A very solid scientific consensus

³¹<https://unfccc.int/news/pope-francis-releases-encyclical-on-climate-and-environment>

indicates that we are presently witnessing a disturbing warming of the climatic system. In recent decades this warming has been accompanied by a constant rise in the sea level and, it would appear, by an increase of extreme weather events, even if a scientifically determinable cause cannot be assigned to each particular phenomenon. Humanity is called to recognize the need for changes of lifestyle, production and consumption, in order to combat this warming or at least the human causes which produce or aggravate it. It is true that there are other factors (such as volcanic activity, variations in the earth's orbit and axis, the solar cycle), yet a number of scientific studies indicate that most global warming in recent decades is due to the great concentration of greenhouse gases (carbon dioxide, methane, nitrogen oxides and others) released mainly as a result of human activity. As these gases build up in the atmosphere, they hamper the escape of heat produced by sunlight at the earth's surface. The problem is aggravated by a model of development based on the intensive use of fossil fuels, which is at the heart of the worldwide energy system. Another determining factor has been an increase in changed uses of the soil, principally deforestation for agricultural purposes.

24. Warming has effects on the carbon cycle. It creates a vicious circle which aggravates the situation even more, affecting the availability of essential resources like drinking water, energy and agricultural production in warmer regions, and leading to the extinction of part of the planet's biodiversity. The melting in the polar ice caps and in high altitude plains can lead to the dangerous release of methane gas, while the decomposition of frozen organic material can further increase the emission of carbon dioxide. Things are made worse by the loss of tropical forests which would otherwise help to mitigate climate change. Carbon dioxide pollution increases the acidification of the oceans and compromises the marine food chain. If present trends continue, this century may well witness extraordinary climate change and an unprecedented destruction of ecosystems, with serious consequences for all of us. A rise in the sea level, for example, can create extremely serious situations, if we consider that a quarter of the world's population lives on the coast or nearby, and that the majority of our megacities are situated in coastal areas.

25. Climate change is a global problem with grave implications: environmental, social, economic, political and for the distribution of

goods. It represents one of the principal challenges facing humanity in our day. Its worst impact will probably be felt by developing countries in coming decades. Many of the poor live in areas particularly affected by phenomena related to warming, and their means of subsistence are largely dependent on natural reserves and ecosystemic services such as agriculture, fishing and forestry. They have no other financial activities or resources which can enable them to adapt to climate change or to face natural disasters, and their access to social services and protection is very limited. For example, changes in climate, to which animals and plants cannot adapt, lead them to migrate; this in turn affects the livelihood of the poor, who are then forced to leave their homes, with great uncertainty for their future and that of their children. There has been a tragic rise in the number of migrants seeking to flee from the growing poverty caused by environmental degradation. They are not recognized by international conventions as refugees; they bear the loss of the lives they have left behind, without enjoying any legal protection whatsoever. Sadly, there is widespread indifference to such suffering, which is even now taking place throughout our world. Our lack of response to these tragedies involving our brothers and sisters points to the loss of that sense of responsibility for our fellow men and women upon which all civil society is founded.

At a London event arranged by The Guardian, Greta Thunberg was asked whether she believed that a general strike could alert politicians to the urgency of the climate emergency. She replied “yes”. Here are some of her other comments:

This is not just young people being sick of politicians. It’s an existential crisis. It is something that will affect the future of our civilization. It’s not just a movement. It’s a crisis and we must take action accordingly.

At a later meeting with members of the U.K. Parliament, Greta Thunberg said:

The U.K.’s active current support of new exploitation of fossil fuels, like for example the U.K. shale gas fracking industry, the expansion of its North Sea oil and gas fields, the expansion of airports, as well as the planning permission for a brand new coalmine, is beyond absurd.



Figure 8.22: Greta Thunberg had the privilege of meeting Pope Francis. Both are outstanding voices for climate action.



Figure 8.23: Of the fossil fuels, all are bad, but coal is the worst.



Figure 8.24: Speaking to a crowd of many thousands at Marble Arch, London, on April 21, 2019, Greta Thunberg said: “For way too long the politicians and the people in power have gotten away with not doing anything ... But we will make sure that they will not get away with it any longer, We will never stop fighting, we will never stop fighting for this planet, for ourselves, our futures and for the futures of our children and grandchildren.”

This ongoing irresponsible behavior will no doubt be remembered in history as one of the greatest failures of humankind. .

Leonardo DiCaprio

Leonardo DiCaprio has won many awards for his work as an actor, writer and producer in both television and films. These include 50 awards from 167 nominations. DiCaprio has been nominated for six Academy Awards, four British Academy Film Awards and nine Screen Actors Guild Awards, winning one award each from them and three Golden Globe Awards from eleven nominations.

In accepting his Best Actor award at the 2016 Oscars ceremony, DiCaprio said: “Climate change is real, it is happening right now. It is the most urgent threat facing our entire species, and we need to work collectively together and stop procrastinating. We need to support leaders around the world who do not speak for the big polluters, but who speak for all of humanity, for the indigenous people of the world, for the billions and billions of underprivileged people out there who would be most affected by this. For our children’s children, and for those people out there whose voices have been drowned out by the politics of greed.”

Leonardo DiCaprio has used his great success as an actor in the service of environmental causes. In 1997, following the box office success of *Titanic*, he set up the Leonardo DiCaprio Foundation, which is devoted to environmental causes. He chaired the national Earth Day celebrations in 2000 during which he interviewed US President Bill Clinton, with whom he discussed the actions needed to avoid catastrophic climate change. In 2007 he had a major role in *The 11th Hour*, a documentary about people’s relationship to nature and global warming. He also co-produced and co-wrote the film.

DiCaprio’s most influential film on climate change is *Before the Flood*³². This film, released in 2016, is a 1 hour and 36 minute documentary in which Leonardo DiCaprio travels to many countries to let viewers observe the already visible effects of global warming. He also talks with many of the world’s leaders, including Pope Francis I, US Presidents Bill Clinton and Barack Obama, and UN Secretary General Ban Ki-moon.

Thom Hartmann

Thom Hartmann was born in 1951 in Lansing Michigan. He worked as a disk jockey during his teens, and, after a highly successful business career, he sold his businesses and devoted his energies to writing, humanitarian projects and

³²<http://www.get.filmovie.us/play.php?movie=tt5929776t>



Figure 8.25: Leonardo DiCaprio at a press conference in 2000 (Wikipedia).



Figure 8.26: **Thom Hartmann speaks to the 2010 Chicago Green Festival (Wikipedia).**

public education. His influential book, *Last Hours of Ancient Sunlight* was published by Three Rivers Press in 1997 and republished in a revised edition in 2004. In 2013, Hartmann published another extremely important book on the same theme: *The Last Hours of Humanity: Warming the World To Extinction*³³.

Hartmann has hosted a nationally syndicated radio show, The Thom Hartmann Program, since 2003 and a nightly television show, The Big Picture, since 2008.

Concerning Hartmann's radio show, Wikipedia states that "As of March 2016, the show was carried on 80 terrestrial radio stations in 37 states as well as on Sirius and XM satellite radio. A community radio station in Africa, Radio Builsa in Ghana, also broadcasts the show. Various local cable TV networks simulcast the program. In addition to Westwood One, the show is now also offered via Pacifica Audioport to non-profit stations in a non-profit compliant format and is simulcast on Dish Network channel 9415 and DirecTV channel 348 via Free Speech TV. The program is carried on Radio Sputnik in London, England."

"Sen. Bernie Sanders (I-VT) appears every Friday during the first hour of the show titled 'Brunch with Bernie'. Ellen Ratner of the Talk Radio News Service provides Washington commentary daily. Victoria Jones who is the

³³<https://www.amazon.com/Last-Hours-Humanity-Warming-Extinction/dp/1629213640>

White House correspondent for Talk Radio News Service appears occasionally as does Dr. Ravi Batra an economics professor at SMU.”

Together with Leonardo DiCaprio, Thom Hartman recently produced and narrated an extremely important short film entitled *Last Hours*³⁴. This film, draws a parallel between the Permian-Triassic mass extinction, and the danger of a human-induced 6th mass extinction. Various experts who appear in the film confirm that our release of CO₂ into the atmosphere is similar to the greenhouse gasses produced by volcanic eruptions prior to the Permian event. The methane hydrate feedback loop is also discussed. The film should be seen by everyone concerned with the future of human civilization and the biosphere. Concerned citizens should also urgently see Hartman and DiCaprio’s short films *Carbon*, *Green World Rising* and *Reforestation*, also available on YouTube .

James Hansen

James Hansen was born in 1941 in Denison, Iowa. He was educated in physics, mathematics and astronomy at the University of Iowa in the space sciences program initiated James Van Allen. He graduated with great distinction. The studies of the atmosphere and temperature of Venus which Hansen made under Van Allen’s supervision lead him to become extremely concerned about similar effects in the earth’s atmosphere.

From 1962 to 1966, James Hansen participated in the National Aeronautical and Space Administration graduate traineeship and, at the same time, between 1965 and 1966, he was a visiting student at the Institute of Astrophysics at the University of Kyoto and in the Department of Astronomy at the University of Tokyo. Hansen then began work at the Goddard Institute for Space Studies in 1967. He began to work for the Goddard Institute for Space Studies in 1967. Between 1981 and 2013, he was head of the Goddard Institute of Space Studies in New York, and since 2014, he has been the director of the Program on Climate Science, Awareness and Solutions at Columbia University’s Earth Institute.

Hansen continued his work with radiative transfer models, attempting to understand the Venusian atmosphere. Later he applied and refined these models to understand the Earth’s atmosphere, in particular, the effects that aerosols and trace gases have on Earth’s climate. Hansen’s development and use of global climate models has contributed to the further understanding of the Earth’s climate. In 2009 his first book, *Storms of My Grandchildren*, was published.

³⁴<https://www.youtube.com/watch?v=2bRrg96UtMc>

James Hansen has refined climate change models, focusing on the balance between aerosols and greenhouse gases. He believes that there is a danger that climate change will become much more rapid if the balance shifts towards the greenhouse gases.

Hansen's Congressional testimony leads to broad public awareness of the dangers

In 1988, Prof. Hansen was asked to testify before the US Congress on the danger of uncontrolled climate change. The testimony marked the start of broad public awareness of the seriousness of the danger, and it was reported in a front page article by the New York Times. However, Hansen believes that governmental energy policies still favor fossil fuels. Therefore he has participated in public demonstrations and he was even arrested in 2011 together with more than a thousand other activists for protesting outside the White House.

James Hansen's TED talk and book

In 2012 he presented a TED Talk: *Why I Must Speak Out About Climate Change*. This talk is easily available on the Internet, and it should be required viewing for everyone who is concerned with the earth's future.

Hansen's book, *Storms of My Grandchildren: The Truth About The Coming Climate Catastrophe, and Our Last Chance To Save Humanity* was published in New York by Bloomsbury Publishing in 2009.

Figure 8.27: **Prof. James Hansen**

Suggestions for further reading

1. A. Gore, *An Inconvenient Truth: The Planetary Emergency of Global Warming and What We Can Do About It*, Rodale Books, New York, (2006).
2. A. Gore, *Earth in the Balance: Forging a New Common Purpose*, Earthscan, (1992).
3. A.H. Ehrlich and P.R. Ehrlich, *Earth*, Thames and Methuen, (1987).
4. P.R. Ehrlich and A.H. Ehrlich, *The Population Explosion*, Simon and Schuster, (1990).
5. P.R. Ehrlich and A.H. Ehrlich, *Healing the Planet: Strategies for Resolving the Environmental Crisis*, Addison-Wesley, (1991).
6. P.R. Ehrlich and A.H. Ehrlich, *Betrayal of Science and Reason: How Anti-Environmental Rhetoric Threatens our Future*, Island Press, (1998).
7. P.R. Ehrlich and A.H. Ehrlich, *One With Nineveh: Politics, Consumption and the Human Future*, Island Press, (2004).
8. D.H. Meadows, D.L. Meadows, J. Randers, and W.W. Behrens III, *The Limits to Growth: A Report for the Club of Rome's Project on the Predicament of Mankind*, Universe Books, New York, (1972).
9. D.H. Meadows et al., *Beyond the Limits. Confronting Global Collapse and Envisioning a Sustainable Future*, Chelsea Green Publishing, Post Mills, Vermont, (1992).

10. D.H. Meadows, J. Randers and D.L. Meadows, *Limits to Growth: the 30-Year Update*, Chelsea Green Publishing, White River Jct., VT 05001, (2004).
11. A. Peccei and D. Ikeda, *Before it is Too Late*, Kodansha International, Tokyo, (1984).
12. V.K. Smith, ed., *Scarcity and Growth Reconsidered*, Johns Hopkins University Press, Baltimore, (1979).
13. British Petroleum, *BP Statistical Review of World Energy*, (published yearly).
14. R. Costanza, ed., *Ecological Economics: The Science and Management of Sustainability*, Colombia University Press, New York, (1991).
15. J. Darmstadter, *A Global Energy Perspective*, Sustainable Development Issue Backgrounder, Resources for the Future, (2002).
16. D.C. Hall and J.V. Hall, *Concepts and Measures of Natural Resource Scarcity*, *Journal of Environmental Economics and Management*, **11**, 363-379, (1984).
17. M.K. Hubbert, *Energy Resources*, in *Resources and Man: A Study and Recommendations*, Committee on Resources and Man, National Academy of Sciences, National Research Council, W.H. Freeman, San Francisco, (1969).
18. Intergovernmental Panel on Climate Change, *Climate Change 2001: The Scientific Basis*, IPCC, (2001).
19. J.A. Krautkraemer, *Nonrenewable Resource Scarcity*, *Journal of Economic Literature*, **36**, 2065-2107, (1998).
20. N. Stern et al., *The Stern Review*, www.sternreview.org.uk, (2006).
21. T.M. Swanson, ed., *The Economics and Ecology of Biodiversity Decline: The Forces Driving Global Change*, Cambridge University Press, (1995).
22. P.M. Vitousek, H.A. Mooney, J. Lubchenco and J.M. Melillo, *Human Domination of Earth's Ecosystems*, *Science*, **277**, 494-499, (1997).
23. World Resources Institute, *World Resources 200-2001: People and Ecosystems: The Fraying Web of Life*, WRI, Washington D.C., (2000).
24. A. Sampson, *The Seven Sisters: The Great Oil Companies of the World and How They Were Made*, Hodder and Staughton, London, (1988).
25. D. Yergin, *The Prize*, Simon and Schuster, New York, (1991).
26. M.B. Stoff, *Oil, War and American Security: The Search for a National Policy on Oil, 1941-1947*, Yale University Press, New Haven, (1980).
27. J. Stork, *Middle East Oil and the Energy Crisis*, Monthly Review, New York, (1976).
28. F. Benn, *Oil Diplomacy in the Twentieth Century*, St. Martin's Press, New York, (1986).

29. K. Roosevelt, *Countercoup: The Struggle for the Control of Iran*, McGraw-Hill, New York, (1979).
30. E. Abrahamian, *Iran Between Two Revolutions*, Princeton University Press, Princeton, (1982).
31. J.M. Blair, *The Control of Oil*, Random House, New York, (1976).
32. M.T. Klare, *Resource Wars: The New Landscape of Global Conflict*, Owl Books reprint edition, New York, (2002).
33. H. Mejcher, *Imperial Quest for Oil: Iraq, 1910-1928*, Ithaca Books, London, (1976).
34. P. Sluglett, *Britain in Iraq, 1914-1932*, Ithaca Press, London, (1976).
35. D.E. Omissi, *British Air Power and Colonial Control in Iraq, 1920-1925*, Manchester University Press, Manchester, (1990).
36. V.G. Kiernan, *Colonial Empires and Armies, 1815-1960*, Sutton, Stroud, (1998).
37. R. Solh, *Britain's 2 Wars With Iraq*, Ithaca Press, Reading, (1996).
38. D. Morgan and D.B. Ottaway, *In Iraqi War Scenario, Oil is Key Issue as U.S. Drillers Eye Huge petroleum Pool*, Washington Post, September 15, (2002).
39. C.J. Cleveland, *Physical and Economic Aspects of Natural Resource Scarcity: The Cost of Oil Supply in the Lower 48 United States 1936-1987*, Resources and Energy **13**, 163-188, (1991).
40. C.J. Cleveland, *Yield Per Effort for Additions to Crude Oil Reserves in the Lower 48 States, 1946-1989*, American Association of Petroleum Geologists Bulletin, **76**, 948-958, (1992).
41. M.K. Hubbert, *Technique of Prediction as Applied to the Production of Oil and Gas*, in *NBS Special Publication 631*, US Department of Commerce, National Bureau of Standards, (1982).
42. L.F. Ivanhoe, *Oil Discovery Indices and Projected Discoveries*, Oil and Gas Journal, **11**, 19, (1984).
43. L.F. Ivanhoe, *Future Crude Oil Supplies and Prices*, Oil and Gas Journal, July 25, 111-112, (1988).
44. L.F. Ivanhoe, *Updated Hubbert Curves Analyze World Oil Supply*, World Oil, November, 91-94, (1996).
45. L.F. Ivanhoe, *Get Ready for Another Oil Shock!*, The Futurist, January-February, 20-23, (1997).
46. Energy Information Administration, *International Energy Outlook, 2001*, US Department of Energy, (2001).
47. Energy Information Administration, *Caspian Sea Region*, US Department of Energy, (2001).
48. National Energy Policy Development Group, *National Energy Policy*, The White House, (<http://www.whitehouse.gov/energy/>), (2004).

49. M. Klare, *Bush-Cheney Energy Strategy: Procuring the Rest of the World's Oil*, Foreign Policy in Focus, (Interhemispheric Resource Center/Institute for Policy Studies/SEEN), Washington DC and Silver City NM, January, (2004).
50. IEA, *CO₂ from Fuel Combustion Fact-Sheet*, International Energy Agency, (2005).
51. H. Youguo, *China's Coal Demand Outlook for 2020 and Analysis of Coal Supply Capacity*, International Energy Agency, (2003).
52. R.H. Williams, *Advanced Energy Supply Technologies*, in **World Energy Assessment: Energy and the Challenge of Sustainability**, UNDP, (2000).
53. H. Lehmann, *Energy Rich Japan*, Institute for Sustainable Solutions and Innovations, Aachen, (2003).
54. D. King, *Climate Change Science: Adapt, Mitigate or Ignore*, Science, **303** (5655), pp. 176-177, (2004).
55. S. Connor, *Global Warming Past Point of No Return*, The Independent, (116 September, 2005).
56. D. Rind, *Drying Out the Tropics*, New Scientist (6 May, 1995).
57. J. Patz et al., *Impact of Regional Climate Change on Human Health*, Nature, (17 November, 2005).
58. M. McCarthy, *China Crisis: Threat to the Global Environment*, The Independent, (19 October, 2005).
59. L.R. Brown, *The Twenty-Ninth Day*, W.W. Norton, New York, (1978).
60. W.V. Chandler, *Materials Recycling: The Virtue of Necessity*, Worldwatch Paper 56, Worldwatch Institute, Washington D.C., (1983).
61. W.C. Clark and others, *Managing Planet Earth*, Special Issue, *Scientific American*, September, (1989).
62. B. Commoner, *The Closing Circle: Nature, Man and Technology*, Bantam Books, New York, (1972).
63. C. Flavin, *Slowing Global Warming: A Worldwide Strategy*, Worldwatch Paper 91, Worldwatch Institute, Washington D.C., (1989).
64. J.R. Frisch, *Energy 2000-2020: World Prospects and Regional Stresses*, World Energy Conference, Graham and Trotman, (1983).
65. J. Gever, R. Kaufmann, D. Skole and C. Vorosmarty, *Beyond Oil: The Threat to Food and Fuel in the Coming Decades*, Ballinger, Cambridge MA, (1986).
66. J. Holdren and P. Herrera, *Energy*, Sierra Club Books, New York, (1971).
67. N. Myers, *The Sinking Ark*, Pergamon, New York, (1972).
68. National Academy of Sciences, *Energy and Climate*, NAS, Washington D.C., (1977).

69. W. Ophuls, *Ecology and the Politics of Scarcity*, W.H. Freeman, San Francisco, (1977).
70. A. Peccei, *The Human Quality*, Pergamon Press, Oxford, (1977).
71. A. Peccei, *One Hundred Pages for the Future*, Pergamon Press, New York, (1977).
72. E. Pestel, *Beyond the Limits to Growth*, Universe Books, New York, (1989).
73. C. Pollock, *Mining Urban Wastes: The Potential for Recycling*, Worldwatch Paper 76, Worldwatch Institute, Washington D.C., (1987).
74. S.H. Schneider, *The Genesis Strategy: Climate and Global Survival*, Plenum Press, (1976).
75. P.B. Smith, J.D. Schilling and A.P. Haines, *Introduction and Summary*, in *Draft Report of the Pugwash Study Group: The World at the Crossroads*, Berlin, (1992).
76. World Resources Institute, *World Resources*, Oxford University Press, New York, (published annually).
77. J.E. Young, John E., *Mining the Earth*, Worldwatch Paper 109, Worldwatch Institute, Washington D.C., (1992).
78. J.R. Craig, D.J. Vaughan and B.J. Skinner, *Resources of the Earth: Origin, Use and Environmental Impact, Third Edition*, Prentice Hall, (2001).
79. W. Youngquist, *Geodestinies: The Inevitable Control of Earth Resources Over Nations and Individuals*, National Book Company, Portland Oregon, (1997).
80. M. Tanzer, *The Race for Resources. Continuing Struggles Over Minerals and Fuels*, Monthly Review Press, New York, (1980).
81. C.B. Reed, *Fuels, Minerals and Human Survival*, Ann Arbor Science Publishers Inc., Ann Arbor Michigan, (1975).
82. A.A. Bartlett, *Forgotten Fundamentals of the Energy Crisis*, American Journal of Physics, **46**, 876-888, (1978).
83. N. Gall, *We are Living Off Our Capital*, Forbes, September, (1986).
84. M. Anklin et al., *Climate instability during the last interglacial period recorded in the GRIP ice core*. Nature **364**, 15 July: 203-207, (1993).
85. O. J. Blanchard and S. Fischer, *Lectures on Macroeconomics*. Cambridge, Mass.: MIT Press. (1989).

Index

- 100.4 degrees Fahrenheit in Arctic, 9
- 166 billion tons lost in 2021, 11
- 600 billion tons of ice lost, 7
- A dangerous feedback loop, 21
- A new Joan of Arc, 78
- A Northern European NWFZ?, 54
- Abrupt climate change, 40
- Absolutely sovereign nation-states, 113
- Accelerated melting, 36
- Acidification of oceans, 31
- Advertisers on mass media, 126
- Air travel, 74
- Al Gore, 128
- Albedo effect, 28, 36, 41
- Alliance for Climate Protection, 128
- Alternative media, 127
- Amazon rainforest, 40, 90
- An Antarctic NWFZ already exists, 52
- An Inconvenient Truth, 128
- Anderson, Kevin, 108, 110
- Angela Merkel, 23
- Antarctic sea ice loss, 40
- Antarctica's Thwaites Glacier, 7
- Anthropocene Extinction, 34
- Anti-science disinformation campaigns, 67
- Antonio Guterres, 23
- Arctic is now more accessible, 51
- Arctic Mediterranean temperatures, 9
- Arctic methane release, 40
- Arctic NWFZ conference, 58
- Arctic peat fires release CO₂, 9
- Arctic permafrost, 110
- Arctic sea ice loss, 36, 40
- Arctic wildfires, 9
- Are we evil?, 76
- Arrhenius, Svante, 74
- Articles dominated by trivia, 114
- Astonishing deceit, 133
- Astonishing degree of cynicism, 67
- Atlas Network, 67
- Atmosphere of Venus, 141
- Atmospheric water vapor, 35
- Attenborough, Sir David, 78, 112, 128, 130
- Ban Ki-moon, 138
- Bangladesh under water, 110
- Banking on Climate Change 2019, 63
- BBC, 130
- Before the Flood, 138
- Bernie Sanders, 140
- Big coal and oil corporations, 114
- Biodiversity, 107
- Biodiversity loss, 31
- Biological annihilation, 35
- Biological diversity, 34
- Biophysical capacity, 106
- Biosphere, 28
- Biosphere is being sacrificed, 99
- Bolsonaro, Jair, 90
- Boreal forest dieback, 40
- Bread and circuses, 122
- British Antarctic Survey, 13
- Brunch With Bernie, 140
- Campaigns that confuse the public, 67

- Canada, 53
- Carbon budget, 80, 116
- Carbon footprint, 80
- Carbon neutrality by 2050, 23
- Carbon pollution accelerating, 28
- Carbon-negative world, 109
- Catastrophic climate change, 23, 28, 74, 89, 105, 116, 125
- Catastrophic destabilization, 11
- Ceballos, Gerardo, 35
- Change is coming, 99
- Change the system, 99
- Civilization coming to an end, 111
- Climate change, 23, 28
- Climate change denial, 63, 122
- Climate change emission pledges, 31
- Climate Change: The Facts, 132
- Climate crisis, 23, 80, 82
- Climate emergency, 89, 103, 104
- Climate financing, 32
- Climate justice, 76
- Climate Justice Now, 98
- Climate Summit, 23
- Climate tipping points, 41
- Climate-driven refugees, 90
- Clinton, Bill, 138
- CO₂ and CH₄ over last 1000 years, 14
- CO₂ and temperature correlated, 14
- Collapse of our civilization, 78, 112
- Colombia University, Climate Science, 141
- Come together and save ourselves, 125
- Come with a plan, 89
- Concerns are justified, 86
- Consume more, 126
- Consumption per capita, 115
- COP24, 96
- Corbyn, Jeremy, 103
- Cretaceous-Paleogene Extinction, 33
- Cultural inertia, 114, 116
- Darkened snow, 36
- Davos Economic Forum, 78
- Death spiral of Arctic sea ice, 21
- Denmark, 53
- Destruction of forests, 128
- Destruction of habitats, 34
- Deuterium temperature proxy, 14
- Developing world, 31
- DiCaprio, Leonardo, 138, 141
- Dirzo, Rudolfo, 35
- Disasters might wake public, 128
- Disempowered TV viewers, 122
- Disinformation campaign, 67
- Divest from the fossil fuel industry, 66
- Divestment movement begins to hurt, 68
- Double-think totalitarian state, 106
- Drought, 31
- Drying of forests and fires, 39
- Earth's atmosphere, 141
- Ecological breakdown, 111
- Ecological catastrophes, 121
- Ecological conscience, 114
- Ecological footprint, 106
- Economic tipping point, 128
- Ecosystem functioning, 35
- Ehrlich, Paul R., 35
- Emergency, 104
- Emergency-scale transition, 126
- Emissions have to stop, 75
- Emissions reduction curve, 126
- Energy, 32
- Entertaining ourselves to death, 114
- Environmental catastrophe, 122
- Environmental crisis accelerates, 124
- Environmental disaster, 126
- Equity, 76
- European Parliament, 87
- Existential crisis, 135
- Existential risk, 105

- Existential risk to civilization, 109
- Expansion of North Sea oil, 135
- Exponential growth, 115
- Extinction of marine species, 33
- Extinction of terrestrial vertebrates, 33
- Extinction Rebellion, 104, 133
- Extreme heatwaves, 110
- Extreme-weather events, 109
- Exxon had the best climate models, 64
- Exxon knew, 64
- Exxon's 1982 internal memo, 64
- Failure of epic proportions, 107
- Failure to respond adequately, 113
- Fake news, 107
- Famine, 116
- Feedback loop, definition, 35
- Feedback loops, 28, 110
- Finland, 53
- Floods, 31
- Florida under water, 110
- Fly more, 126
- Focus on what needs to be done, 96
- Forest die-back, 110
- Forest fires, 39
- Fossil Free MIT, 66
- Fossil fuel corporations, 64, 122
- Fossil fuel extraction must stop, 78, 112
- Fossil fuels, 23, 64, 113, 115
- Framework Convention, 31
- Free University of Berlin, 11
- Friday school strikes, 27
- Fridays for the Future, 82
- Future generations, 87
- Future human needs, 106
- Future of our civilization, 135
- General strike for climate action?, 135
- Glaciation, 34
- Global catastrophic risk, 111
- Global Challenges Foundation, 110, 111
- Global climate strike, 82
- Global inequalities, 86
- Global temperature, 28
- Global warming, 31, 86
- Goddard Institute, Space Studies, 141
- Goodman, Amy, 104
- Gore, Al, 128
- Governments left to wither, 125
- Greatest failure of humankind, 138
- Green economy, 23
- Greenhouse effect, 36
- Greenland ice cores, 40
- Greta Thunberg, 23, 27
- Greta Thunberg meets Pope Francis, 133
- Greta Thunberg speaks at Marble Arch, 135
- Greta Thunberg's TED talk, 74
- Growth implies future collapse, 114
- Growth of population and industry, 114
- Guardian, 104
- Guterres warns world leaders, 23
- Guterres, Antonio, 23, 78, 89, 92, 113
- Halt extraction of fossil fuels, 78, 112
- Halving CO₂ by 2030, 86
- Hansen's testimony to Congress, 142
- Hansen, James, 108, 141
- Hartmann, Thom, 140
- Health, 32
- Heat waves, 31
- Heat waves in Sweden, 98
- Henderson, Bill, 125
- High waves in the Beaufort sea, 21
- Holocene Extinction, 34
- Hopeful signs of change, 70
- House of Commons, 103
- Human ego is boundless, 115
- Humans cause global warming, 31
- Hurricanes more severe, 108
- Iceland, 53

- Imagine what we could do together, 77
- Immediate action required, 78, 112
- Indian monsoon disruption, 40
- Indigenous people, 138
- Indigenous population, 53
- Industrial infrastructure, 113
- Inside Climate News, 64
- Institutional inertia, 113, 116
- Intense flooding, 108
- Internal assessments, 64
- International agreements, 32
- International Arctic cooperation, 52
- Inundation of coastal cities, 31
- Investment in renewables, 70
- IPCC, 32, 86, 107, 111, 128
- IPCC report from Incheon, 2018, 89
- Irreversible adverse climate change, 108
- Irreversible biodiversity loss, 31
- Irreversible warming, 64
- Isotope analysis gives temperatures, 18
- It's not too late, 132
- IUCN, 34
- James Hansen, 141
- James Hansen's TED talk, 142
- James van Allen, 141
- Keep that oil in the ground, 77, 78, 113
- Koch brothers, 67
- Lack of action, 31
- Large scale Arctic fishing, 52
- Last glacial period, 14
- Last Hours (YouTube), 141
- Last Hours of Ancient Sunlight, 140
- Late Devonian Extinction, 33
- Layers of peat are burning, 9
- Lenton, Timothy Michael, 40
- Leonardo DiCaprio, 138, 141
- Life.styles from mass media, 120
- Limiting fossil fuel production, 125
- Limiting global warming to 1.5°C, 89
- Limits for adaption, 111
- Limits to Growth, 114
- Line in the sand, 89
- Lobbying against climate change action, 66
- Look for action. Then hope will come, 116
- Looming financial instability, 107
- Losing battle against climate change, 23
- Low-carbon economy, 78, 113
- Low-lying islands, 8
- Luxuries of the few, 99
- Major extinction event, 35
- Making excuses, 122
- Malnutrition, 31
- Man-made disaster, 78, 112
- Mann, Michael E., 108
- Marine Ice Cliff Instability, 8
- Markets solve all problems?, 125
- Mass media, 75, 114, 115, 119
- Massive non-linear events, 109
- McKibben, Bill, 68
- Media as a battleground, 119
- Media neglect of climate change, 121
- Melting of polar icecaps, 110
- Merkel, Angela, 23
- Methane hydrate feedback loop, 28, 33, 36, 41
- Methane release also unprecedented, 14
- Methane, 10,000 gigatons, 39
- Miami, 8
- Microscopic fixes for vast problems, 124
- Military conflicts must be avoided, 52
- Mitigation, 32
- Modern powerholders, 119
- Modern societies, 120
- Monbiot, George, 104, 122

- Monetizing underground “assets”, 64, 122
- Money and growth our main concerns, 80
- Monsoon disruption, 40
- Moral responsibility, 80
- More than hope, we need action, 77
- Multigenerational families, 120
- Multiple interrelated crises, 116
- Mumbai, 8
- Myopic national self-interest, 106

- NASA, 141
- National Academy of Sciences, 35
- National Geographic Chanel, 119
- Nationalism a dangerous anachronism, 113
- Natural environment, 128
- Natural habitat destruction, 34
- Natural resources, 32
- Neoliberalism, 125
- New Joan of Arc, 78
- New York, 8
- No one ever talked about it, 75
- Nobel Peace Prize, 128
- Non-Proliferation Regime, 51
- Northwest Passage for shipping, 52
- Norway, 53
- Nuclear families, 120
- Nuclear submarines patrol Arctic, 54
- Nuclear war is possible, 109

- Obama, Barack, 138
- Older people marginalized, 120
- Ordovician-Silurian Extinction, 33
- Orwell, George, 106
- Our house is on fire, 80
- Our leaders are behaving like children, 78, 113

- Pace of change, 111
- Package of broadcasts, 121
- Paleoclimate records, 13
- Palm oil production, 128
- Paris Agreement, 76, 86, 105, 109
- Paris goals, 125
- Permafrost melting, 40
- Permian extinction, 31
- Permian-Triassic Extinction, 28, 33
- Personal utopia, 115
- Planetary boundaries, 107
- Pledges remain unmet, 31
- Polar ice cores, 13
- Polar nuclear-weapon-free zones, 51
- Polar Portal, 11
- Policymakers’ magical thinking, 107
- Policymaking cognitatively dissonant, 106
- Polite conversation, 114
- Political expediency, 106
- Political will, 90
- Politics of global warming, 63, 122
- Politics of greed, 138
- Poor and most vulnerable, 32
- Pope Francis I, 87, 133, 138
- Popularity and ratings, 114
- Population extinction pulse, 35
- Population losses and declines, 35
- Population stabilization, 115
- Positive feedback loops, 35
- Post-fossil-fuel era, 107
- Postman, Neil, 114
- Potsdam Institute, 11, 32
- Poverty alleviation, 32
- Power and possessions, 115
- PR offensives, 133
- Predatory delay, 125, 126
- Preventing an ecological apocalypse, 122
- Profits of stockholders, 114
- Propaganda, 119
- Propaganda and entertainment, 121
- Protesting at the Swedish parliament,

- 96
- Public education, 119
- Public opinion, 119
- Pull the emergency brake, 96
- Quick action must be taken, 116
- Rapid change is required, 76
- Rate of species loss, 35
- Real power belongs to the people, 99
- Recession will come, 115
- Record-breaking heatwaves, 108
- Regional agreements, 32
- Renewable energy, 28, 115
- Reporting climate change, 119
- Responsibility towards future generations, 116
- Restrict air travel, 74
- Revolutions in outlook and lifestyles, 113
- Rio Earth Summit, 105
- Risk management, 32
- Risk to human civilization, 109
- Role of the media, 119
- Rules have to be changed, 77
- Russia, 53
- Sanders, Bernie, 140
- Saturation pressure, 35
- Saving the future, 77, 78, 112, 113
- Saving threatened species, 128
- Scale up solutions, 23
- Schoolstrike for climate action, 82
- Science, 86
- Science means nothing to politicians, 77
- Scientific evidence, 31
- Sea ice loss, 36
- Sea ice melting, 21
- Sea level rise, 31, 40
- Sea level rise accelerating, 28
- Sea level rise of several meters, 8
- Sea-Bed Treaty, 53
- Severe hurricanes, 108
- Shanghai, 8
- Shell and Exxon knew, 64
- Shooting Santa Claus, 115
- Short-term political advantage, 106
- Shrinking ice sheets, 28
- Siberian town of Verkhoyansk, 9
- Siberian Traps, 33
- Sir David Attenborough, 128
- Sixth mass extinction, 35, 76
- Slandering scientists, 67
- Smoke destroys health, 67
- Social conscience, 114
- Social games, 75
- Solar energy, 116
- Solutions exist, 87
- Soot particles, 36
- Southern Hemisphere's NWFZ'S, 51
- Speak out in clear language, 80
- Species loss, 34
- Spent \$674 billion on new reserves, 66
- Staggering ignorance of Trump, 133
- State of the Planet broadcast, 23
- Steady-state economics, 115
- Stop procrastinating, 138
- Stop the expansion of extraction, 125
- Storms of My Grandchildren, 141
- Struggle for power and possessions, 115
- Student climate strike in Belgium, 78
- Sustainability crisis, 75
- Sustainable society, 87
- Svante Arrhenius, 74
- Svante Thunberg, 74
- Sweden, 96
- Symbols of power, 119
- Tax carbon, not salaries, 27
- Tax pollution, not people, 27
- Television, 114
- Television part of education, 119

- Television underestimated, 119
- Tell it like it is, 96
- Ten feet of sea level rise, 7
- The 11th Hour, 138
- The albedo effect, 21
- The Big Picture, 140
- The Case for Optimism (TED), 128
- The Guardian, 34, 104, 119, 122, 128, 135
- The Last Hours of Humanity, 140
- The party is over, 114
- The rules have to be changed, 78, 113
- Thermohaline circulation, 40
- Thermonuclear war, 116
- Thom Hartmann, 140
- Thunberg, Greta, 23, 27, 74, 78, 87, 96, 98, 99, 113, 116, 133
- Thunberg, Svante, 74
- Thwaites Glacier may shatter, 7
- Tipping point, 28
- Tipping points, 90
- Tipping points and feedback, 40
- Tipping points, definition, 40
- Tobacco and fossil fuel industries, 67
- Tokyo, 8
- Top Gear, 126
- Traditional societies, 120
- Triassic-Jurassic Extinction, 33
- Triumphant denialism, 126
- Tropical cyclones, 31
- Tropical rain forests, 34
- Trump, Donald, 28, 90
- Truthout, 104
- UK declares climate emergency, 103
- UN Framework Convention, 31
- UN General Assembly, 23
- UN Secretary-General, 92
- Understatement of Existential Climate Risk, 105
- United Nations Framework Convention, 105
- Unprecedented changes, 80
- Unprecedented heat waves, 31
- Unprecedented rate of increase of CO₂, 13
- Unstable Greenland cliffs of ice, 12
- Unsustainable lifestyles in media, 126
- Urgency of our situation, 92
- USA, 53
- Values from the mass media, 120
- Van Allen, James, 141
- Vapor pressure, 35
- Vested-interest pressure, 108
- Volcanic eruptions in Siberia, 33
- Warning from the World Bank, 31
- Water scarcity, 31
- Water vapor a greenhouse gas, 35
- Watering-down scientific findings, 108
- We have the facts and solutions, 77
- We have to change, 75
- We have to speak clearly, 99
- We must act now, 90
- We will never stop fighting, 135
- Welfare, 32
- West African monsoon loss, 40
- What Lies Beneath, 105
- Why wasn't it made illegal?, 75
- Why were there no restrictions?, 75
- Wildfires in Sweden, 98
- Willful blindness, 115
- Wilson, E.O., 35
- Wind energy, 115
- Winning slowly means losing, 126
- World Bank, 28, 31
- World Bank Group, 32
- World Bank warning, 31
- World Development Report, 32
- World Economic Forum survey, 109
- World Meteorological Organization, 9, 28

World Meteorological Organization report, 89

World's poorest three billion, 110

Worship of power, 115

YouTube, 127