

SAVVING THE FUTURE

John Scales Avery

February 5, 2019

INTRODUCTION¹

“Today we are heading for unprecedented dangers and conflicts, up to and including the end of a habitable planet in the foreseeable future, depriving all future generations of their right to life and the lives of preceding generations of meaning and purpose.

“This apocalyptic reality is the elephant in the room. Current policies threaten temperature increases triggering permafrost melting and the release of ocean methane hydrates which would make our earth unliveable, according to research presented by the British Government Met office at the Paris Climate Conference.

“The myth that climate change is conspiracy to reduce freedom is spread by a powerful and greedy elite which has largely captured governments to preserve their privileges in an increasingly unequal world.” Jakob von Uexküll

“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 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?” Greta Thunberg

¹This book makes use of articles and book chapters that I have previously written on subjects related to institutional and cultural inertia, but a great deal of new material has been added



Figure 1: 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.”



Figure 2: UN Secretary-General Antonio Guterres, and 15-year-old Swedish climate activist Greta Thunberg addressing the opening ceremony of COP24.

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 because of institutional and cultural inertia, we are failing to take the steps that are necessary to avoid disaster.

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 15-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 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, 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 Niel 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 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 not 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. ²

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. ³

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

²<http://eruditio.worldacademy.org/issue-5/article/urgent-need-renewable-energy>

³<http://steadystate.org/category/herman-daly/>

Contents

1	ACCELERATING CHANGE LEADS TO CIVILIZATION’S CRISIS	13
1.1	Genetic, cultural, and technological evolution	13
1.2	The threat of an ecological megacatastrophe	19
1.3	Space-age science and stone-age politics	24
1.4	The threat of widespread global famine	28
1.5	Civilization’s crisis: A set of linked challenges	31
2	THE CLIMATE EMERGENCY	39
2.1	Why is climate change an emergency?	39
2.2	Scientists have long been aware of the dangers	40
2.3	Quick action is needed to save the long-term future	41
2.4	Is the transition to 100% renewable energy possible?	42
2.5	Renewables are now much cheaper than fossil fuels!	45
2.6	An economic tipping point	49
2.7	An unprecedented investment opportunity	50
2.8	For creating jobs, renewables beat fossil fuels	52
2.9	The Stern Review	53
2.10	Major producers of fossil fuels	60
2.11	Blood for oil	62
2.12	Fossil fuel extraction must stop!	62
2.13	Extinction events and feedback loops	63
2.14	A warning from the World Bank	66
2.15	Permian-Triassic extinction event	67
2.16	The Holocene (Anthropocene) extinction	68
2.17	Global warming and atmospheric water vapor	70
2.18	The albedo effect	70
2.19	The methane hydrate feedback loop	73
2.20	A feedback loop from warming of soils	73
2.21	Drying of forests and forest fires	74
2.22	Tipping points and feedback loops	74

3	OUR HOUSE IS ON FIRE	83
3.1	Adam Smith's invisible hand is at our throats	83
3.2	Limits to growth and climate change	88
3.3	Exponential growth	91
3.4	The case for economic reform	93
3.5	A human-initiated 6th geological extinction event	96
3.6	Our duty to future generations	97
3.7	The urgent need for renewable energy	99
3.8	The United Nations Climate Summit	107
3.9	Climate change means lifestyle change	108
3.10	Will a disaster wake us up?	110
3.11	Paris, India and coal	111
3.12	The US and Brazil move towards fascism	115
3.13	Climate change denial	122
3.14	The fossil fuel industry's denial campaign	122
3.15	Showing unsustainable lifestyles in mass media	125
3.16	Only 12 years left to limit climate change catastrophe	125
3.17	COP24, the climate summit in Poland	126
3.18	The coal industry's heavy hand at COP24	136
3.19	The 2019 Davos Economic Forum	137
4	POPULATION STABILIZATION TO AVOID FAMINE	147
4.1	Population stabilization today	147
4.2	Why are economists addicted to growth?	149
4.3	Information-driven population growth	150
4.4	Biology and economics	153
4.5	Loss of biodiversity	155
4.6	Economics without growth	158
4.7	China and India	163
4.8	Population projections in Africa	169
4.9	What is the future of megacities?	171
4.10	The threat of a large-scale global famine	173
4.11	Reforming our food and agricultural systems	175
5	THE GREEN NEW DEAL	193
5.1	Alexandria Ocasio-Cortez and the Green New Deal	193
5.2	Roosevelt's original New Deal	202
5.3	Keynesian economics	204
5.4	Reserve indices of non-renewable resources	209
5.5	The transition from growth to a steady state - minimizing the trauma	209
5.6	The transition to a sustainable economy	211
5.7	Population and goods per capita	213
5.8	Entropy and economics	213

6	OVERCOMING INSTITUTIONAL INERTIA	229
6.1	Why don't we act immediately?	229
6.2	Fossil fuel infrastructure	230
6.3	The remarkable properties of exponential growth	232
6.4	Renewable energy is now cheaper than fossil fuels!	233
6.5	Overcoming the inertia of our political institutions	248
6.6	Fascism then and now	250
6.7	Overcoming the inertia of our educational institutions	266
7	OVERCOMING CULTURAL INERTIA	295
7.1	Automobile worship - a false religion	295
7.2	US Evangelicals believe that Trump was sent by God to be King	299
7.3	Religion, culture and tradition	303
7.4	Pope Francis addresses the climate emergency	309
7.5	Education for a culture of peace	317
7.6	Value-creating education: Soka Gakkai	325
7.7	The Eqbal Ahmed Centre For Public Education	328
7.8	Gandhi's message for today's world	332
7.9	We stand on each other's shoulders	338
7.10	The collective human consciousness	340
A	SVANTE ARRHENIUS AND CLIMATE SCIENCE	355
B	HUMANITY UNITED FOR UNIVERSAL DEMILITARIZATION	359
C	THE NUCLEAR AGE PEACE FOUNDATION	365
D	THE IMPORTANCE OF ALTERNATIVE MEDIA	371

Chapter 1

ACCELERATING CHANGE LEADS TO CIVILIZATION'S CRISIS

1.1 Genetic, cultural, and technological evolution

The explosion of human knowledge

Cultural evolution depends on the non-genetic storage, transmission, diffusion and utilization of information. The development of human speech, the invention of writing, the development of paper and printing, and finally in modern times, mass media, computers and the Internet - all these have been crucial steps in society's explosive accumulation of information and knowledge. Human cultural evolution proceeds at a constantly-accelerating speed, so great in fact that it threatens to shake society to pieces.

Every species changes gradually through genetic evolution; but with humans, cultural evolution has rushed ahead with such a speed that it has completely outstripped the slow rate of genetic change. Genetically, we are quite similar to our neolithic ancestors, but their world has been replaced by a world of quantum theory, relativity, supercomputers, antibiotics, genetic engineering and space telescopes; unfortunately, by a world of nuclear weapons and nerve gas too.

Because of the slowness of genetic evolution in comparison to the rapid and constantly-accelerating rate of cultural change, our bodies and emotions (as Malthus put it, the "passions of mankind") are not completely adapted to our new way of life. They still reflect the way of life of our hunter-gatherer ancestors.

Within rapidly-moving cultural evolution, we can observe that technical change now moves with such astonishing rapidity that neither social institutions, nor political structures, nor education, nor public opinion can keep pace. The lightning-like pace of technical progress has made many of our ideas and institutions obsolete. For example, the absolutely sovereign nation-state and the institution of war have both become dangerous anachronisms in an era of instantaneous communication, global interdependence and all-

destroying weapons.

In many respects, human cultural evolution can be regarded as an enormous success. However, at the start of the 21st century, most thoughtful observers agree that civilization is entering a period of crisis. As all curves move exponentially upward - population, production, consumption, rates of scientific discovery, and so on - one can observe signs of increasing environmental stress, while the continued existence and spread of nuclear weapons threaten civilization with destruction. Thus, while the explosive growth of knowledge has brought many benefits, the problem of achieving a stable, peaceful and sustainable world remains serious, challenging and unsolved.

Modern science has, for the first time in history, offered humankind the possibility of a life of comfort, free from hunger and cold, and free from the constant threat of death through infectious disease. At the same time, science has given humans the power to obliterate their civilization with nuclear weapons, or to make the earth uninhabitable through overpopulation and pollution. The question of which of these paths we choose is literally a matter of life or death for ourselves and our children.

Will we use the discoveries of modern science constructively, and thus choose the path leading towards life? Or will we use science to produce more and more lethal weapons, which sooner or later, through a technical or human failure, may result in a catastrophic nuclear war? Will we thoughtlessly destroy our beautiful planet through unlimited growth of population and industry? The choice among these alternatives is ours to make. We live at a critical moment of history - a moment of crisis for civilization.

Measured on the time-scale of genetic evolution, the cultural evolution of our species has been astonishingly rapid. Humans have been living on the earth for roughly two million years (more or less depending on where one draws the line between our human and prehuman ancestors). During almost all of this time, our ancestors lived by hunting and food-gathering. They were not at all numerous, and not conspicuously different from other animals.

Then, suddenly, during the brief space of ten thousand years, our species exploded in numbers from a few million to more than seven billion, populating all parts of the earth, and even setting foot on the moon. Genetically, we are almost identical with our hunter-gatherer ancestors who lived 10,000-40,000 years ago, but cultural evolution has changed our way of life beyond recognition.

During the initial stages of human cultural evolution, the rate of change was slow enough for genetic adaptation to keep pace. The co-evolution of speech, tool use, and an enlarged brain in hominids took place over a period of several million years, and there was ample time for cultural evolution and genetic adaptation to follow each other. The prolonged childhood that characterizes our species, and the behavior patterns of familial and tribal solidarity, were built into the genomes of our ancestors during the era of slow change, when cultural and genetic evolution moved together in equilibrium. However, as the pace of cultural information accumulation quickened, genetic change could no longer keep up.

Genetically we are almost identical with our Neolithic ancestors; but their world has been replaced by a world of quantum theory, relativity, supercomputers, antibiotics, genetic

engineering and space telescopes - unfortunately also a world of nuclear weapons and nerve-gas. Because of the slowness of genetic evolution in comparison to the rapid and constantly-accelerating rate of cultural change, our bodies and emotions are not adapted to our new way of life. They still reflect the way of life of our hunter-gatherer ancestors.

In addition to the contrast between the slow pace of genetic evolution when compared with the rapid and constantly accelerating rate of cultural evolution, we can also notice a contrast between rapidly- and slowly-moving aspects of cultural change: Social institutions and structures seem to change slowly when compared with the lightning-like pace of scientific and technological innovation. Thus, tensions and instability characterize information-driven society, not only because the human nature we have inherited from our ancient ancestors is not appropriate to our present way of life, but also because science and technology change so much more rapidly than institutions, laws, and attitudes.

Space-age science and stone-age politics make an extraordinarily dangerous mixture. It seems probable that in the future, the rapidity of scientific and technological change will produce ethical dilemmas and social tensions even more acute than those we experience today. It is likely that the fate of our species (and the fate of the biosphere) will be made precarious by the astonishing speed of scientific and technological change unless this progress is matched by the achievement of far greater ethical and political maturity than we have yet attained.

Science has proved to be double-edged - capable of great good, but also of great harm. Information-driven human cultural evolution is a spectacular success - but can it become stable? Terrestrial life can look back on almost four billion years of unbroken evolutionary progress. Can we say with confidence that an equal period stretches ahead of us?

Population cannot continue to increase, because we are rapidly approaching the limits of the earth's carrying capacity. Will human numbers overshoot these limits and afterwards crash disastrously? There is certainly a danger that this will happen.

Besides the challenge of stabilizing global population, the information-driven human society of the future will face another daunting task: Because of the enormously destructive weapons that have already been produced through the misuse of science, and because of the even worse weapons that may be invented in the future, the long-term survival of civilization can only be insured if society is able to eliminate the institution of war. This task will be made more difficult by the fact that human nature seems to contain an element of tribalism.

Humans tend to show great kindness towards close relatives and members of their own group, and are even willing to sacrifice their lives in battle in defense of their own family, tribe or nation. This tribal altruism is often accompanied by inter-tribal aggression - great cruelty towards the "enemy", i.e. towards members of a foreign group that is perceived to be threatening ones own. The fact that human nature seems to contain a tendency towards tribalism is the reason why we find football matches entertaining, and the reason why Arthur Koestler once remarked: "We can control the movements of a space-craft orbiting about a distant planet, but we cannot control the situation in Northern Ireland." In the words of the Spanish writer, Ortega y Gasset, "We live at a time when man, lord of all things, is not lord of himself"



Figure 1.1: **Space-age science and stone-age politics make an extraordinarily dangerous mixture**

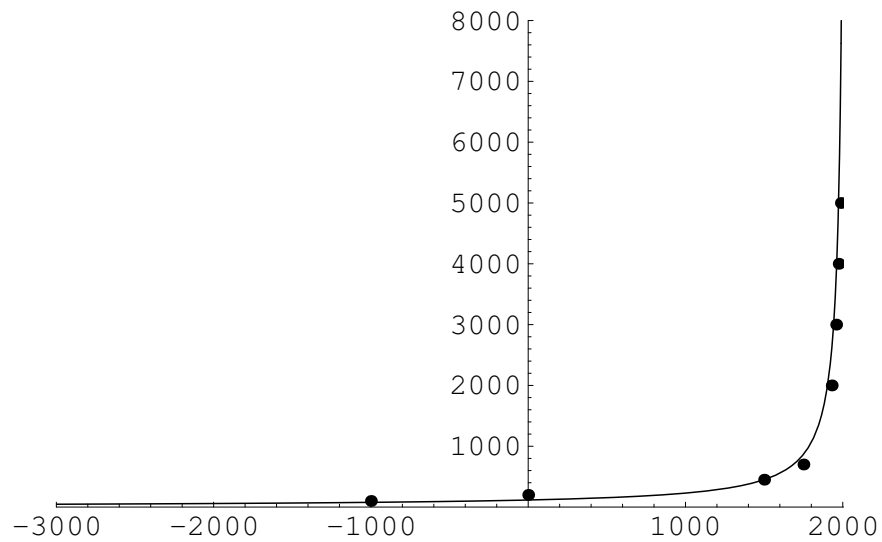


Figure 1.2: Starting with the Neolithic agricultural revolution and the invention of writing, human culture began to develop with explosive speed. This figure shows the estimated human population as a function of time during the last 4,000 years. The dots are population estimates in millions, while the solid curve is the hyperbola $p = c/(2020 - y)$, where p is the global human population, y is the year and $c = 234000$. The curve reflects an explosively accelerating accumulation of information. Culturally transmitted techniques of agriculture allowed a much greater density of population than was possible for hunter-gatherers. The growth of population was further accelerated by the invention of printing and by the industrial and scientific developments which followed from this invention.

How could evolutionary forces have acted to make the pattern of tribal altruism and inter-tribal aggression a part of human nature? To put the same question differently, how could our ancestors have increased the chances for survival of their own genes by dying in battle in defense of their tribe? The statistician R.A. Fisher and the evolutionary biologist J.B.S. Haldane considered this question in the 1930's, and more recently it has also been discussed by W.D. Hamilton. Their solution was the concept of population genetics, in which the genetically homogeneous group as a whole - now sometimes called the "deme" - is taken to be the unit upon which evolutionary forces act.

Haldane and Fisher postulated that the small tribes in which our ancestors lived were genetically homogeneous, since marriage within the tribe was more probable than marriage outside it. This being the case, a patriotic individual who died for the tribe, killing many members of a competing tribe in the process, increased the chance of survival for his or her own genes, which were carried into the future by the surviving members of the "hero's" group. The tribe as a whole either lived or died; and those with the best "team spirit" survived most frequently.

Because of the extraordinarily bitter and cruel conflicts between ethnic groups which can be found in both ancient and modern history, it is necessary to take this hypothesis seriously. This does not mean that the elimination of the institution of war is impossible, but it means that the task will require the full resources and full cooperation of the world's educational systems, religions, and mass media. Human behavior is determined by an interaction between biological inheritance and the cultural and social context in which we are brought up. It will be necessary to educate children throughout the world in such a way that they will think of humanity as a single group - a large family to which all humans belong, and to which all owe their ultimate loyalty.

In addition to educational reform, and reform of the images presented by the mass media, the elimination of war will require the construction of a democratic, just, and humane system of international governance, whose laws will act on individuals rather than on states. The problems involved are difficult, but they *must* be solved if the information-driven society of the future is to achieve stability.

No one living today asked to be born at a moment of crisis for human civilization, but in fact history has given us an enormous responsibility, and two daunting tasks: If civilization is to survive, we must not only stabilize the global population but also, even more importantly, we must eliminate the institution of war. We face these daunting tasks with an inherited emotional nature that has not changed much during the last 40,000 years. Furthermore, we face the challenges of the 21st century with an international political system based on the anachronistic concept of the absolutely sovereign nation-state. However, the human brain has shown itself to be capable of solving even the most profound and complex problems. The mind that has seen into the heart of the atom must not fail when confronted with paradoxes of the human heart.

The problem of building a stable, just, and war-free world is difficult, but it is not impossible. The large regions of our present-day world within which war has been eliminated can serve as models. There are a number of large countries with heterogeneous populations (for example Argentina, Brazil, the United States, China and India) within which it has



Figure 1.3: **On our shrunken globe today, there is room for one group only - the family of humankind.**

been possible to achieve internal peace and social cohesion, and if this is possible within such extremely large regions, it must also be possible globally.

We must replace the old world of international anarchy, chronic war and institutionalized injustice, by a new world of law. The United Nations Charter, the Universal Declaration of Human Rights and the International Criminal Court are steps in the right direction, but these institutions need to be greatly strengthened and reformed. One of the goals of this book is to discuss in detail the reforms that are needed, using knowledge gained from the experiences of successful federations, past and present.

We also need a new global ethic, where loyalty to one's family and nation will be supplemented by a higher loyalty to humanity as a whole.

1.2 The threat of an ecological megacatastrophe

Why is climate change an emergency?

Quick change is needed to save the long-term future.

The central problem which the world faces in its attempts to avoid catastrophic climate change is a contrast of time scales. In order to save human civilization and the biosphere from the most catastrophic effects of climate change we need to act immediately, Fossil fuels must be left in the ground. Forests must be saved from destruction by beef or palm oil production.

These vitally necessary actions are opposed by powerful economic interests, by powerful fossil fuel corporations desperate to monetize their underground "assets", and by corrupt

politicians receiving money from the beef or palm oil industries.

However, although some disastrous effects climate change are already visible, the worst of these calamities lie in the distant future. Therefore it is difficult to mobilize the political will for quick action. We need to act immediately, because of the danger of passing tipping points beyond which climate change will become irreversible despite human efforts to control it.

Tipping points are associated with feedback loops, such as the albedo effect and the methane hydrate feedback loop. The albedo effect is important in connection with whether the sunlight falling on polar seas is reflected or absorbed. While ice remains, most of the sunlight is reflected, but as areas of sea surface become ice-free, more sunlight is absorbed, leading to rising temperatures and further melting of sea ice, and so on, in a loop.

The methane hydrate feedback loop involves vast quantities of the powerful greenhouse gas methane, CH_4 , frozen in a crystalline form surrounded by water molecules. 10,000 gigatons of methane hydrates are at present locked in Arctic tundra or the continental shelves of the world's oceans. Although oceans warm very slowly because of thermal inertia, the long-term dangers from the initiation of a methane-hydrate feedback loop are very great. There is a danger that a very large-scale anthropogenic extinction event could be initiated unless immediate steps are taken to drastically reduce the release of greenhouse gases.

Scientists have long been aware of the dangers

Scientists have long been aware that CO_2 and other greenhouse gases released into the earth's atmosphere through human activities can cause dangerous climate change. László Szombatfalvy's important book, "The Greatest Challenges of Our Time", (Ekerlids, 2010), gives the following history of our knowledge of the link between greenhouse gases and climate change:

"As far back as 100 years ago, Swedish scientists observed that human activities could affect the climate. Arvid Högbom, professor of geology in Stockholm, warned in 1895 that anthracite burning would increase carbon dioxide content in the air. The following year, Svante Arrhenius, professor of physics and Nobel Prize Laureate, estimated that doubling of the content of carbon dioxide in the atmosphere would lead to an increase of the earth's average temperature by 5-6 degrees C. However, with the low emissions at that time, the process would take several thousand years.

"In 1938, measurements by Guy S. Callendar, an English researcher, confirmed theories that the amount of carbon dioxide in the atmosphere had actually increased since the previous century. His report made little impact since attention at that time was focused on the outbreak of World War II.

"During the 1950s and 1960s, several research reports were published supporting Svante Arrhenius's calculation of carbon dioxide emissions' warming effects. But the time perspective in these reports has been reduced considerably.

"In the 1970s, it was discovered that emissions of several other greenhouse gases from human activities heightened carbon dioxide's effects.



Figure 1.4: The continued extraction and burning of fossil fuels threatens the earth with an ecological megacatastrophe.



Figure 1.5: Fifteen-year-old Swedish climate activist Greta Thunberg spoke eloquently to the opening session of COP24, the United Nations Climate meeting in Poland

“In 1988, the International Panel on Climate Control, IPCC, was organized. Every fourth or fifth year since 1990, the IPCC has published climate change reports that are increasingly more extensive and ominous.

“In December 1997, the first international agreement to limit emissions of greenhouse gases was signed in Japan. Known as the Kyoto Protocol, the agreement’s goal is that industrialized nations reduce emissions of greenhouse gases by 5.2 percent by 2012, compared with 1990 levels. The Protocol has been hitherto ratified by 176 countries, but unfortunately not by the most important country in this matter: USA.”

More recently, on December 12, 2015, the Paris Agreement was adopted by consensus by the 196 parties of the United Nations Framework Convention on Climate Change. As of June, 2017, 195 UNFCCC members have signed the Agreement, and 153 nations have ratified it.

The Paris Agreement aims at “Holding the increase in the global average temperature to well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change.”

Stabilizing global population

One hopes that human wisdom and ethics will continue to grow, but indefinite growth of population and industry on a finite earth is a logical impossibility.

Today we are pressing against the absolute limits of the earth’s carrying capacity. There

are many indications that the explosively increasing global population of humans, and the growth of pollution-producing and resource-using industries are threatening our earth with an environmental disaster. Among the serious threats that we face are catastrophic anthropogenic climate change, extinction of species, and a severe global famine, perhaps involving billions of people rather than millions. Such a famine may occur by the middle of the present century when the end of the fossil fuel era, combined with the effects of climate change reduce our ability to support a growing population.

Experts agree that the following steps are needed if we are to avoid a catastrophic global famine and a population crash:

1. Higher education and higher status for women throughout the world. Women need higher education to qualify for jobs outside their homes. They need higher status within their families so they will not be forced into the role of baby-producing machines.
2. Primary health care for all. Children should be vaccinated against preventable diseases. Materials and information for family planning should be provided for all women who desire smaller families. Advice should be given on improving sanitation.
3. The provision of clean water supplies near to homes is needed in order to reduce the incidence of water-borne diseases. In some countries today, family members, including children, spend large amounts of time carrying water home from distant sources.
4. State provision of care for the elderly is a population-stabilization measure because in many countries, parents produce many children so that the children will provide for them in their old age.
5. In many countries child labor is common, and in some there is even child slavery. Parents who regard their children as a source of income are motivated to produce large families. Enforceable laws against child labor and slavery contribute to population stabilization.
6. General economic progress has been observed to contribute to population stabilization. However in some countries there is a danger of population growing so rapidly that it prevents the economic progress that would otherwise have stabilized population. This situation is known as the demographic trap.
7. Forced marriage should be forbidden, and very early marriage discouraged.

The battle for birth control

Thomas Robert Malthus' *Essay on The Principle of Population*, the first edition of which was published in 1798, was one of the the first systematic studies of the problem of population in relation to resources. Earlier discussions of the problem had been published by Botero in Italy, Robert Wallace in England, and Benjamin Franklin in America. However Malthus' *Essay* was the first to stress the fact that, in general, powerful checks operate continuously to keep human populations from increasing beyond their available food supply.

In a later edition, published in 1803, he buttressed this assertion with carefully collected demographic and sociological data from many societies at various periods of their histories.

Malthus considered birth control to be a form of vice, and as “preventive checks” to excessive population growth he instead recommended celibacy, late marriage and “moral restraint” within marriage. Had he been writing today, Malthus would undoubtedly have agreed that birth control is the most humane method of avoiding the grim “positive checks” that prevent populations from exceeding their supply of food - famine, disease and war.

The battle for birth control was not easily won. Part of the opposition to contraceptive methods came from industrialists who were happy to have an excess supply of workers to whom they could pay starvation wages.

Achieving a sustainable and peaceful global society

Here are some of the reforms that will be needed:

1. We must achieve a steady-state economic system.
2. We must restore democracy in our own countries whenever it has been replaced by oligarchy.
3. We must decrease economic inequality both between nations and within nations.
4. We must break the power of corporate greed. Economics must be given both a social conscience and an ecological conscience.
5. We must leave fossil fuels in the ground.
6. We must stabilize and ultimately reduce the global population to a level that can be supported by sustainable agriculture after the end of the fossil fuel era.
7. We must stop using material goods for social competition. This will be necessary in order to reduce per-capita consumption.
8. We must eliminate the institution of war. Thermonuclear weapons have made war prohibitively dangerous.
9. We must build a new global ethical system built on the concept of a universal human family.

1.3 Space-age science and stone-age politics

Tribal emotions and nationalism

In discussing conflicts, we must be very careful to distinguish between two distinct types of aggression exhibited by both humans and animals. The first is intra-group aggression, which is often seen in rank-determining struggles, for example, when two wolves fight for pack leadership, or when males fight for the privilege of mating with females. Another completely different type of aggression is seen when a group is threatened by outsiders. Most animals, including humans, then exhibit a communal defense response - self-sacrificing and heroic combat against whatever is perceived to be an external threat. It is this second type of aggression that makes war possible.



Figure 1.6: **We have seen on the screen the radiant love of the Führer on the faces of the Hitler Youth...**

Arthur Koestler has described inter-group aggression in an essay entitled *The Urge to Self-Destruction*, where he writes:

“Even a cursory glance at history should convince one that individual crimes, committed for selfish motives, play a quite insignificant role in the human tragedy compared with the numbers massacred in unselfish love of one’s tribe, nation, dynasty, church or ideology... Wars are not fought for personal gain, but out of loyalty and devotion to king, country or cause...

“We have seen on the screen the radiant love of the Führer on the faces of the Hitler Youth... They are transfixed with love, like monks in ecstasy on religious paintings. The sound of the nation’s anthem, the sight of its proud flag, make you feel part of a wonderfully loving community. The fanatic is prepared to lay down his life for the object of his worship, as the lover is prepared to die for his idol. He is, alas, also prepared to kill anybody who represents a supposed threat to the idol.”

Members of tribe-like groups are bound together by strong bonds of altruism and loyalty. Echoes of these bonds can be seen in present-day family groups, in team sports, in the fellowship of religious congregations, and in the bonds that link soldiers to their army comrades and to their nation.

Warfare involves not only a high degree of aggression, but also an extremely high degree of altruism. Soldiers kill, but they also sacrifice their own lives. Thus, patriotism and duty are as essential to war as the willingness to kill.

Tribalism involves passionate attachment to one’s own group, self-sacrifice for the sake of the group, willingness both to die and to kill if necessary to defend the group from its enemies, and belief that in case of a conflict, one’s own group is always in the right. Unfortunately these emotions make war possible; and today a Third World War might lead

to the destruction of civilization.

The mystery of self-sacrifice in war

At first sight, the willingness of humans to die defending their social groups seems hard to explain from the standpoint of Darwinian natural selection. After the heroic death of such a human, he or she will be unable to produce more children, or to care for those already born. Therefore, one might at first suppose that natural selection would work strongly to eliminate the trait of self-sacrifice from human nature. However, the theory of population genetics and group selection can explain both the willingness of humans to sacrifice themselves for their own group, and also the terrible aggression that they sometimes exhibit towards competing groups. It can explain both intra-group altruism and inter-group aggression.

Fischer, Haldane, Hamilton and Wilson

The idea of group selection in evolution was proposed in the 1930s by J.B.S. Haldane and R.A. Fischer, and more recently it has been discussed by W.D. Hamilton and E.O. Wilson.

If we examine altruism and aggression in humans, we notice that members of our species exhibit great altruism towards their own children. Kindness towards close relatives is also characteristic of human behavior, and the closer the biological relationship is between two humans, the greater is the altruism they tend to show towards each other. This profile of altruism is easy to explain on the basis of Darwinian natural selection since two closely related individuals share many genes and, if they cooperate, the genes will be more effectively propagated.

To explain the communal defense mechanism from an evolutionary point of view,- the willingness of humans to kill and be killed in defense of their communities - we have only to imagine that our ancestors lived in small tribes and that marriage was likely to take place within a tribe rather than across tribal boundaries. Under these circumstances, each tribe would tend to consist of genetically similar individuals. The tribe itself, rather than the individual, would be the unit on which the evolutionary forces of natural selection would act.

According to the group selection model, a tribe whose members showed altruism towards each other would be more likely to survive than a tribe whose members cooperated less effectively. Since several tribes might be in competition for the same territory, successful aggression against a neighboring group could increase the chances for survival of one's own tribe. Thus, on the basis of the group selection model, one would expect humans to be kind and cooperative towards members of their own group, but at the same time to sometimes exhibit aggression towards members of other groups, especially in conflicts over territory. One would also expect intergroup conflicts to be most severe in cases where the boundaries between groups are sharpest - where marriage is forbidden across the boundaries.

Language, Religion and Tribal Markings

In biology, a species is defined as a group of mutually fertile organisms. Thus, all humans form a single species, since mixed marriages between all known races will produce children, and subsequent generations in mixed marriages are also fertile. However, although there is never a biological barrier to marriages across ethnic and racial boundaries, there are often very severe cultural barriers.

Irenäus Eibel-Eibesfeldt, a student of Konrad Lorenz, introduced the word “pseudospeciation” to denote cases where cultural barriers between two groups of humans are so strongly marked that marriages across the boundary are difficult and infrequent.

In such cases, he pointed out, the two groups function as though they were separate species, although from a biological standpoint this is nonsense. When two such groups are competing for the same land, the same water, the same resources, and the same jobs, the conflicts between them can become very bitter indeed. Each group regards the other as being “not truly human”.

In his book *The Biology of War and Peace*, Eibel-Eibesfeldt discusses the “tribal markings” used by groups of humans to underline their own identity and to clearly mark the boundary between themselves and other groups. One of the illustrations in his book shows the marks left by ritual scarification on the faces of the members of certain African tribes. These scars would be hard to counterfeit, and they help to establish and strengthen tribal identity. Seeing a photograph of the marks left by ritual scarification on the faces of African tribesmen, it is impossible not to be reminded of the dueling scars that Prussian army officers once used to distinguish their caste from outsiders.

Surveying the human scene, one can find endless examples of signs that mark the bearer as a member of a particular group - signs that can be thought of as “tribal markings”: tattoos; piercing; bones through the nose or ears; elongated necks or ears; filed teeth; Chinese binding of feet; circumcision, both male and female; unique hair styles; decorations of the tongue, nose, or naval; peculiarities of dress, kilts, tartans, school ties, veils, chadors, and headdresses; caste markings in India; use or nonuse of perfumes; codes of honor and value systems; traditions of hospitality and manners; peculiarities of diet (certain foods forbidden, others preferred); giving traditional names to children; knowledge of dances and songs; knowledge of recipes; knowledge of common stories, literature, myths, poetry or common history; festivals, ceremonies, and rituals; burial customs, treatment of the dead and ancestor worship; methods of building and decorating homes; games and sports peculiar to a culture; relationship to animals, knowledge of horses and ability to ride; non-rational systems of belief. Even a baseball hat worn backwards or the professed ability to enjoy atonal music can mark a person as a member of a special “tribe”.

By far, the most important mark of ethnic identity is language, and within a particular language, dialect and accent. If the only purpose of language were communication, it would be logical for the people of a small country like Denmark to stop speaking Danish and go over to a more universally-understood international language such as English. However, language has another function in addition to communication: it is also a mark of identity. It establishes the boundary of the group.

After language, the most important “tribal marking” is religion. It seems probable that in the early history of our hunter-gatherer ancestors, religion evolved as a mechanism for perpetuating tribal traditions and culture. Like language, and like the innate facial expressions studied by Darwin, religion is a universal characteristic of all human societies. All known races and cultures practice some sort of religion. Thus, a tendency to be religious seems to be built into human nature.

Formation of Group Identity

Although humans originally lived in small, genetically homogeneous tribes, the social and political groups of the modern world are much larger, and are often multiracial and multiethnic.

There are a number of large countries that are remarkable for their diversity, for example, Brazil, Argentina and the United States. Nevertheless, it has been possible to establish social cohesion and group identity within each of these enormous nations. India and China too, are mosaics of diverse peoples, but nevertheless, they function as coherent societies. Thus, we see that group identity is a social construction, in which artificial “tribal markings” define the boundaries of the group.

As an example of the use of tribal markings to establish social cohesion over a large group of genetically dissimilar humans, one can think of the role of baseball and football in the United States. Affection for these sports and knowledge of their intricacies establish social bonds that transcend racial and religious barriers.

One gains hope for the future by observing how it has been possible to produce both internal peace and social cohesion over very large areas of the globe - areas that contain extremely diverse populations. The difference between making large, ethnically diverse countries function as coherent sociopolitical units and making the entire world function as a unit is not very great.

Since group identity is a social construction, it is not an impossible goal to think of enlarging the already-large groups of the modern world to include all of humanity.

1.4 The threat of widespread global famine

The threat of a large-scale global famine by the middle of the 21st century

Unless efforts are made to stabilize and ultimately reduce global population, there is a serious threat that climate change, population growth, and the end of the fossil fuel era could combine to produce a large-scale famine by the middle of the 21st century.

As glaciers melt in the Himalayas and the Andes, depriving India, China and South America of summer water supplies; as sea levels rise, drowning fertile rice-growing regions of Southeast Asia; as droughts reduce the food production of North America and Southern Europe; as groundwater levels fall in China, India, the Middle East and the United States;



Figure 1.7: **Unless efforts are made to stabilize and ultimately reduce global population, there is a serious threat that climate change, population growth, and the end of the fossil fuel era could combine to produce a large-scale famine by the middle of the 21st century.**

and as high-yield modern agriculture becomes less possible because fossil fuel inputs are lacking, the 800 million people who are currently undernourished may not survive at all.

Energy inputs of agriculture

Modern agriculture has become highly dependent on fossil fuels, especially on petroleum and natural gas. This is especially true of production of the high-yield grain varieties introduced in the Green Revolution, since these require especially large inputs of fertilizers, pesticides and irrigation. Today, fertilizers are produced using oil and natural gas, while pesticides are synthesized from petroleum feedstocks, and irrigation is driven by fossil fuel energy. Thus agriculture in the developed countries has become a process where inputs of fossil fuel energy are converted into food calories.

Predictions of drought in the Stern Review

According to a report presented to the Oxford Institute of Economic Policy by Sir Nicholas Stern on 31 January, 2006, areas likely to lose up to 30% of their rainfall by the 2050's because of climate change include much of the United States, Brazil, the Mediterranean region, Eastern Russia and Belarus, the Middle East, Southern Africa and Southern Australia. Meanwhile rainfall is predicted to increase up to 30% in Central Africa, Pakistan, India, Bangladesh, Siberia, and much of China.

Stern and his team point out that “We can... expect to see changes in the Indian monsoon, which could have a huge impact on the lives of hundreds of millions of people in India, Pakistan and Bangladesh. Most climate models suggest that the monsoon will change, although there is still uncertainty about exactly how. Nevertheless, small changes in the monsoon could have a huge impact. Today, a fluctuation of just 10% in either direction from average monsoon rainfall is known to cause either severe flooding or drought. A weak summer monsoon, for example, can lead to poor harvests and food shortages among the rural population - two-thirds of India’s almost 1.1 billion people. Heavier-than-usual monsoon downpours can also have devastating consequences...”

In some regions, melting of glaciers can be serious from the standpoint of dry-season water supplies. For example, melts from glaciers in the Hindu Kush and the Himalayas now supply much of Asia, including China and India, with a dry-season water supply. Complete melting of these glacial systems would cause an exaggerated runoff for a few decades, after which there would be a drying out of some of the most densely populated regions of the world.

Ocean current changes and failure of monsoons

It is expected that climate change will affect ocean currents, and hence also affect monsoon rainfall. We are already experiencing a diversion of the Gulf Stream due to southward currents of cold water from melting ice in the Arctic. This has caused what is known as the *North Atlantic Anomaly*. While most regions of the world are experiencing rising temperatures, the North Atlantic and several northern European countries are exceptions to this rule, and have cooled. Complete failure of the Gulf Stream would lead to much colder temperatures in Europe.

Changes in ocean currents have already lead to the failure of the West African Monsoon, and this has already produced severe food insecurity in West Africa.

In the future, climate-changed ocean currents may lead to failures of monsoons in South-east Asia, and thus damage the food supply of almost two billion people.

Falling water tables around the world

Under many desert areas of the world are deeply buried water tables formed during glacial periods when the climate of these regions was wetter. These regions include the Middle East and large parts of Africa. Water can be withdrawn from such ancient reservoirs by deep wells and pumping, but only for a limited amount of time.

In oil-rich Saudi Arabia, petroenergy is used to drill wells for ancient water and to bring it to the surface. Much of this water is used to irrigate wheat fields, and this is done to such an extent that Saudi Arabia exports wheat. The country is, in effect, exporting its ancient heritage of water, a policy that it may, in time, regret. A similarly short-sighted project is Muammar Qaddafi’s enormous pipeline, which will bring water from ancient sub-desert reservoirs to coastal cities.

In the United States, the great Ogallala aquifer is being overdrawn. This aquifer is an enormous stratum of water-saturated sand and gravel under-lying parts of northern Texas, Oklahoma, New Mexico, Kansas, Colorado, Nebraska, Wyoming and South Dakota. The average thickness of the aquifer is about 70 meters. The rate of water withdrawal from the aquifer exceeds the rate of recharge by a factor of eight.

Thus we can see that in many regions, the earth's present population is living on its inheritance of water, rather than its income. This fact, coupled with rapidly increasing populations and climate change, may contribute to a very serious food crisis partway through the 21st century.

1.5 Civilization's crisis: A set of linked challenges

The threats and challenges facing the world today are not independent but linked. Let us first list them, and then explore the links.

- **THREATS TO THE ENVIRONMENT:** The global environment is being destroyed by excessive consumption in the industrialized countries, combined with rapid population growth in developing nations. Climate change threatens to melt glaciers and polar ice. Complete melting of Greenland's inland ice would result in a 7 meter rise in sea level. Complete melting of the Antarctic ice cap would produce an additional 5 meters of rise.
- **GROWING POPULATION, VANISHING RESOURCES:** The fossil fuel era is ending. In order to avoid catastrophic climate change, we urgently need to leave fossil fuels in the ground. But even if this were not so the fossil fuel era would end because of finite resources. By 2050, oil and natural gas will be prohibitively expensive. They will no longer be used as fuels, but will be reserved as feedstocks for chemical synthesis. Within a hundred years, the same will be true of coal. The reserve indices for many metals are between 10 and 100 years. Reserve indices are defined as the size of the known reserves of metals divided by the current annual rates of production.
- **THE GLOBAL FOOD CRISIS:** It is predicted that by 2050, the world's population of humans will reach 9 billion. This is just the moment when the oil and natural gas, on which modern energy-intensive agriculture depend, will become so expensive that they will no longer be used as fuels. Climate change may also contribute to a global food crisis. Melting of Himalayan glaciers threatens the summer water supplies of both India and China. Rising sea levels threaten to inundate low-lying agricultural land, and aridity produced by climate change may reduce grain harvests. Furthermore, aquifers throughout the world are being introduced overdrawn, and water tables are falling. Topsoil is also being lost. These elements combine to produce a threat of widespread famine by the middle of the 21st Century.

- **INTOLERABLE ECONOMIC INEQUALITY:** Today 2.7 billion people live on less than \$2 a day - 1.1 billion on less than \$1 per day. 18 million of our fellow humans die each year from poverty-related causes. Meanwhile, obesity is becoming a serious health problem in the rich part of the world. In 2006, 1.1 billion people lacked safe drinking water, and waterborne diseases killed an estimated 1.8 million people. The developing countries are also the scene of a resurgence of other infectious diseases, such as malaria, drug-resistant tuberculosis and HIV/AIDS.
- **THE THREAT OF NUCLEAR WAR:** Despite the end of the Cold War, the threat of a nuclear catastrophe remains severe. During the Cold War, the number and power of nuclear weapons reached insane heights - 50,000 nuclear weapons with a total explosive power equivalent to roughly a million Hiroshima bombs. Expressed differently, the total explosive power was equivalent to 20 billion tons of TNT, 4 tons for each person on earth. Today the total number of these weapons has been cut to approximately 15,000, but there are still enough to destroy human civilization many times over. The danger of accidental nuclear war remains severe, since many nuclear missiles are on hair-trigger alert, ready to be fired within minutes of a warning being received. Continued over a long period of time, the threat of accident will grow to a near certainty. Meanwhile, the number of nations possessing nuclear weapons is growing, and there is a danger that if an unstable government is overthrown (for example, Pakistan's), the country's nuclear weapons will fall into the hands of subnational groups. Against nuclear terrorism there is no effective defense.
- **THE MILITARY-INDUSTRIAL COMPLEX:** In 2018, world military budgets reached a total of 1.7 trillion dollars (i.e. 1.7 million million dollars). This amount of money is almost too large to be imagined. The fact that it is being spent means that many people are making a living from the institution of war. Wealthy and powerful lobbies from the military-industrial complex are able to influence mass media and governments. Thus the institution of war persists, although we know very well that it is a threat to civilization and that it is responsible for much of the suffering that humans experience.
- **LIMITS TO GROWTH:** A "healthy" economic growth rate of 4% per year corresponds to an increase by a factor of 50 in a century, by a factor of 2,500 in two centuries and 125,000 in three centuries. No one can maintain that resource-using, waste-producing economic activities can continue to grow except by refusing to look more than a certain distance into the future. It seems likely that the boundaries for certain types of growth will be reached during the 21st century. (Culture can of course continue to grow.) We face a difficult period of transition from an economy that depends on growth for its health to a new economic system: steady-state economics.

The problems just mentioned are difficult and serious, but they all have solutions. We can try to show how the challenges facing civilization are interlinked and thus to throw

some light on the remedies.

Present global economic problems should be seen as an advance warning of the limits to growth that will be reached by the middle of the 21st century. They offer an opportunity to take steps towards ecological sustainability and towards an economic system that does not depend on growth for its health - a steady-state economic system.

As the world economy reaches the limits of growth for resource-using activities, unemployment will become a threat; but public health work, re-forestation, soil conservation, windmill construction, hydrogen technology research, and construction of energy-conserving buildings are all labor-intensive activities that will help to prevent unemployment while at the same time aiding the transition to sustainability.

Poverty causes overpopulation, and overpopulation causes poverty; war causes poverty, and poverty causes war; poverty causes disease, and disease causes poverty.

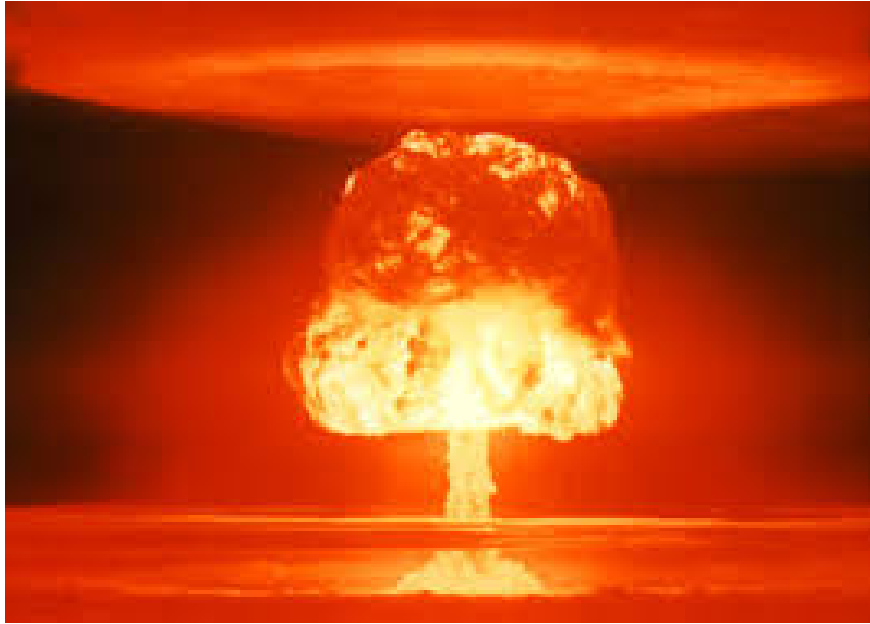
There is a reciprocal relationship between intolerable economic inequality and war. Military might is used by powerful industrialized nations to maintain economic hegemony over less developed countries. This is true today, even though the colonial era is supposed to be over (as has been amply documented by Professor Michael Klare in his books on "Resource Wars").

But, conversely, intolerable economic inequality is also a cause of war: Abolition of the institution of war will require the replacement of "might makes right" by the rule of international law. It will require development of effective global governance. But reform and strengthening of the United Nations is blocked by wealthy countries because they are afraid of losing their privileged positions. If global economic inequality were less enormous, the problem of unifying the world would be simplified.

Today's military spending of almost two trillion US dollars per year would be more than enough to finance safe drinking water for the entire world, and to bring primary health care and family planning advice to all. If used constructively, the money now wasted (or worse than wasted) on the institution of war could also help the world to make the transition from fossil fuel use to renewable energy systems.

The dangers of nuclear weapons are also linked to the problem of climate change because of the widespread (but false) belief that civilian nuclear power generation is carbon neutral. On the basis of this false premise, it is argued that nuclear power is an answer to the threat of global warming. But because it is almost impossible to distinguish between civilian and military nuclear programs, the widespread use of nuclear power throughout the world would carry with it serious dangers of nuclear proliferation.

Since the challenges and threats facing the world today are linked, we must adopt a holistic approach in solving them. We must also find ways of overcoming the barriers posed by institutional and cultural inertia.



Chad Crowe





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).

Chapter 2

THE CLIMATE EMERGENCY

2.1 Why is climate change an emergency?

Quick change is needed to save the long-term future.

The central problem which the world faces in its attempts to avoid catastrophic climate change is a contrast of time scales. In order to save human civilization and the biosphere from the most catastrophic effects of climate change we need to act immediately, Fossil fuels must be left in the ground. Forests must be saved from destruction by beef or palm oil production.

These vitally necessary actions are opposed by powerful economic interests, by powerful fossil fuel corporations desperate to monetize their underground “assets”, and by corrupt politicians receiving money the beef or palm oil industries.

However, although some disastrous effects climate change are already visible, the worst of these calamities lie in the distant future. Therefore it is difficult to mobilize the political will for quick action. We need to act immediately, because of the danger of passing tipping points beyond which climate change will become irreversible despite human efforts to control it.

Tipping points are associated with feedback loops, such as the albedo effect and the methane hydrate feedback loop. The albedo effect is important in connection with whether the sunlight falling on polar seas is reflected or absorbed. While ice remains, most of the sunlight is reflected, but as areas of sea surface become ice-free, more sunlight is absorbed, leading to rising temperatures and further melting of sea ice, and so on, in a loop.

The methane hydrate feedback loop involves vast quantities of the powerful greenhouse gas methane, CH_4 , frozen in a crystalline form surrounded by water molecules. 10,000 gigatons of methane hydrates are at present locked in Arctic tundra or the continental shelves of the world’s oceans. Although oceans warm very slowly because of thermal inertia, the long-term dangers from the initiation of a methane-hydrate feedback loop are very great. There is a danger that a very large-scale anthropogenic extinction event could be initiated unless immediate steps are taken to drastically reduce the release of greenhouse gases.

2.2 Scientists have long been aware of the dangers

Scientists have long been aware that CO₂ and other greenhouse gases released into the earth's atmosphere through human activities can cause dangerous climate change. László Szombatfalvy's important book, "The Greatest Challenges of Our Time", (Ekerlids, 2010), gives the following history of our knowledge of the link between greenhouse gases and climate change:

"As far back as 100 years ago, Swedish scientists observed that human activities could affect the climate. Arvid Högbom, professor of geology in Stockholm, warned in 1895 that anthracite burning would increase carbon dioxide content in the air. The following year, Svante Arrhenius, professor of physics and Nobel Prize Laureate, estimated that doubling of the content of carbon dioxide in the atmosphere would lead to an increase of the earth's average temperature by 5-6 degrees C. However, with the low emissions at that time, the process would take several thousand years.

"In 1938, measurements by Guy S. Callendar, an English researcher, confirmed theories that the amount of carbon dioxide in the atmosphere had actually increased since the previous century. His report made little impact since attention at that time was focused on the outbreak of World War II.

"During the 1950s and 1960s, several research reports were published supporting Svante Arrhenius's calculation of carbon dioxide emissions' warming effects. But the time perspective in these reports has been reduced considerably.

"In the 1970s, it was discovered that emissions of several other greenhouse gases from human activities heightened carbon dioxide's effects.

"In 1988, the International Panel on Climate Control, IPCC, was organized. Every fourth or fifth year since 1990, the IPCC has published climate change reports that are increasingly more extensive and ominous.

"In December 1997, the first international agreement to limit emissions of greenhouse gases was signed in Japan. Known as the Kyoto Protocol, the agreement's goal is that industrialized nations reduce emissions of greenhouse gases by 5.2 percent by 2012, compared with 1990 levels. The Protocol has been hitherto ratified by 176 countries, but unfortunately not by the most important country in this matter: USA."

More recently, on December 12, 2015, the Paris Agreement was adopted by consensus by the 196 parties of the United Nations Framework Convention on Climate Change. As of June, 2017, 195 UNFCCC members have signed the Agreement, and 153 nations have ratified it.

The Paris Agreement aims at "Holding the increase in the global average temperature to well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change."

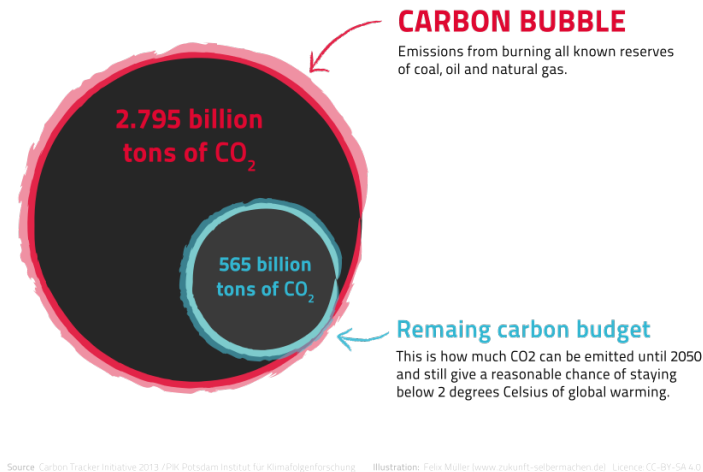


Figure 2.1: **The Carbon Bubble according to data by the Carbon Tracker Initiative 2013. In order to avoid tipping points that will make human attempts to avoid catastrophic climate change useless, we must leave most of the known fossil fuel reserves in the ground!**

2.3 Quick action is needed to save the long-term future

The worst effects of catastrophic climate change lie in the distant future, a century or even many centuries from the present; but disaster can only be avoided if quick action is taken. The nations of the world must act immediately to reduce and eventually stop the use of fossil fuels and the destruction of forests. If decisive action is not taken within the next few decades, feedback loops will make human intervention useless. These feedback loops include the albedo effect, the methane hydrate feedback loop, and the fact as tropical forests become drier, they become vulnerable to fires ignited by lightning. These fires accelerate the drying, and thus a feed-back loop is formed.

As time passes, and as the disastrous consequences of climate change become more apparent, the political will required for action will increase; but by that time it may be too late. We are rapidly approaching several crucial tipping points.

At present, the average global rate of use of primary energy is roughly 2 kW_t per person. In North America, the rate is 12 kW_t per capita, while in Europe, the figure is 6 kW_t . In Bangladesh, it is only 0.2 kW_t . This wide variation implies that considerable energy savings are possible, through changes in lifestyle, and through energy efficiency.

2.4 Is the transition to 100% renewable energy possible?

Remaining reserves and rates of use of fossil fuels

	Reserves	2005 rate of use	Years remaining
Coal	780 TWy	3.5 TW	217 years
Oil	250 TWy	6.0 TW	42 years
Natural gas	250 TWy	3.7 TW	68 years
Total	1260 TWy	13.2 TW	(95 years)

Year	Demand	Population	Per Capita
1980	9.48 TW	4.45 bil.	2.13 kW
1985	10.3 TW	4.84 bil.	2.11 kW
1990	11.6 TW	5.99 bil.	2.20 kW
1995	12.3 TW	5.68 bil.	2.16 kW
2003	14.1 TW	6.30 bil.	2.23 kW
2010	17.1 TW	6.84 bil.	2.50 kW
2015	18.9 TW	7.23 bil.	2.58 kW
2020	20.5 TW	7.61 bil.	2.70 kW
2025	22.3 TW	7.91 bil.	2.82 kW
2030	24.2 TW	8.30 bil.	2.93 kW

If we ask whether the transition to 100% renewable energy is possible, the answer is very simple: It is not only possible; it is inevitable! This is because the supply of fossil fuels is finite, and at the present rate of use they will be exhausted in less than a century. While the transition to 100% renewables is inevitable, the vitally important point to remember is that if we are to avoid disaster, the transition must come quickly.

In this book, we will use kilowatts (kW), megawatts (MW) and terawatts (TW) as the units in which we discuss the rate of use of energy. A megawatt is equal to a thousand kilowatts or a million watts. A terawatt is equal to a thousand megawatts, or a million kilowatts or a billion (1,000,000,000) watts. A citizen of the European Union uses energy

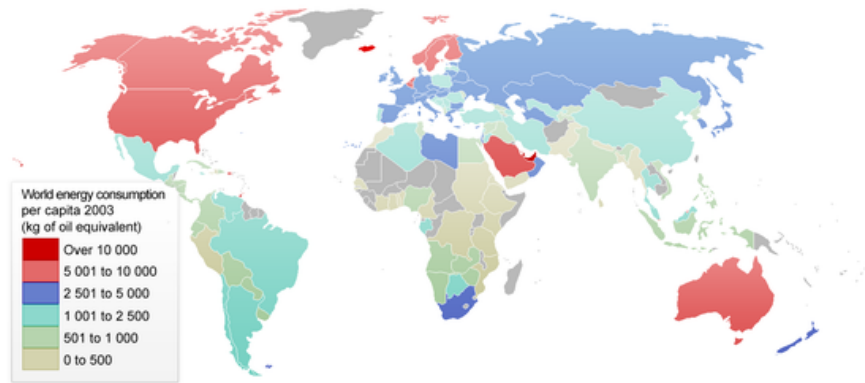


Figure 2.2: A map of the world showing per capita rates of energy use.

at the rate of about 6 kilowatts, while in North America, the rate of energy use is double that amount. The global average rate of energy use is a little over 2 kilowatts. Since there are now 7.5 billion people in the world, our present rate of energy use is roughly 15 terawatts,

The total available energy from fossil fuels can be measured in terawatt.years (TWy). Rough estimates of global coal reserves of coal, oil and natural gas are given by the table shown above.

The present rate of use of fossil fuels is greater than the 2005 rate shown in the table, and the remaining reserves are smaller than those shown. It is assumed that as oil becomes exhausted, coal will be converted into liquid fuels, as was done in Germany during World War II.

A second table, shown below, illustrates the historical and projected total global energy demand as a function of time between 1980 and 2030. In this slightly out-of-date table, the last year using historical data is 2003, later years being estimates based on projections.

Notice that the per capita energy use is almost constant. Our rapidly growing demand for energy is primarily the result of the world's rapidly growing population of humans. It would be wise to stabilize human populations because of the threat of human-caused ecological catastrophes and the danger of an extremely large-scale famine, involving billions of people rather than millions. Such a famine is threatened because growing populations require a growing food supply, climate changes threaten agriculture through droughts, melting glaciers and loss of agricultural land. The end of the fossil fuel era will also mean the end of high-yield petroleum-based agriculture.

The rate of growth of renewable energy

There is reason for hope that even the high energy demands show in the second table can be met by renewables. The basis of this hope can be found in the extremely high present rate of growth of renewable energy, and in the remarkable properties of exponential growth.

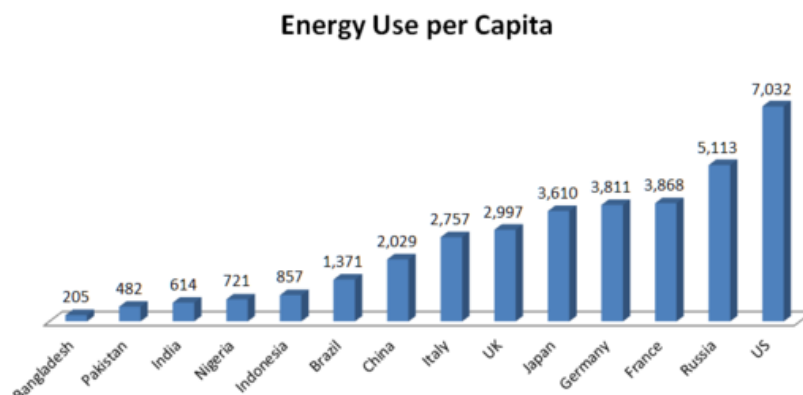


Figure 2.3: **Energy use per capita by country (World Bank data)**

According to figures recently released by the Earth Policy Institute, the global installed photovoltaic capacity is currently able to deliver 242,000 megawatts, and it is increasing at the rate of 27.8% per year. Wind energy can now deliver 370,000 megawatts, and it is increasing at the rate of roughly 20% per year.

Because of the astonishing properties of exponential growth, we can calculate that if these growth rates are maintained, renewable energy can give us 24.8 terawatts within only 15 years! This is far more than the world's present use of all forms of energy.

2.5 Renewables are now much cheaper than fossil fuels!

According to an article written by Megan Darby and published in *The Guardian* on 26 January, 2016, "Solar power costs are tumbling so fast the technology is likely to fast outstrip mainstream energy forecasts.

"That is the conclusion of Oxford University researchers, based on a new forecasting model published in *Research Policy*¹.

"Commercial prices have fallen by 58% since 2012 and by 16

"Since the 1980s, panels to generate electricity from sunshine have got 10% cheaper each year. That is likely to continue, the study said, putting solar on course to meet 20% of global energy needs by 2027.' "

Solar energy

Unlike the burning of fossil fuels, renewables like solar energy do not release pollutants into the atmosphere. In China, public opinion has shifted in favor of renewables because of air pollution in cities.

¹<http://www.sciencedirect.com/science/article/pii/S0048733315001699>

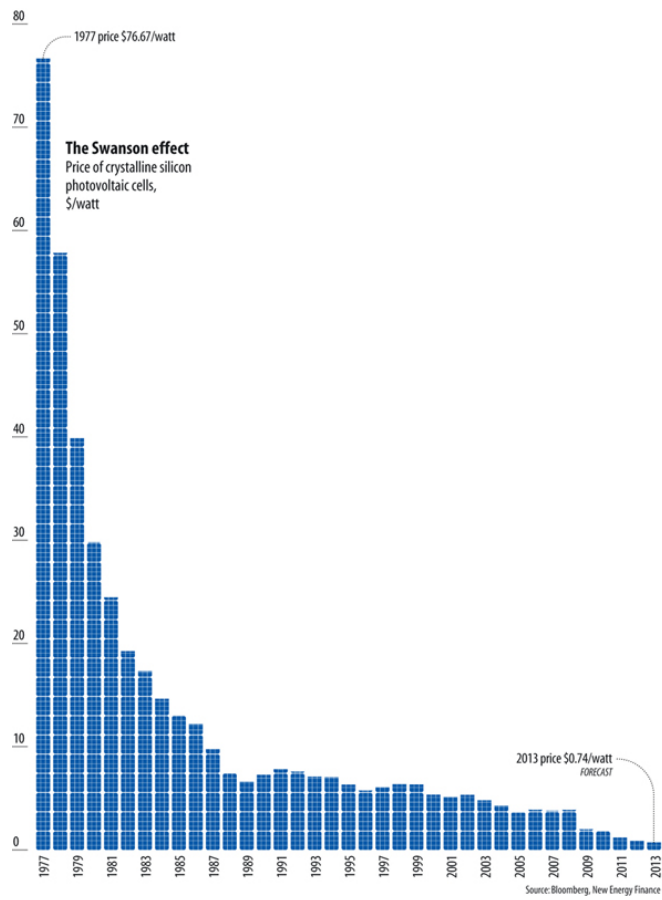


Figure 2.4: The cost of photovoltaic cell panels is falling rapidly

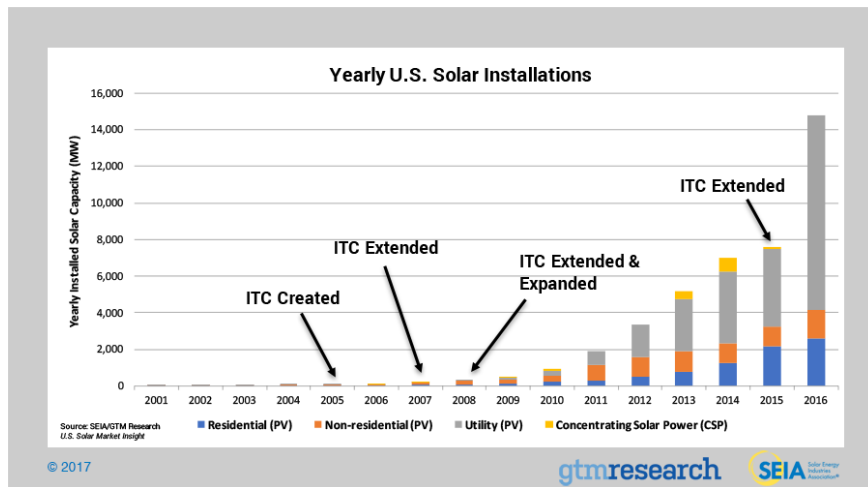


Figure 2.5: Driven by falling prices, new solar installations in the United States are increasing rapidly. The acronym ITC stands for Solar Investment Tax Credit. Commercial prices have fallen by 58% since 2012 and by 16% in the last year



Figure 2.6: Air pollution from the burning of coal has become a serious problem in China. This problem has helped to shift Chinese public opinion away from the burning of coal and towards renewables. China has now become a major manufacturer of photovoltaic cells.

Photovoltaic cells

The price of solar photovoltaic panels has declined 99 percent over the last four decades, from \$74 a watt in 1972 to less than 70 cents a watt in 2014.

Between 2009 and 2014, solar panel prices dropped by three fourths, helping global PV installations grow 50 percent per year.

Deutsche Bank notes that as of early 2014, solar PV was already competitive with average residential, commercial or industrial electricity rates in 14 countries, and in California - even without subsidies. By late 2014 there were nearly 600,000 individual PV systems in the United States, almost twice as many as in 2012. This number may well pass 1 million in 2016.

In 2013, just 12 percent of U.S. homebuilders offered solar panels as an option for new single-family homes. More than half of them anticipate doing so by 2016. Four of the top five U.S. home construction firms - DR Horton, Lennar Corp, PulteGroup and KB Home - now automatically include solar panels on every new house in certain markets.

In 2007 there were only 8,000 rooftop solar installations in coal-heavy Australia; now there are over a million.

Saudi Arabia has 41,000 megawatts of solar PV operating, under construction and planned - enough to generate up to two thirds of the country's electricity.

For the roughly 1.3 billion people without access to electricity, it is now often cheaper and more efficient simply to install solar panels rooftop-by-rooftop than to build a central power plant and transmission infrastructure.

Wind energy

Over the past decade, world wind power capacity grew more than 20 percent a year, its increase driven by its many attractive features, by public policies supporting its expansion, and by falling costs.

By the end of 2014, global wind generating capacity totaled 369,000 megawatts, enough to power more than 90 million U.S. homes. Wind currently has a big lead on solar PV, which has enough worldwide capacity to power roughly 30 million U.S. homes.

China is now generating more electricity from wind farms than from nuclear plants, and should have little trouble meeting its official 2020 wind power goal of 200,000 megawatts. For perspective, that would be enough to satisfy the annual electricity needs of Brazil.

In nine U.S. states, wind provides at least 12 percent of electricity. Iowa and South Dakota are each generating more than one quarter of their electricity from wind.

In the Midwestern United States, contracts for wind power are being signed at a price of 2.5 cents per kilowatt-hour (kWh), which compares with the nationwide average grid price of 10-12 cents per kWh.

Although a wind farm can cover many square miles, turbines occupy little land. Coupled with access roads and other permanent features, a wind farm's footprint typically comes to just over 1 percent of the total land area covered by the project.

Wind energy yield per acre is off the charts. For example, a farmer in northern Iowa could plant an acre in corn that would yield enough grain to produce roughly \$1,000 worth of fuel-grade ethanol per year, or the farmer could put on that same acre a turbine that generates \$300,000 worth of electricity per year. Farmers typically receive \$3,000 to \$10,000 per turbine each year in royalties. As wind farms spread across the U.S. Great Plains, wind royalties for many ranchers will exceed their earnings from cattle sales.

The problem of intermittency

Many forms of renewable energy encounter the problem of intermittency. For example, on windy days, Denmark's windmills generate more than enough electricity to meet the needs of the country, but on days when the wind is less strong, the electrical energy generated is insufficient. Denmark solves this problem by selling surplus electrical power to Germany on windy days, and buying power from hydroelectric-rich Norway on less windy days.

The problem of intermittency can alternatively be solved by pumping water to uphill reservoirs when the wind is strong, and letting the stored water drive turbines when the wind is weak. The problem of intermittency can also be solved with lithium ion storage batteries, by splitting water into hydrogen and oxygen, or by using other types of fuel cells.

Developing countries: No need for grids

When cell phones came into general use, developing countries with no telephone networks were able to use the new technology through satellites, thus jumping over the need for country-wide telephone lines. Similarly, village solar or wind installations in the developing countries can supply power locally, bypassing the need for a grid.

2.6 An economic tipping point

Renewables are now cheaper than fossil fuels

Solar energy and wind energy have recently become cheaper than fossil fuels. Thus a tipping point has been passed. From now on, despite frantic efforts of giant fossil fuel corporations to prevent it from happening, the transition to 100% renewable energy will be driven by economic forces alone.

Subsidies to the fossil fuel industry

<http://www.imf.org/en/News/Articles/2015/09/28/04/53/sonew070215a>

<http://priceofoil.org/fossil-fuel-subsidies/>

2.7 An unprecedented investment opportunity

Investment in electric vehicles

On July 5, 2017, the Volvo Car Group made the following announcement: ²

“Volvo Cars, the premium car maker, has announced that every Volvo it launches from 2019 will have an electric motor, marking the historic end of cars that only have an internal combustion engine (ICE) and placing electrification at the core of its future business.

“The announcement represents one of the most significant moves by any car maker to embrace electrification and highlights how over a century after the invention of the internal combustion engine electrification is paving the way for a new chapter in automotive history.

“This is about the customer,’ said Håkan Samuelsson, president and chief executive. ‘People increasingly demand electrified cars and we want to respond to our customers’ current and future needs. You can now pick and choose whichever electrified Volvo you wish.’

“Volvo Cars will introduce a portfolio of electrified cars across its model range, embracing fully electric cars, plug in hybrid cars and mild hybrid cars.

“It will launch five fully electric cars between 2019 and 2021, three of which will be Volvo models and two of which will be high performance electrified cars from Polestar, Volvo Cars’ performance car arm. Full details of these models will be announced at a later date.”

The electric vehicle investment opportunity was also illustrated by the 2017 vote of Germany’s Bundesrat to ban the manufacture of internal combustion engines after 2030 ³.

The article announcing the vote adds that “It’s a strong statement in a nation where the auto industry is one of the largest sectors of the economy; Germany produces more automobiles than any other country in Europe and is the third largest in the world. The resolution passed by the Bundesrat calls on the European Commission (the executive arm of the European Union) to ‘evaluate the recent tax and contribution practices of Member States on their effectiveness in promoting zero-emission mobility,’ which many are taking to mean an end to the lower levels of tax currently levied on diesel fuel across Europe.”

France plans to end the sale of vehicles powered by gasoline and diesel by 2040, environment minister Nicolas Hulot announced recently.

Hulot made the announcement on Thursday, June 13, 2017, in Paris as he launched the country’s new Climate Plan to accelerate the transition to clean energy and to meet its targets under the Paris climate agreement.

To ease the transition, Hulot said the French government will offer tax incentives to replace fossil-fuel burning cars with clean alternatives.

Furthermore, the government of India has recently announced its intention to only

²<https://www.media.volvocars.com/global/en-gb/media/pressreleases/210058/volvo-cars-to-go-all-electric>

³<https://arstechnica.com/cars/2016/10/germanys-bundesrat-votes-to-ban-the-internal-combustion-engine-by-2030/>

nave electric vehicles by 2030⁴. This hugely ambitious plan was announced during the 2017 Confederation of Indian Industry Annual Session. Besides the avoidance of climate change, which might make many regions of India uninhabitable, the motive for replacing 28 million combustion engine vehicles by electric ones was the severe air pollution from which India suffers. Severe air pollution also motivates efforts by the government of China to promote the transition to electric vehicles.

The governments of Norway and the Netherlands have taken steps towards banning the internal combustion engine⁵. Both the upper and lower houses of the Netherlands' government voted to ban cars driven by internal combustion engines by 2025, the same year in which Norway plans to sell nothing but zero-emission vehicles.

In a report commissioned by the investment bankers Cowan & Co, managing director and senior research analyst Jeffrey Osborne, predicted that electric vehicles will cost less than gasoline-powered cars by the early- to mid-2020s due to falling battery prices as well as the costs that traditional carmakers will incur as they comply to new fuel-efficiency standards. Osbourne pointed out that a number of major car brands are hopping onto the electric bandwagon to compete in a space carved out by industry disrupter, Tesla.

“We see the competitive tides shifting in 2019 and beyond as European [car makers] roiled by the diesel scandal and loss of share to Tesla in the high margin luxury segment step on the gas and accelerate the pace of EV introductions”, he wrote.

Bloomberg New Energy Finance reported similar predictions: “Falling battery costs will mean electric vehicles will also be cheaper to buy in the U.S. and Europe as soon as 2025,” the report said. “Batteries currently account for about half the cost of EVs, and their prices will fall by about 77 percent between 2016 and 2030.”

In October, 2017, General Motors unveiled plans to roll out 20 new entirely electric car models by 2023, with two of the new EVs coming out in the next 18 months. Meanwhile, Ford announced the creation of “Team Edison,” intended to accelerate the company’s EV development and partnership work. The name, is “seemingly in direct response to Elon Musk’s Tesla, which recently surpassed Ford’s market capitalization.”

Tesla’s Chairman, highly successful inventor and entrepreneur Elon Musk, has made massive investments in factories manufacturing electric vehicles, improved lithium ion storage cells, and photovoltaic panels, as will be discussed in Chapter 2.

Investment in wind turbine energy

In Denmark, the wind turbine industry contributes substantially to the country’s positive balance of payments. According to Wikipedia, “The Danish wind turbine industry is the world’s largest. Around 90% of the national output is exported, and Danish companies accounted for 38% of the world turbine market in 2003, when the industry employed some 20,000 people and had a turnover of around 3 billion euro.”

⁴<https://www.greentechmedia.com/articles/read/what-country-will-become-the-first-to-ban-internal-combustion-cars>

⁵<http://www.prnewswire.com/news-releases/the-dutch-revolution-in-smart-charging-of-electric-vehicles-597268791.html>

Denmark's two largest wind turbine manufacturers are Vestas and Simiens Wind Power. Vestas employs more than 21,000 people globally. In February 2016, Vestas got its largest order of 1,000 MW (278 x 3.6 MW) for the Fosen project near Trondheim in Norway. It costs DKK 11 billion, and should deliver 3.4 TWh per year.

In 2015 Siemens Wind had a combined market share of 63% of European offshore wind turbines (nearly 75% in 2009 by capacity and number). In 2011, Siemens Wind Power had 6.3% share of the world wind turbine market, and was the second largest in 2014.

In many countries, including Australia, Canada, Denmark, Germany, India, The Netherlands, United Kingdom, and United States, wind turbine cooperatives have sprung up. In these cooperatives, communities share the costs and profits of wind turbine projects. For example, the Hepburn Wind Project in Victoria, Australia, owns two 2MW wind turbines which produce enough power for 2,300 households.

Investment in solar energy

Global revenues from solar photovoltaic installations are expected to reach \$1.2 trillion between the present and 2024 according to a recent article⁶

Another article⁷ states that "The global electric power industry is evolving into a model that offers more diversity, both in terms of generation and in the ownership of generation assets, and solar PV is one technology at the head of this change. Following years of unsustainable pricing and oversupply, demand for solar PV systems has finally caught up, with 2015 expected to be the year when the global solar PV market shifts and starts to compete with other technologies. According to a recent report from Navigant Research, global revenue from solar PV installations is expected to total more than \$1.2 trillion from 2015 to 2024."

2.8 For creating jobs, renewables beat fossil fuels

Here are some excerpts from a 2016 report issued by the Solar Foundation:

- One out of every 50 new jobs added in the United States in 2016 was created by the solar industry, representing 2 percent of all new jobs.
- Solar jobs in the United States have increased at least 20 percent per year for the past four years, and jobs have nearly tripled since the first Solar Jobs Census was released in 2010.
- Over the next 12 months, employers surveyed expect one out of every 50 new jobs added in the United States in 2016 was created by the solar industry, representing 2 percent of all new jobs.

⁶<https://cleantechnica.com/2016/01/25/global-revenue-solar-pv-installations-expected-reach-1-2-trillion/>

⁷<http://www.navigantresearch.com/newsroom/global-revenue-from-solar-pv-installations-is-expected-to-total-more-than-1-2-trillion-from-2015-to-2024>

- In 2016, the five states with the most solar jobs were California, Massachusetts, Texas, Nevada, and Florida.
- The solar industry added \$84 billion to the US GDP in 2016 to see total solar industry employment increase by 10 percent to 286,335 solar workers.
- The solar industry added \$84 billion to the US GDP in 2016.

2.9 The Stern Review

Background of the Stern Review

The Stern Review on the Economics of Climate Change is a 700 page document commissioned by the government of the United Kingdom and released on 30 October, 2006. The research behind this report was conducted by a team led by Nicolas Stern (Baron Stern of Brentford), chair of the Grantham Research Institute on Climate Change and the Environment.

The Stern Review discusses the catastrophic climate change which will result if prompt action is not taken, and it proposes that 1% of global GDP be used annually to prevent such disasters. In 2014, the global GDP was estimated to be 77.9 trillion dollars, so that the 1% investment in renewable energy recommended by Lord Stern and his research team would have amounted to nearly a trillion dollars.

The Middle East

According to current estimates, 81.5% of the world's proven crude oil reserves are located in OPEC Member Countries, with the bulk of OPEC oil reserves in the Middle East, amounting to 65.5% of the OPEC total.

China

China's large reserves of coal lie near to the surface, and are thus very easily accessible. Mining of coal has driven the country's rapid industrial growth, but it has also produced a severe public health problem because of air pollution.

In April, 2017, China's rate of economic growth was 6.9%⁸. This rate of growth, if continued, would mean that China's economy would double every ten years. and increase by a factor of 1024 every century. Obviously this is impossible. Never-ending economic growth on a finite planet is a logical absurdity. China's high economic growth rate, is driven by its use of coal, and this must quickly stop if ecological disaster is to be avoided.



Figure 2.7: Protesters at the 2017 G20 meeting in Hamburg Germany.

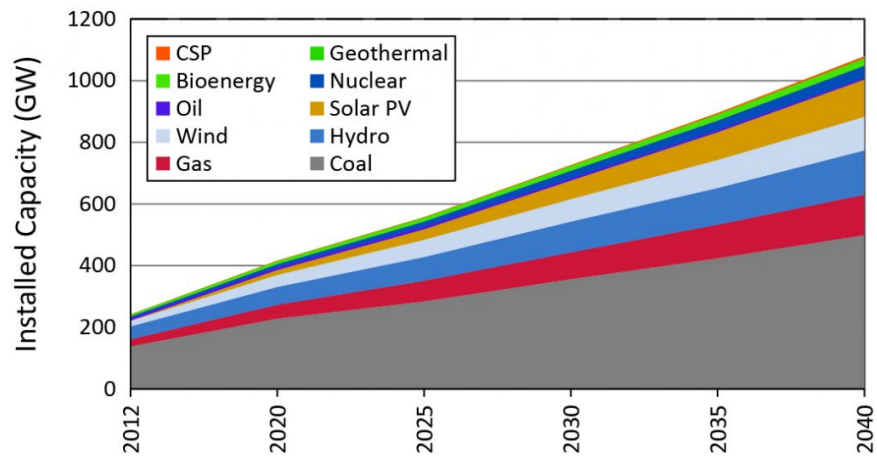


Figure 2.8: India's installed and future energy mix, as visualized by the World Coal Association

India

The MIT Technology Review recently published an important article entitled *India's Energy Crisis*⁹.

The article makes alarming reading in view of the world's urgent need to make a very rapid transition from fossil fuels to 100% renewable energy. We must make this change quickly in order to avoid a tipping point beyond which catastrophic climate change will be unavoidable.

The MIT article states that "Since he took power in May, 2014, Prime Minister Narendra Modi has made universal access to electricity a key part of his administration's ambitions. At the same time, he has pledged to help lead international efforts to limit climate change. Among other plans, he has promised to increase India's total power generating capacity to 175 gigawatts, including 100 gigawatts of solar, by 2022. (That's about the total power generation of Germany.)"

However India plans to expand its industrial economy, and to do this, it is planning to very much increase its domestic production and use of coal. The MIT article continues, pointing out that

However India plans to expand its industrial economy, and to do this, it is planning to very much increase its domestic production and use of coal. The MIT article continues, pointing out that "Such growth would easily swamp efforts elsewhere in the world to curtail carbon emissions, dooming any chance to head off the dire effects of global climate change. (Overall, the world will need to reduce its current annual emissions of 40 billion tons by 40 to 70 percent between now and 2050.) By 2050, India will have roughly 20 percent of the world's population. If those people rely heavily on fossil fuels such as coal to expand the economy and raise their living standards to the level people in the rich world have enjoyed for the last 50 years, the result will be a climate catastrophe regardless of anything the United States or even China does to decrease its emissions. Reversing these trends will require radical transformations in two main areas: how India produces electricity, and how it distributes it."

The Indian Minister of Power, Piyush Goyal, is an enthusiastic supporter of renewable energy expansion, but he also supports, with equal enthusiasm, the large-scale expansion of domestic coal production in India.

Meanwhile, the consequences of global warming are being felt by the people of India. For example, last May, a heat wave killed over 1,400 people and melted asphalt streets.¹⁰

Have India's economic planners really thought about the long-term future? Have they considered the fact that drastic climate change could make India completely uninhabitable?

⁸<https://tradingeconomics.com/china/gdp-growth-annual>

⁹<http://www.technologyreview.com/featuredstory/542091/indias-energy-crisis/>

¹⁰<https://www.rt.com/news/262641-india-heat-wave-killed/>



Figure 2.9: Oil production on the shelf in the Russian Arctic.

Russia

According to Wikipedia, “The petroleum industry in Russia is one of the largest in the world. Russia has the largest reserves, and is the largest exporter, of natural gas. It has the second largest coal reserves, the eighth largest oil reserves, and is one of the largest producer of oil. It is the third largest energy user.”

One of the difficulties of reducing Russia’s fossil fuel production is that the Russian economy depends so heavily on its oil and gas industries. Many European countries also depend on natural gas from Russia for winter heating of homes and workplaces.

North America

Canadian oil sands

Canada’s oil-sands deposits contain an amount of carbon comparable to the world’s total reserves of conventional oil. Oil is currently being extracted by methods that release four times as much carbon into the atmosphere as is contained in the refined oil from the deposits. Nevertheless, the government of Canada wholeheartedly supports extraction of oil from the tar sands.

The position of the Canadian government has been strongly criticized by leading climate scientist Professor James Hansen. A recent article in *The Guardian*¹¹, reported him as saying; “To leave our children with a manageable situation, we need to leave the unconventional fuel in the ground. Canada’s ministers are acting as salesmen for those people

¹¹<https://www.theguardian.com/environment/2013/may/19/tar-sands-exploitation-climate-scientist>



Figure 2.10: **Get rich quick at the oil sands.**

who will gain from the profits of that industry. But I don't think they are looking after the rights and wellbeing of the population as a whole.

"The thing we are facing overall is that the fossil fuel industry has so much money that they are buying off governments. Our democracies are seriously handicapped by the money that is driving decisions in Washington and other capitals."

Fracking in the United States

According to the US Department of Energy (DOE), in 2013 at least two million oil and gas wells in the US have been hydraulically fractured, and that of new wells being drilled, up to 95% are hydraulically fractured. The output from these wells makes up 43% of the oil production and 67% of the natural gas production in the United States.

Because of earthquakes and poisoning of water supplies caused by fracking, this practice has been banned by several states in the US, and nine countries or regions in Europe: France, Bulgaria, Roumania, Germany, The Czech Republic, Luxembourg, Northern Ireland, Spain and Switzerland,

Latin America

Venezuela's Belt of Tar

The Orinoco River Basin in Venezuela contains the world's largest deposit of extra-heavy oil and tar. The amount of carbon contained in this deposit is comparable to the carbon content of all the world's known reserves of conventional oil, and also larger than the carbon contained in Canada's oil sands.

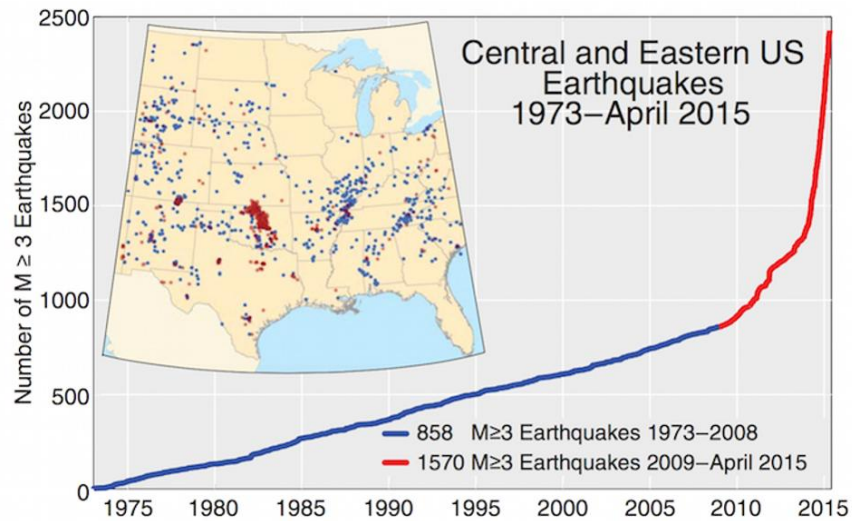


Figure 2.11: The sharply increased number of earthquakes in the United States has been linked to fracking. The use of fracking has also caused poisoning of water supplies.



Figure 2.12: Venezuela's Belt of Tar under the Orinoco River Basin is the world's largest deposit of extra-heavy oil and tar.

The Belt of Tar follows the line of the Orinoco river. It is approximately 600 kilometers (370 mi) from east to west, and 70 kilometers (43 mi) from north to south, with an area about 55,314 square kilometers (21,357 sq mi). The Orinoco deposit is estimated to contain 1.2 trillion barrels of extra-heavy oil.

The government of Venezuela has no plans for halting extraction from the Belt of Tar. On the contrary, detailed plans have been made for expanded exploitation of the deposit¹².

Extraction of oil in Brazil

According to a recent article in *The Guardian*¹³ “The discovery of tens of billions of barrels of oil in fields far off the coast of Rio de Janeiro was billed as one of the biggest finds of this century when it was announced in 2006.

“Many hoped it would deliver a bonanza for education and health and make Brazil one of world’s major economies.

“But with the country’s biggest energy company, Petrobras, mired in debt and scandal, the low price of oil and the dangers of a second Deepwater Horizon, the viability of this massive undertaking has never been under more scrutiny.”

The Brazilian offshore deposits are called “presalt oil”, since they lie under a thick layer of salt deposits.

According to the article in *The Guardian*, “Suggestions by climate campaigners that this reservoir of fossil fuel is a ‘carbon bomb’ that should be left in the ground, are dismissed as hypocrisy.”

The article quotes the geologist who discovered the off-shore fields as saying “The big countries of the world today developed without any concern for the environment. The base of US development was the oil in the Gulf of Mexico. The base of the UK’s industrial revolution was coal. How can they now say we can’t use our own pre-salt?”

The European Union

Coal in Germany and Poland

In 2016, Germany produced 176,100,000 tonnes of coal while Poland produced 131,100,000 tonnes. In the past, Poland experienced severe ecological effects from acid rain due to the burning of coal. Polish forests were destroyed by the effects of acid rain, and the facades of statues and buildings in Krakow and elsewhere were dissolved by the acid. Today the situation is improving, but the two countries are still heavily dependant on coal.

¹²<https://en.wikipedia.org/wiki/PDVSA>

¹³<https://www.theguardian.com/environment/ng-interactive/2015/jun/25/brazils-gamble-on-deep-water-oil-guanabara-bay>

North Sea oil

According to Wikipedia, “The British and Norwegian sections hold most of the remainder of the large oil reserves. It is estimated that the Norwegian section alone contains 54% of the sea’s oil reserves and 45% of its gas reserves- More than half of the North Sea oil reserves have been extracted, according to official sources in both Norway and the UK. For Norway, the Norwegian Petroleum Directorate [28] gives a figure of 4,601 million cubic meters of oil (corresponding to 29 billion barrels) for the Norwegian North Sea alone (excluding smaller reserves in Norwegian Sea and Barents Sea) of which 2,778 million cubic meters (60%) has already been produced prior to January 2007. UK sources give a range of estimates of reserves, but even using the most optimistic ‘maximum’ estimate of ultimate recovery, 76% had been recovered at end 2010.[citation needed] Note the UK figure includes fields which are not in the North Sea (onshore, West of Shetland).

2.10 Major producers of fossil fuels

The top 20 oil-producing nations in 2016

Wikipedia’s article entitles *List of countries by oil production* gives information shown in the table below. In the table, which is based on data from the International Energy Agency, production is measured in barrels of oil per day

1	Russia	10,551,497
2	Saudi Arabia	10,460,710
3	United States	8,875,817
4	Iraq	4,451,516
5	Iran	3,990,956
6	China	3,980,650
7	Canada	3,662,694
8	United Arab Emirates	3,106,077
9	Kuwait	2,923,825
10	Brazil	2,515,459
11	Venezuela	2,276,967
12	Mexico	2,186,877
13	Nigeria	1,999,885
14	Angola	1,769,615
15	Norway	1,647,975
16	Kazakhstan	1,595,199
17	Qatar	1,522,902
18	Algeria	1,348,361
19	Oman	1,006,841
20	United Kingdom	939,760

The top 10 coal producing nations in 2016

Wikipedia gives a similar list of coal producing nations. Only the top 10 are shown here, since these countries completely dominate global coal production. In the table, production is measured in millions of tonnes per year.

1	China	3411.0
2	India	692.4
3	United States	660.6
4	Australia	492.8
5	Indonesia	434.0
6	Russia	385.4
7	South Africa	251.3
8	Germany	176.1
9	Poland	131.1
10	Kazakhstan	102.4
	World	7,460.4

The world production of coal is falling. In 2014 it was 8,164.9 tonnes, in 2015, 7,861.1 tonnes, and in 2016 7,460.4 tonnes. Nevertheless, global production of coal remains worryingly high. If catastrophic climate change is to be avoided, it must stop altogether within one or two decades. At the moment the world is still producing roughly 1 tonne of coal per capita each year.

List of countries by natural gas production

Here is a similar table for natural gas. Production is measured in m³ per year. The final column indicates the date of the data.

1	United States	728,200,000,000	2014
2	Russia	578,700,000,000	2014
3	Iran	438,000,000,000	2017
4	Canada	143,100,000,000	2012
5	Qatar	133,200,000,000	2011
6	Norway	114,700,000,000	2012
7	China	107,200,000,000	2012
8	Saudi Arabia	103,200,000,000	2012
9	Algeria	82,760,000,000	2011
10	Netherlands	80,780,000,000	2012
	World	4,359,000,000,000	2010

2.11 Blood for oil

There is a close relationship between petroleum and war. James A. Paul, Executive Director of the Global Policy Forum, has described this relationship very clearly in the following words:

“Modern warfare particularly depends on oil, because virtually all weapons systems rely on oil-based fuel - tanks, trucks, armored vehicles, self-propelled artillery pieces, airplanes, and naval ships. For this reason, the governments and general staffs of powerful nations seek to ensure a steady supply of oil during wartime, to fuel oil-hungry military forces in far-flung operational theaters.”

“Just as governments like the US and UK need oil companies to secure fuel for their global war-making capacity, so the oil companies need their governments to secure control over global oilfields and transportation routes. It is no accident, then, that the world’s largest oil companies are located in the world’s most powerful countries.”

“Almost all of the world’s oil-producing countries have suffered abusive, corrupt and undemocratic governments and an absence of durable development. Indonesia, Saudi Arabia, Libya, Iraq, Iran, Angola, Colombia, Venezuela, Kuwait, Mexico, Algeria - these and many other oil producers have a sad record, which includes dictatorships installed from abroad, bloody coups engineered by foreign intelligence services, militarization of government and intolerant right-wing nationalism.”

The resource curse

The way in which the industrialized countries maintain their control over less developed nations can be illustrated by the “resource curse”, i.e. the fact that resource-rich developing countries are no better off economically than those that lack resources, but are cursed with corrupt and undemocratic governments. This is because foreign corporations extracting local resources under unfair agreements exist in a symbiotic relationship with corrupt local officials.

One might think that taxation of foreign resource-extracting firms would provide developing countries with large incomes. However, there is at present no international law governing multinational tax arrangements. These are usually agreed to on a bilateral basis, and the industrialized countries have stronger bargaining powers in arranging the bilateral agreements.

2.12 Fossil fuel extraction must stop!

“Leave the oil in the soil! Leave the coal in the hole! Leave the gas under the grass!” That was message of protesters at the 2017 G20 meeting. But from the facts shown in this chapter, we can see that on the whole, fossil fuels are not being left in the ground, where they have to remain if an ecological disaster is to be avoided. On the contrary, the extraction of coal, oil and gas continues almost as though the climate emergency did

not exist. Most politicians, with their eyes focused on the present, seem blind to future dangers. They think primarily about the jobs and living standards of their constituents, and about the next election. Meanwhile, the future of human civilization is neglected and remains in peril.¹⁴

The fact that historically, the highly industrialized nations were primarily responsible for atmospheric CO₂ increases does not excuse the developing countries from their responsibility for saving the future. Today China's coal, India's coal, Venezuela's tar sands and Brazil's pre-salt oil are among the greatest threats, and in these countries as elsewhere, extraction must stop.

We have to wake up! Business as usual cannot continue!

2.13 Extinction events and feedback loops

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.¹⁵

¹⁴See <https://www.theguardian.com/commentisfree/2017/sep/18/enough-tiptoeing-around-lets-make-this-clear-coal-kills-people>

¹⁵<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>

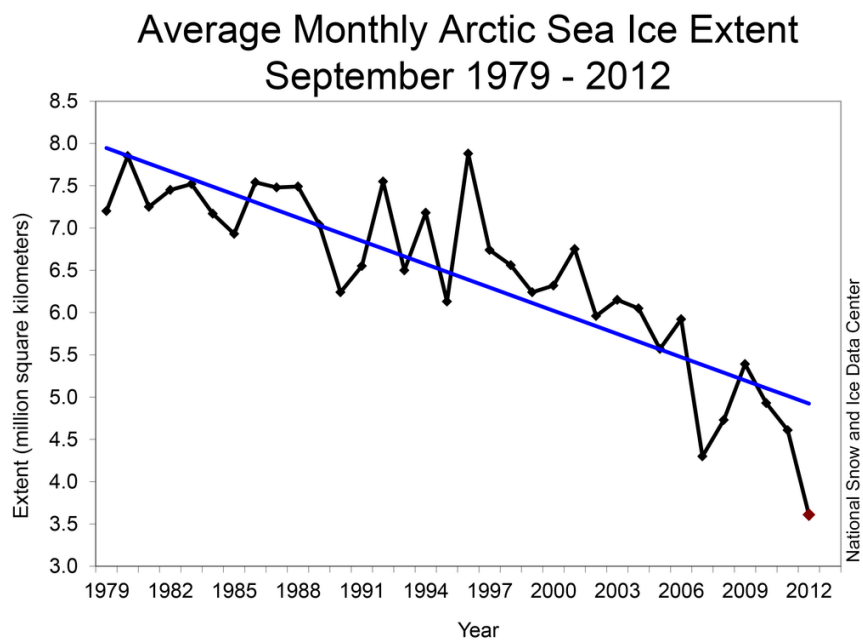


Figure 2.13: Monthly September ice extent for 1979 to 2012 shows a decline of **13.0%** per decade. One can also see that the straight line does not really fit the data, which more nearly resemble a downward curve will that reach zero in the period 2016-2019. Source: National Snow and Ice Data Center. Wikimedia Commons

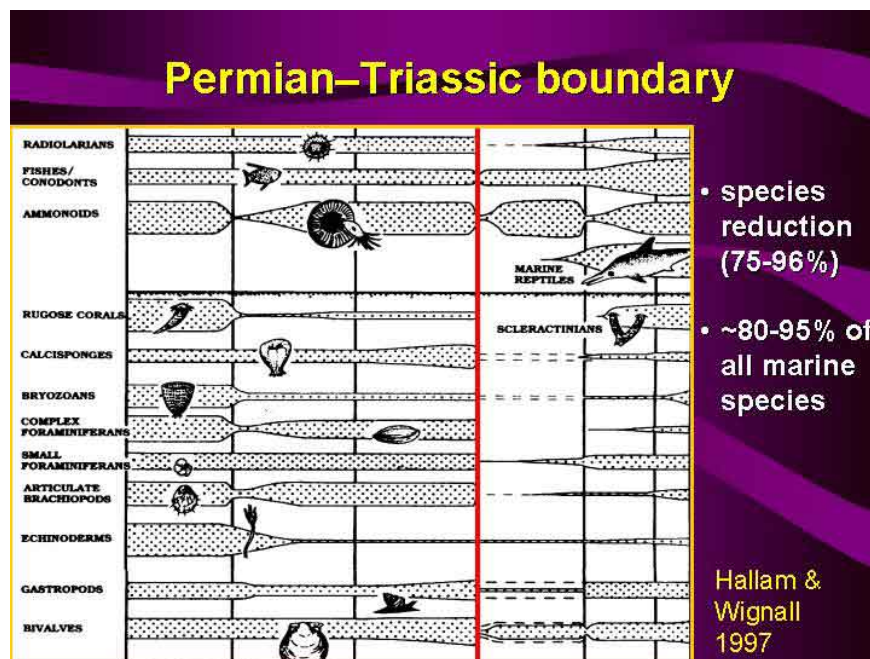


Figure 2.14: Loss of species caused by the Permian-Triassic extinction event. Unless quick steps are taken to lower our greenhouse gas emissions, we may cause a similar extinction event, which will threaten the survival of our own species. Source: Australian Frontiers of Science, www.sciencearchive.org.au

2.14 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.¹⁶

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 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

¹⁶<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>

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.

2.15 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.¹⁷ In the Permian-Triassic extinction, 96% of all marine species and 76% of all terrestrial vertebrates disappeared forever. The cause of this extremely severe

¹⁷ <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/>

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 "trapped".) 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.

2.16 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 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,"¹⁸

"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."

¹⁸<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>

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*¹⁹ “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 IUCN²⁰ 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 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.”

¹⁹<https://www.theguardian.com/environment/2010/mar/07/extinction-species-evolve>

²⁰International Union for the Conservation of Nature

2.17 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."

2.18 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.

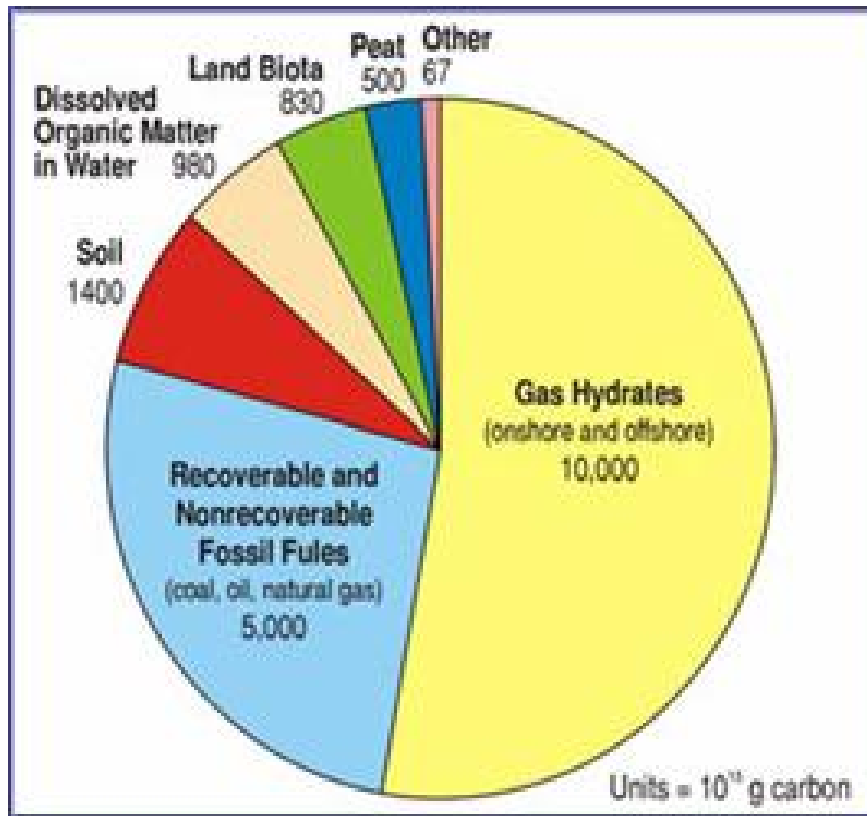


Figure 2.15: The worrying thing about the methane/hydrate feedback loop is the enormous amount of carbon in the form of hydrate crystals, 10,000 gigatons most of it on the continental shelves of oceans. This greater than the amount of carbon in all other forms that might potentially enter the earth's atmosphere.



Figure 2.16: When ocean temperatures rise, methane hydrate crystals become unstable, and methane gas bubbles up to ocean surfaces.

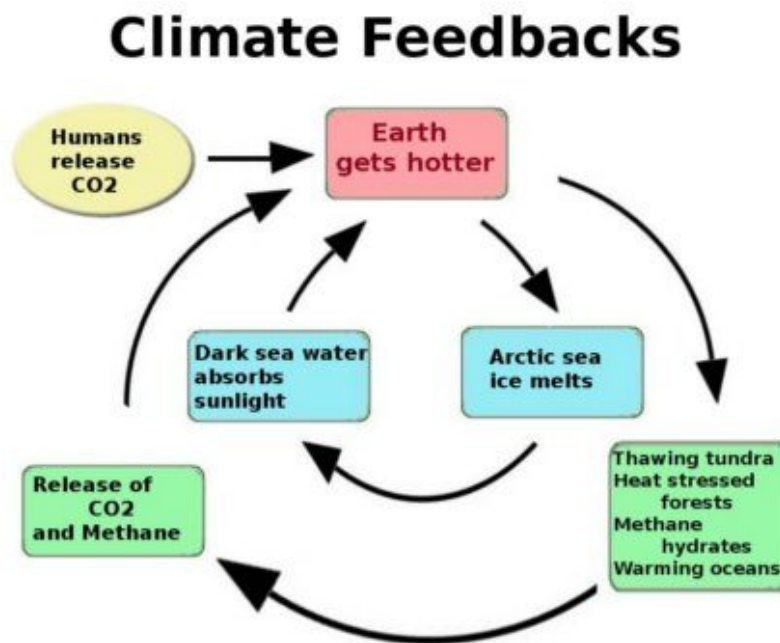


Figure 2.17: This diagram shows two important feedback loops, one involving the albedo effect, and the other involving methane hydrates.

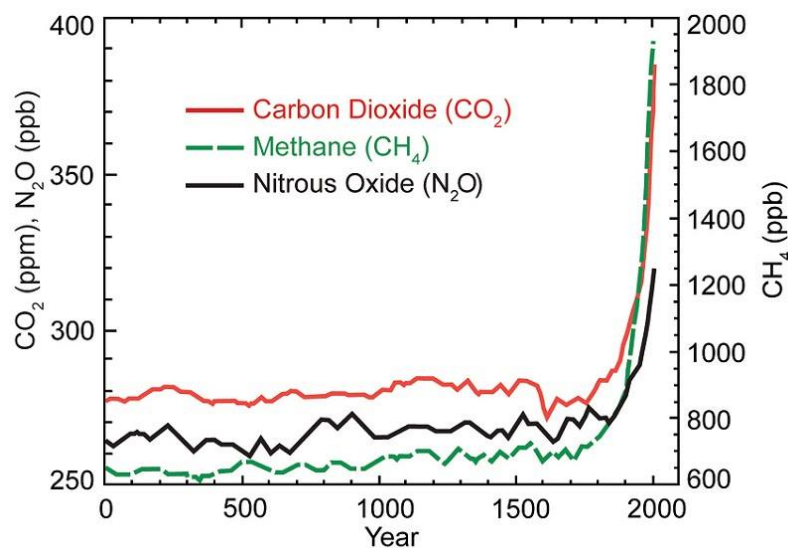


Figure 2.18: A “hockey stick” graph showing atmospheric concentrations of three important greenhouse gases during the last 2,000 years. The most dramatically increasing of these is methane.

2.19 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 CO_2 .

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 CO_2 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.

2.20 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*²¹. The

²¹J.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).

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.

2.21 Drying of forests and forest fires

According to a recent article in *Nature*²², “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.’

“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.”

2.22 Tipping points and feedback loops

A tipping point is usually defined as the threshold for an abrupt and irreversible change²³. 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

²²<http://www.nature.com/news/forest-fires-burn-out-1.11424>

²³Other 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.

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

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 rainforest 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. 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, *Geodesinies: 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).
86. Ehrlich P-R (1995) *The scale of the human enterprise and biodiversity loss*, in *Extinction Rates*, eds Lawton JH, May RM (Oxford Univ Press, Oxford, UK), pp 214-226.
87. Dirzo R, et al. (2014) *Defaunation in the Anthropocene*. Science **345**:401-406.
88. Young HS, McCauley DJ, Galletti M, Dirzo R (2016) *Patterns, causes, and consequences of Anthropocene defaunation*. Annu Rev Ecol Evol Syst **47**:433-458.
89. World Wide Fund for Nature (2016) *Living Planet Report 2016. Risk and resilience in a new era*. (WWF International, Gland, Switzerland), 2017.
90. Maxwell SL, Fuller RA, Brooks TM, Watson JEM (2016) *Biodiversity: The ravages of guns, nets and bulldozers*. Nature **536**:143-145.
91. Laliberte AS, Ripple WJ (2004) *Range contractions of North American carnivores and ungulates*. BioScience **54**:123-138.
92. Worm B, Tittensor DP (2011) *Range contraction in large pelagic predators*. Proc Natl Acad Sci USA **108**:11942-11947.
93. Ripple WJ, et al. (2014) *Status and ecological effects of the world's largest carnivores*. Science **343**:1241-1248.

94. Barnosky AD, et al. (2011) *Has the Earth's sixth mass extinction already arrived?* Nature **471**:51-57.
95. Ceballos G, Garcia A, Ehrlich PR (2010) *The sixth extinction crisis: Loss of animal populations and species.* J. Cosmology **8**:1821-1831.
96. Ceballos G, et al. (2015) *Accelerated modern human-induced species losses: Entering the sixth mass extinction.* Sci Adv **1**:e1400253.
97. Wake DB, Vredenburg VT (2008) *Colloquium paper: Are we in the midst of the sixth mass extinction? A view from the world of amphibians.* Proc Natl Acad Sci USA **105**:11466-11473.
98. McCallum ML (2015) *Vertebrate biodiversity losses point to a sixth mass extinction.* Biol Conserv **24**:2497-2519.
99. Pimm SL, et al. (2014) *The biodiversity of species and their rates of extinction, distribution, and protection.* Science **344**:1246752.
100. McCauley DJ, et al. (2015) *Marine defaunation: Animal loss in the global ocean.* Science **347**:1255641.
101. Collen B, Böhm M, Kemp R, Baillie J (2012) *Spineless: Status and Trends of the World's Invertebrates* (Zoological Society of London, London). Red List
102. Daily G (1997) *Nature's Services: Societal Dependence on Natural Ecosystems.* (Island Press, Covello, CA).
103. Naeem S, Duffy JE, Zavaleta E (2012) *The functions of biological diversity in an age of extinction.* Science **336**:1401-1406.
104. Estes JA, et al. (2011) *Trophic downgrading of planet Earth.* Science **333**:301-306.
105. Brosi BJ, Briggs HM (2013) *Single pollinator species losses reduce floral fidelity and plant reproductive function.* Proc Natl Acad Sci USA **110**:13044-13048.
106. Briggs JC (2014) *Global biodiversity gain is concurrent with decreasing population sizes.* Biodiver J **5**:447-452.
107. Hooper DU, et al. (2012) *A global synthesis reveals biRed Listodiversity loss as a major driver of ecosystem change.* Nature **486**:105-108. Red List
108. Ehrlich PR (2014) *The case against de-extinction: It's a fascinating but dumb idea.* Yale Environment 360 (Yale University, New Haven, CT). Available at bit.ly/1gAIuJF. Accessed JunStudiese 10, 2017.
109. Hobbs RJ, Mooney HA (1998) *Broadening the extinction debate: Population deletions and additions in California and Western Australia.* Conserv Biol **12**:271-283. Studies
110. Hughes JB, Daily GC, Ehrlich PR (1997) *Population diversity: Its extent and extinction.* Science **278**:689-692.
111. Ceballos G, Ehrlich PR (2002) *Mammal population losses and the extinction crisis.* Science **296**:904-907.
112. Gaston KJ, Fuller RA (2008) *Commonness, population depletion and conservation biology.* Trends Ecol Evol **23**:14-19.
113. International Union of Conservation of Nature (2015) *The IUCN Red List of Threatened Species, Version 2015.2* (IUCN, 2015). Available at www.iucnredlist.org. Accessed February 10, 2016. Revised January 10, 2017.

114. Durant SM, et al. (2017) *The global decline of cheetah *Acinonyx jubatus* and what it means for conservation*. Proc Natl Acad Sci USA **114**:528-533.
115. Henschel P, et al. (2014) *The lion in West Africa is critically endangered*. PLoS One **9**:e83500.
116. Challender D, et al. (2016) *On scaling up pangolin conservation*. Traffic Bulletin **28**: 19-21.
117. Fennessy J, et al. (2016) *Multi-locus analyses reveal four giraffe species instead of one*. Curr Biol **26**:2543-2549.
118. Butchart S, Dunn E (2003) *Using the IUCN Red List criteria to assess species with declining populations*. Conserv Biol **17**:1200-1202.
119. Gaston K, Blackburn T (2008) *Pattern and Process in Macroecology* (Blackwell Publishing, Hoboken, NJ). Red List
120. Thomas JA (2016) ECOLOGY. Butterfly communities under threat. Science **353**:216-218.
121. Régnier C, et al. (2015) *Mass extinction in poorly known taxa*. Proc Natl Acad Sci USA **112**:7761-7766.25.
122. Hughes JB, Daily GC, Ehrlich PR (1997) *Population diversity: Its extent and extinction*. Science **278**:689-692.
123. Ceballos G, Ehrlich PR (2002) *Mammal population losses and the extinction crisis*. Science **296**:904-907.
124. Cardinale BJ, et al. (2012) *Biodiversity loss and its impact on humanity*. Nature **486**: 59-67.
125. Hurlbert AH, Jetz W (2007) *Species richness, hotspots, and the scale dependence of range maps in ecology and conservation*. Proc Natl Acad Sci USA **104**:13384-13389.
126. Peterson AT, Navarro-Sigüenza AG, Gordillo A (2016) *Assumption- versus data-based approaches to summarizing species' ranges*. Conserv Biol, 10.1111/cobi.12801.
127. Martínez-Ramos M, Ortíz-Rodríguez I, Pinero D, Dirzo R, Sarukhán J (2016) *Humans disrupt ecological processes within tropical rainforest reserves*. Proc Natl Acad Sci USA **113**:5323-5328.
128. Camargo-Sanabria AA, Mendoza E, Guevara R, Martínez-Ramos M, Dirzo R (2015) *Experimental defaunation of terrestrial mammalian herbivores alters tropical rainforest understorey diversity*. Proc Biol Sci **282**:20142580.
129. Petipas RH, Brody AK (2014) *Termites and ungulates affect arbuscular mycorrhizal richness and infectivity in a semiarid savanna*. Botany **92**:233-240.
130. Wardle DA, et al. (2004) *Ecological linkages between aboveground and belowground biota*. Science **304**:1629-1633.
131. Ceballos G, Ehrlich AH, Ehrlich PR (2015) **The Annihilation of Nature: Human Extinction of Birds and Mammals**, (Johns Hopkins Univ Press, Baltimore).
132. Knoll AH (2015) *Life on a Young Planet: The First Three Billion Years of Evolution on Earth*, (Princeton Univ Press, Princeton, NJ).
133. Barnosky AD, et al. (2014) *Introducing the scientific consensus on maintaining humanity's life support systems in the 21st century: Information for policy makers*. The Anthropocene Review **1**:78-109.

134. Ceballos G, Ehrlich PR, Soberón J, Salazar I, Fay JP (2005) *Global mammal conservation: What must we manage?* Science **309**:603-607.
135. Brown IL, Ehrlich PR (1980) *Population biology of the checkerspot butterfly, Euphydryas chalcedona structure of the Jasper Ridge colony.* Oecologia **47**:239-251.
136. Environmental Systems Research Institute (2011) *Release 10. Documentation Manual*, (Environmental Systems Research Institute, Redlands, CA).
137. Balling, R. C. 1988. *The climate impact of Sonoran vegetation discontinuity.* Climate Change **13**: 99-109.
138. Balling, R. C. 1991. *Impact of desertification on regional and global warming.* Bulletin of the American Meteorological Society **72**: 232-234.
139. Barigozzi, C. (ed.). 1986. *The Origin and Domestication of Cultivated Plants.* Amsterdam: Elsevier.
140. Botkin, D. B. 1989. *Science and the global environment.* In: D. B. Botkin et al., *Global Change.* New York: Academic Press, pp. 1-14.
141. Bryson, R. 1972. *Climate modification by air pollution.* In: N. Polunin (ed.), *The Environmental Future.* London: Macmillan, pp. 133-174.
142. Dregne, H. E., M. Kassas, and B. Rozanov. 1991. *A new assessment of the world status of desertification.* Desertification Control Bulletin, **no. 20**: 6-18.
143. FAO (Food and Agriculture Organization). 1991. *Protection of land resources: Deforestation* UNCED Prepcomm., 2nd session, Doc. A/CONF. 15/PC/27.
144. Hare, F. K. and L. A. J. Ogallo. 1993. *Climate Variation, Drought and Desertification.* WMO-No. 653. Geneva: WMO.
145. Houghton, J. T., B. A. Callander, and S. K. Varney (eds.). 1992. *Climate Change 1992. The Supplementary Report to the IPCC Scientific Assessment.* (Cambridge: Cambridge University Press.
146. Hulme, M. and M. Kelly. 1993. *Exploring the links between desertification and climate change.* Environment **35(6)**: 5-11, 39-45.
147. Jackson, R. D. and S. B. Idso. 1975. *Surface albedo and desertification.* Science **189**: 1012-1013.
148. Matthews, E. 1983. *Global vegetation and land use: New high-resolution databases for climatic studies.* Journal of Climate and Meteorology **22**: 474-487.
149. Schlesinger, W. H., et al. 1990. *Biological feedback in global desertification.* Science **247**: 1043-1048.
150. Turner, B. L., et al. 1990. "Two types of global environmental changes: Definitional and special-scale issues in their human dimensions." Global Environmental Change **1**: 14-22.
151. UNESCO. 1960. *Medicinal plants of arid zones.* Arid Zone Research **13**.
152. Vavilov, N. I. 1949. *The Origin, Variation, Immunity and Breeding of Cultivated Plants.* Waltham, Mass.: Chronica Botanica

Chapter 3

OUR HOUSE IS ON FIRE

3.1 Adam Smith's invisible hand is at our throats

The invisible hand

As everyone knows, Adam Smith invented the theory that individual self-interest is, and ought to be, the main motivating force of human economic activity, and that this, in effect, serves the wider social interest. He put forward a detailed description of this concept in an immense book, "The Wealth of Nations" (1776).

Adam Smith (1723-1790) had been Professor of Logic at the University of Glasgow, but in 1764 he withdrew from his position at the university to become the tutor of the young Duke of Buccleuch. In those days a Grand Tour of Europe was considered to be an important part of the education of a young nobleman, and Smith accompanied Buccleuch to the Continent. To while away the occasional dull intervals of the tour, Adam Smith began to write an enormous book on economics which he finally completed twelve years later. He began his "Inquiry into the Nature and Causes of the Wealth of Nations" by praising division of labor. As an example of its benefits, he cited a pin factory, where ten men, each a specialist in his own set of operations, could produce 48,000 pins in a day. In the most complex civilizations, Smith stated, division of labor has the greatest utility.

The second factor in prosperity, Adam Smith maintained, is a competitive market, free from monopolies and entirely free from governmental interference. In such a system, he tells us, the natural forces of competition are able to organize even the most complex economic operations, and are able also to maximize productivity. He expressed this idea in the following words:

"As every individual, therefore, endeavors as much as he can, both to employ his capital in support of domestic industry, and so to direct that industry that its produce may be of greatest value, each individual necessarily labours to render the annual revenue of the Society as great as he can."

"He generally, indeed, neither intends to promote the public interest, nor knows how much he is promoting it. By preferring the support of domestic to that of foreign industry, he intends only his own security; and by directing that industry in such a manner as its

produce may be of greatest value, he intends only his own gain; and he is in this, as in many other cases, led by an invisible hand to promote an end that was no part of his intention. Nor is it always the worse for Society that it was no part of it. By pursuing his own interest, he frequently promotes that of Society more effectively than when he really intends to promote it.”

In other words, Smith maintained that self-interest (even greed) is a sufficient guide to human economic actions. The passage of time has shown that he was right in many respects. The free market, which he advocated, has turned out to be the optimum prescription for economic growth. However, history has also shown that there is something horribly wrong or incomplete about the idea that individual self-interest alone, uninfluenced by ethical and ecological considerations, and totally free from governmental intervention, can be the main motivating force of a happy and just society. There has also proved to be something terribly wrong with the concept of unlimited economic growth. Here is what actually happened:

In pre-industrial Europe, peasant farmers held a low but nevertheless secure position, protected by a web of traditional rights and duties. Their low dirt-floored and thatched cottages were humble but safe refuges. If a peasant owned a cow, it could be pastured on common land.

With the invention of the steam engine and the introduction of spinning and weaving machines towards the end of the 18th Century, the pattern changed, at first in England, and afterwards in other European countries. Land-owners in Scotland and Northern England realized that sheep were more profitable to have on the land than “crofters” (i.e., small tenant farmers), and families that had farmed land for generations were violently driven from their homes with almost no warning. The cottages were afterwards burned to prevent the return of their owners.

The following account of the Highland Clearances has been left by Donald McLeod, a crofter in the district of Sutherland: “The consternation and confusion were extreme. Little or no time was given for the removal of persons or property; the people striving to remove the sick or helpless before the fire should reach them; next struggling to save the most valuable of their effects. The cries of the women and children; the roaring of the affrighted cattle, hunted at the same time by the yelling dogs of the shepherds amid the smoke and fire, altogether presented a scene that completely baffles description - it required to be seen to be believed... The conflagration lasted for six days, until the whole of the dwellings were reduced to ashes and smoking ruins.”

Between 1750 and 1860, the English Parliament passed a large number of “Enclosure Acts”, abolishing the rights of small farmers to pasture their animals on common land that was not under cultivation. The fabric of traditional rights and duties that once had protected the lives of small tenant farmers was torn to pieces. Driven from the land, poor families flocked to the towns and cities, hoping for employment in the textile mills that seemed to be springing up everywhere. According to the new rules by which industrial society began to be governed, traditions were forgotten and replaced by purely economic laws.

Labor was viewed as a commodity, like coal or grain, and wages were paid according

to the laws of supply and demand, without regard for the needs of the workers. Wages fell to starvation levels, hours of work increased, and working conditions deteriorated.

John Fielden's book, "The Curse of the Factory System" was written in 1836, and it describes the condition of young children working in the cotton mills. "The small nimble fingers of children being by far the most in request, the custom instantly sprang up of procuring 'apprentices' from the different parish workhouses of London, Birmingham and elsewhere... Overseers were appointed to see to the works, whose interest it was to work the children to the utmost, because their pay was in proportion to the quantity of pay that they could exact."

"Cruelty was, of course, the consequence; and there is abundant evidence on record to show that in many of the manufacturing districts, the most heart-rending cruelties were practiced on the unoffending and friendless creatures... that they were flogged, fettered and tortured in the most exquisite refinements of cruelty, that they were in many cases starved to the bone while flogged to their work, and that they were even in some instances driven to commit suicide... The profits of manufacture were enormous, but this only whetted the appetite that it should have satisfied."

Dr. Peter Gaskell, writing in 1833, described the condition of the English mill workers as follows: "The vast deterioration in personal form which has been brought about in the manufacturing population during the last thirty years... is singularly impressive, and fills the mind with contemplations of a very painful character... Their complexion is sallow and pallid, with a peculiar flatness of feature caused by the want of a proper quantity of adipose substance to cushion out the cheeks. Their stature is low - the average height of men being five feet, six inches... Great numbers of the girls and women walk lamely or awkwardly... Many of the men have but little beard, and that in patches of a few hairs... (They have) a spiritless and dejected air, a sprawling and wide action of the legs..."

"Rising at or before daybreak, between four and five o'clock the year round, they swallow a hasty meal or hurry to the mill without taking any food whatever... At twelve o'clock the engine stops, and an hour is given for dinner... Again they are closely immured from one o'clock till eight or nine, with the exception of twenty minutes, this being allowed for tea. During the whole of this long period, they are actively and unremittingly engaged in a crowded room at an elevated temperature."

Dr. Gaskell described the housing of the workers as follows: "One of the circumstances in which they are especially defective is that of drainage and water-closets. Whole ranges of these houses are either totally undrained, or very partially... The whole of the washings and filth from these consequently are thrown into the front or back street, which, often being unpaved and cut into deep ruts, allows them to collect into stinking and stagnant pools; while fifty, or even more than that number, having only a single convenience common to them all, it is in a very short time choked with excrementous matter. No alternative is left to the inhabitants but adding this to the already defiled street."

"It frequently happens that one tenement is held by several families... The demoralizing effects of this utter absence of domestic privacy must be seen before they can be thoroughly appreciated. By laying bare all the wants and actions of the sexes, it strips them of outward regard for decency - modesty is annihilated - the father and the mother, the brother and

the sister, the male and female lodger, do not scruple to commit acts in front of each other which even the savage keeps hid from his fellows.”

The landowners of Scotland were unquestionably following self-interest as they burned the cottages of their crofters; and self-interest motivated overseers as they whipped half-starved child workers in England’s mills. Adam Smith’s “invisible hand” no doubt guided their actions in such a way as to maximize production. But whether a happy and just society was created in this way is questionable. Certainly it was a society with large areas of unhappiness and injustice. Self-interest alone was not enough. A society following purely economic laws - a society where selfishness is exalted as the mainspring for action - lacks both the ethical and ecological dimensions needed for social justice, widespread happiness, and sustainability

Our greed-based economic system today

Today our greed-based, war addicted, and growth-obsessed economic system poses even greater threats than it did during the early phases of the Industrial Revolution. Today it threatens to destroy human civilization and much of the biosphere.

According to a recently-published study by Oxfam, just 1 percent of the world’s population controls nearly half of the planet’s wealth. The study says that this tiny slice of humanity controls 110 trillion US dollars, or 65 times the total wealth of the poorest 3.5 billion people. The world’s 85 richest people own as much as the poorest 50 percent of humanity. 70 percent of the world’s people live in a country where income inequality has increased in the past three decades.

This shocking disparity in wealth has led to the decay of democracy in many countries, because the very rich have used their money to control governments, and also to control the mass media and hence to control public opinion. The actions of many governments today tend not to reflect what is good for the people (or more crucially, what is good for the future of our planet), but rather what is good for special interest groups, for example, the fossil fuel industry and the military-industrial complex.

An excellent description of the military-industrial complex was given by US President Dwight D. Eisenhower. When he retired, he made a memorable farewell address, containing the following words: “...We have been compelled to create an armaments industry of vast proportions. Added to this, three and a half million men are directly engaged in the defense establishment....In the councils of government, we must guard against the acquisition of unwarranted influence, whether sought or unsought, by the military-industrial complex. The potential for the disastrous rise of misplaced power exists and will persist.”

In another speech, Eisenhower said: “Every gun that is made, every warship launched, every rocket fired, signifies in a final sense, a theft from those who hunger and are not fed, those who are cold and are not clothed. The world in arms is not spending money alone. It is spending the sweat of its laborers, the genius of its scientists, and the hopes of its children.”

Today the world spends roughly 1,700,000,000,000 US dollars on armaments, almost 2 trillion. This vast river of money, almost too great to be imagined, flows into the pockets



Figure 3.1: **Our greed-based economic system is driving us towards disaster.**

of arms manufacturers, and is used by them to control governments, which in turn vote for bloated military budgets and aggressive foreign policies which provoke the endless crises and conflicts that are necessary to justify the diversion of such vast sums of money from urgently-needed social goals into the bottomless pit of war.

The reelection of the slave-like politicians is ensured by the huge sums made available for their campaigns by the military-industrial complex. This pernicious circular flow of money, driving endless crises, has sometimes been called “The Devil’s Dynamo”. Thus the world is continually driven to the brink of thermonuclear war by highly dangerous interventions such as the recent ones in North Africa, the Middle East, Ukraine, South and Central America, and the Korean Peninsula.

It is doubtful that any of the political or military figures involved with this arrogant risking of human lives and the human future have any imaginative idea of what a thermonuclear war would be like. In fact it would be an ecological catastrophe of huge proportions, making large areas of the world permanently uninhabitable through long-lived radioactive contamination. The damage to global agriculture would be so great as to produce famine leading to a billion or more deaths from starvation. All the nations of the earth would suffer, neutrals as well as belligerents.

Besides supporting the appalling war machine, our bought-and-paid-for politicians also fail to take the actions that would be needed to prevent the worst effects of climate change. The owners of the fossil fuel industries have even mounted advertising campaigns to convince the public that the threat of anthropogenic climate change is not real. Sadly, the

threat of catastrophic climate change is all too real, as 99 percent the worlds climate scientists have warned. The world has recently passed a dangerous landmark in atmospheric CO₂ concentration, 400 ppm. The last time that the earth experienced such high concentrations of this greenhouse gas were several million years ago. At that time the Arctic was free from ice, and sea levels were 40 meters higher than they are today.

Global warming is a slow and long-term effect, so such high sea levels will be slow in arriving, but ultimately we must expect that coastal cities and much of the world's low-lying land will be under water. We must also expect many tropical regions of the world to become uninhabitable because of high temperatures. Finally there is a threat of famine because agriculture will be hit by high temperatures and aridity.

There are several very dangerous feedback loops that may cause the earth's temperatures to rise much faster than has been predicted by the International Panel on Climate Change. By far the most dangerous of these comes from the melting of methane hydrate crystals that are currently trapped in frozen tundra and on the floor of seabeds.

At high pressures, methane combines with water to form crystals called hydrates or clathrates. These crystals are stable at the temperatures currently existing on ocean floors, but whenever the water temperature rises sufficiently, the crystals become unstable and methane gas bubbles to the surface. This effect has already been observed in the Arctic seas north of Russia.

The total amount of methane clathrates on ocean floors is not precisely known, but it is estimated to be very large indeed, corresponding to between 3,000 and 11,000 gigatons of carbon. The release of even a small fraction of this amount of methane into our atmosphere would greatly accelerate rising temperatures, leading to the release of still more methane, in a highly dangerous feedback loop. We must at all costs avoid global temperatures which will cause this feedback loop to trigger in earnest.

Human motivations were not always so selfish

For the reasons mentioned above, we can see that an economic system where selfishness and greed are exalted as the mainspring for human actions lacks both a social conscience and an ecological conscience. Both these dimensions are needed for the long-term survival of human civilization and the biosphere.

We must remember, however, that the worship of the free market and the exaltation of selfishness are relatively recent developments in human history. During most of their million-year history, humans lived in small groups, not in great cities or nations, and sharing was part of their lifestyle. Perhaps that lifestyle is the one to which we should return if we wish the human future to stretch out for another million years.

3.2 Limits to growth and climate change

Classical economists like Smith and Ricardo pictured the world as largely empty of human activities. According to the "empty-world" picture of economics, the limiting factors in the

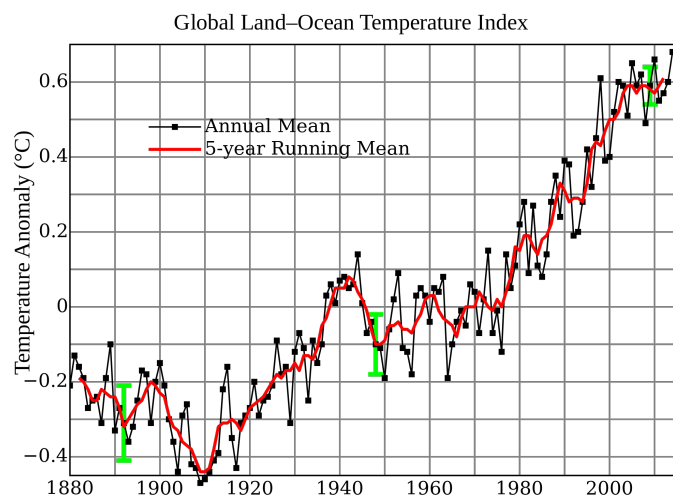


Figure 3.2: Unless the release of greenhouse gases into the atmosphere is stopped, we will soon reach a tipping point after which feedback loops beyond our control will cause catastrophic climate change. Source wikipedia.org

production of food and goods are shortages of capital and labor. The land, forests, fossil fuels, minerals, oceans filled with fish, and other natural resources upon which human labor and capital operate, are assumed to be present in such large quantities that they are not limiting factors. In this picture, there is no naturally-determined upper limit to the total size of the human economy. It can continue to grow as long as new capital is accumulated, as long as new labor is provided by population growth, and as long as new technology replaces labor by automation.

Biology, on the other hand, presents us with a very different picture. Biologists remind us that if any species, including our own, makes demands on its environment which exceed the environment's carrying capacity, the result is a catastrophic collapse both of the environment and of the population which it supports. Only demands which are within the carrying capacity are sustainable. For example, there is a limit to regenerative powers of a forest. It is possible to continue to cut trees in excess of this limit, but only at the cost of a loss of forest size, and ultimately the collapse and degradation of the forest. Similarly, cattle populations may for some time exceed the carrying capacity of grasslands, but the ultimate penalty for overgrazing will be degradation or desertification of the land. Thus, in biology, the concept of the carrying capacity of an environment is extremely important; but in economic theory this concept has not yet been given the weight that it deserves.

There is much evidence to indicate that the total size of the human economy is rapidly approaching the absolute limits imposed by the carrying capacity of the global environment. For example, biologists estimate that between 10,000 and 50,000 species are being driven into extinction each year as the earth's rainforests are destroyed.

The burning of fossil fuels and the burning of tropical rain forests have released so much carbon dioxide that the atmospheric concentration of this greenhouse gas has increased from a preindustrial value of 260 ppm to its present value: 400 ppm. Most scientists agree



Figure 3.3: **Air pollution has become a significant cause of death in both Asia and Africa.**

that unless steps are taken to halt the burning of rain forests and to reduce the use of fossil fuels, the earth's temperature will steadily rise during the coming centuries. This gradual long-term climate change will threaten future agricultural output by changing patterns of rainfall. Furthermore, the total melting of the Arctic and Antarctic icecaps, combined with the thermal expansion of the oceans, threatens to produce a sea level rise of up to 12 meters. Although these are slow, long-term effects, we owe it to future generations to take steps now to halt global warming.

The dogma of growth

According to Adam Smith, the free market is the dynamo of economic growth. The true entrepreneur does not indulge in luxuries for himself and his family, but reinvests his profits, with the result that his business or factory grows larger, producing still more profits, which he again reinvests, and so on. This is indeed the formula for exponential economic growth.

Economists (with a few notable exceptions such as Aurelio Pecci and Herman Daly) have long behaved as though growth were synonymous with economic health. If the gross national product of a country increases steadily by 4 percent per year, most economists express approval and say that the economy is healthy. If the economy could be made to grow still faster (they maintain), it would be still more healthy. If the growth rate should fall, economic illness would be diagnosed.

However, it is obvious that on a finite Earth, neither population growth nor resource-using and pollution-generating economic growth can continue indefinitely. A "healthy" economic growth rate of 4 percent per year corresponds to an increase by a factor of 50 in a century. (The reader is invited to calculate the factor of increase in five centuries.

The answer is 312,500,000!) No one can maintain that this type of growth is sustainable except by refusing to look more than a short distance into the future. Sooner or later (perhaps surprisingly soon) an entirely new form of economics will be needed - not the empty-world economics of Adam Smith, but what might be called “full-world economics”, or “steady-state economics”.

Although indefinitely continued industrial growth on a finite earth is a logical impossibility, growth is nevertheless the most sacred dogma of both economists and politicians, perhaps because of our fractional reserve banking system, which collapses unless there is growth. Anyone who challenges this dogma is treated as a heretic. For example, Professor Tim Jackson recently wrote an excellent book, “Prosperity Without Growth: Economics for a Finite Planet”, which challenged the concept of unlimited growth. He suffered for his heresy, although he was not actually burned at the stake: The Sustainable Development Commission (of which Jackson was the Economics Commissioner) was abolished by the British government.

If the world continues on the path of unlimited industrial growth, any chance of preventing catastrophic climate change will be lost.

3.3 Exponential growth

Exponential growth of any quantity with time has some remarkable characteristics, which we ought to try to understand better, since this understanding will help us to predict the future. The knowledge will also show us the tasks which history has given to our generation. We must perform these tasks with urgency in order to create a future in which our descendants will be able to survive.

If any quantity, for example population, industrial production or indebtedness, is growing at the rate of 3% per year, it will double in 23.1 years; if it is growing at the rate of 4% per year, the doubling time is 17.3 years. For a 5% growth rate, the doubling time is 13.9 years, if the growth rate is 7% (the rate of economic growth that China’s leaders hope to maintain), the doubling time is only 9.9 years. If you want to find out the doubling time for any exponentially growing quantity, just divide 69.3 years by the growth rate in percent.

Looking at the long-term future, we can calculate that any quantity increasing at the modest rate of 3% per year will grow by a factor of 20.1 in a century. This implies that in four centuries, whatever is growing at 3% will have increased by a factor of 163,000. These facts make it completely clear that long-continued economic growth on a finite planet is a logical absurdity. Yet economists and governments have an almost religious belief in perpetual economic growth. They can only maintain this belief by refusing to look more than a short distance into the future.

Exponential decay of any quantity follows similar but inverse rules. For example, if the chance of a thermonuclear war will be initiated by accident or miscalculation or malice is 3% in any given year, the chance that the human race will survive for more than four centuries under these conditions is only 1 in 163,000, i.e. 0.000625 percent. Clearly, in the

long run, if we do not completely rid ourselves of nuclear weapons, our species will have little hope of survival.

Besides nuclear war, the other great threat to the survival of the human species and the biosphere is catastrophic climate change. The transition to 100% renewable energy must take place within about a century because fossil fuels will become too rare and expensive to burn. But scientists warn that if the transition does not happen much faster than that, there is a danger that we may reach a tipping point beyond which feedback loops, such as the albedo effect and the methane hydrate feedback loop, could 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 degrees C during the 21st century. This is dangerously close to the temperature which initiated the Permian-Triassic extinction event: 6 degrees C above normal. During the Permian-Triassic extinction event, which occurred 252 million years ago. In this event, 96 percent of all marine species were wiped out, as well as 70 percent of all terrestrial vertebrates.¹

Is a quick transition to 100% renewable energy technically possible? The remarkable characteristics of exponential growth can give us hope that it can indeed be done, provided that we make the necessary effort.

The Earth Policy Institute recently reported that “Between 2008 and 2013, as solar panel prices dropped by roughly two thirds, the PV installed worldwide skyrocketed from 16,000 to 139,000 megawatts... In its January 2014 solar outlook report, Deutsche Bank projected that 46,000 megawatts would be added to global PV capacity in 2014 and that new installations would jump to a record 56,000 megawatts in 2015.”

An analysis of the data given by the Earth Policy Institute shows that global installed photovoltaic capacity is now increasing by 27.8% per year. Because of the remarkable properties of exponential growth, we can predict that by 2034, the world's installed PV capacity will have reached 47.7 terawatts, more than twice today's global consumption of all forms of energy (provided, of course, that the present rate of growth is maintained).

We can see from this analysis, and from data presented by Lester Brown and his coauthors Janet Larsen, Mathew Roney and Emily Adams, in their recent book “The Great Transition”, that the urgently-needed replacement of fossil fuels by renewable energy is technically achievable. But it also requires political will. For example the present rapid rate of growth of global PV capacity was initiated by the German government's enlightened financial policies. Government measures helping renewables are vital. At present, governments give billions in direct and indirect support of fossil fuel giants, which in turn sponsor massive advertising campaign to convince the public that anthropogenic climate change is not real. Our task, for the sake of future generations, is to provide the political will needed for the great transition.²

¹ <http://www.worldbank.org/en/news/feature/2012/11/18/Climate-change-report-warns-dramatically-warmer-world-this-century>

² <http://www.earth-policy.org/books/tgt>
<http://eruditio.worldacademy.org/issue-5/article/urgent-need-renewable-energy>

For the sake of future generations, let us also work with dedication for the great transition to a world without nuclear weapons, a world without war, and a world with an economic system that does not depend on growth.

3.4 The case for economic reform

The serious threats which civilization is facing in the 21st century are well known. Nevertheless, it may be useful to list them and to examine how they are related to each other and to our growth-obsessed, war-addicted economic system.

Climate change

The concentration of carbon dioxide in the earth's atmosphere recently passed 400 ppm. The last time that the levels of this heat-trapping gas were so high was several million years ago. At that time the Arctic was free from ice and sea levels were 40 meters higher than they are today. The isotope ratio in gases trapped in Arctic ice cores shows that there is a close correlation between carbon dioxide concentration and temperature. Therefore we must expect that, after some delay, the Arctic will once again be ice-free, and that ocean levels will be very much higher than at present.

As global temperatures increase there are several feedback loops that may be initiated, which will cause temperatures to increase even more sharply. One of these is the albedo effect: As the polar oceans become ice-free, light-reflecting white ice and snow will be replaced by dark, light-absorbing water. As the balance between absorption and reflection is changed, the temperature will rise further, melting more ice. Thus the effect is self-reinforcing.

Another feedback loop, which may cause temperatures to increase more rapidly than predicted by standard models, is the drying out and burning of tropical rain forests. When tropical forests, such as those in the Amazon Basin, are dried out by increasing temperatures, they become vulnerable to fires started by lightning. The effect of the fires is to release more carbon into the atmosphere, thus increasing the temperature and starting still more fires, in a vicious circle.

By far the most serious threatened feedback loop, however, comes from methane clathrates (hydrates) in frozen tundra and especially on ocean floors. Methane is a very much more potent greenhouse gas than carbon dioxide, although its half-life in the atmosphere is only 7 years. At high pressures, methane combines with water to form crystals called clathrates. These crystals are stable at the temperatures currently existing on ocean floors, but whenever the water temperature rises sufficiently, the crystals become unstable and methane gas bubbles to the surface. This effect has already been observed in the Arctic seas north of Russia. The total amount of methane clathrates on ocean floors is not precisely known, but it is estimated to be very large, corresponding to between 3,000 and 11,000 gigatons of carbon. The release of even a small fraction of this amount of methane into our atmosphere

would greatly accelerate rising temperatures, leading to the release of still more methane, in a dangerous feedback loop.

The serious effects of climate change can already be observed in the form of droughts and floods, as well as the increased severity of hurricanes, tornadoes and wildfires. In the long term, anthropogenic climate change threatens to make much of the world uninhabitable and to lead to large-scale species extinctions.

How is it that our supposedly rational species has not long ago mobilized the political will to take the steps needed to prevent catastrophic climate change? Perhaps we can find an answer to this question by examining the faults in our present economic system: For example, large oil corporations, motivated only by greed, see the melting of Arctic ice not as a warning of future catastrophe, but as an opportunity to exploit the fossil fuel resources of the region, thus adding another dangerous feedback loop to those already mentioned. The more the Arctic icecap melts, the more oil can be extracted and burned, thus raising the temperature still further and melting more ice!

The threat of global famine

There is a danger that a famine of unprecedented scale may occur during the present century, caused by prohibitively high prices of fossil fuels (on which modern agriculture depends) compounded by population growth and the effects of climate change.

Has the number of humans in the world already exceeded the earth's sustainable limits? Will the global population of humans crash catastrophically after having exceeded the carrying capacity of the environment? There is certainly a danger that this will happen, a danger that the 21st century will bring very large scale famines to vulnerable parts of the world, because modern energy-intensive agriculture will be dealt a severe blow by prohibitively high petroleum prices, and because climate change will reduce the world's agricultural output.

When the major glaciers in the Himalayas have melted, they will no longer be able to give India and China summer water supplies; rising oceans will drown much agricultural land; and aridity will reduce the output of many regions that now produce much of the world's grain. Falling water tables in overdrawn aquifers, and loss of topsoil will add to the problem. We should be aware of the threat of a serious global food crisis in the 21st century if we are to have a chance of avoiding it.

We saw above how famine-producing climate change is driven by flaws in our present economic system. The threat of large-scale famine is also related to our economic system's addiction to war. The enormous quantities of money that are presently wasted on war could be used instead to stabilize the world's population.

Sir Partha Dasgupta of Cambridge University has pointed out that the changes needed to break the cycle of overpopulation and poverty are all desirable in themselves. Besides education and higher status for women, they include state-provided social security for old people, provision of water supplies near to dwellings, provision of health services to all, abolition of child labor and general economic development.

The intrinsically desirable measures advocated by Sir Partha could be carried out globally for a tiny fraction of the money that is currently poured into the bottomless pit of war. Furthermore, a small fraction of global military expenses could sponsor agricultural research and programs for soil and water conservation. Thus we begin to see that the serious threats that the world will face during the 21st century (and in the more distant future) are closely related to each other and to reform of our flawed economic system.

The threat of economic collapse

It is obvious that endless growth of industry on a finite planet is a logical impossibility, and this is especially clear if we look at the long-term future. Nevertheless, for most economists and all governments, growth is the Holy Grail. To question the need for growth is political and economic heresy.

Some understanding of this irrational fixation on growth can be obtained by examining our fractional reserve banking system. In this system, private banks keep only a small fraction of the money that is entrusted to them by their depositors and lend out the remaining amount. Thus the money supply is controlled by the private banks rather than by the government, and also that profits made from any expansion of the money supply go to private corporations instead of being used to provide social services.

When an economy is growing, the fractional reserve banking system is unjust but not catastrophic. However if the economy contracts, the system produces a disaster. The depositors ask banks for their money, but it is not there. It has been lent out. We are familiar with this situation from the subprime mortgage crisis of 2008, when enormous banks were threatened with collapse, and were only saved by massive bailouts at the taxpayers' expense.

Looking towards the future, we can see that we are approaching a situation in which growth of industry will no longer be possible because of ecological constraints and because of exhaustion of non-renewable resources. When growth is no longer possible, economic stability can only be achieved by reforming our fractional reserve banking system.

What other reforms are needed? Labor must be moved to tasks related to ecological sustainability. The tasks include development of renewable energy, reforestation, soil and water conservation, replacement of private transportation by public transport. Health and family planning services must also be made available to all.

Opportunities for employment must be shared among those in need of work, even if this means reducing the number of hours that each person works each week and simultaneously reducing the use of luxury goods, unnecessary travel, conspicuous consumption and so on. It will be necessary for governments to introduce laws reducing the length of the working week, thus ensuring that opportunities for employment are shared equally.

It is clear that our present economic system, where selfishness is exalted as the main-spring for action, lacks both the ethical and ecological dimensions that are needed to ensure the long-term survival of human civilization. We must mobilize the political will to reform the system, before it is too late.

3.5 A human-initiated 6th geological extinction event

Geologists studying the strata of rocks have observed 5 major extinction events. These are moments in geological time when most of the organisms then living suddenly became extinct. The largest of these was the Permian-Triassic extinction event, which occurred 252 million years ago. In this event, 96 percent of all marine species were wiped out, as well as 70 percent of all terrestrial vertebrates.

In 2012, the World Bank issued a report warning that without quick action to curb CO₂ emissions, global warming is likely to reach 4 degrees C during the 21st century. This is dangerously close to the temperature which initiated the Permian-Triassic extinction event: 6 degrees C above normal.³

The Permian-Triassic thermal maximum seems to have been triggered by global warming and CO₂ release from massive volcanic eruptions in a region of northern Russia known as the Siberian Traps. The amount of greenhouse gases produced by these eruptions is comparable to the amount emitted by human activities today.⁴

Scientists believe that once the temperature passed 6 degrees C above normal, a feedback loop was initiated in which methane hydrate crystals on the ocean floors melted, releasing methane, a potent greenhouse gas. The more methane released the more methane hydrate crystals were destabilized, raising the temperature still further, releasing more methane gas, and so on in a vicious circle. This feedback loop raised the global temperature to 15 degrees C above normal, causing the Permian-Triassic mass extinction.

No reputable doctor who diagnoses cancer would keep this knowledge from the patient. The reaction of the patient may be to reject the diagnosis and get another doctor, but no matter. It is very important that the threatened person should hear the diagnosis, because, with treatment, there is hope of a cure.

Similarly, the scientific community, when aware of a grave danger to our species and the biosphere, has a duty to bring this knowledge to the attention of as broad a public as possible, even at the risk of unpopularity. The size of the threatened catastrophe is so immense as to dwarf all other considerations. All possible efforts must be made to avoid it.

Consider what may be lost if a 6th mass extinction event occurs, caused by our own actions: It is possible that a few humans may survive in mountainous regions such as the Himalayas, but this will be a population of millions rather than billions. If an event comparable to the Permian-Triassic thermal maximum occurs, the family trees of virtually all of the people, animals and plants alive today will end in nothing.

The great and complex edifice of human civilization is a treasure whose value is almost above expression; and this may be lost unless we give up many of our present enjoyments.

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

⁴ <https://www.youtube.com/watch?v=sRGVTK-AAvw>
<https://www.youtube.com/watch?v=MVwmi7HCmSI>
<https://www.youtube.com/watch?v=AjZaFjXfLec>
<https://www.youtube.com/watch?v=m6pFDu7ILV4>

Each living organism, each animal or plant, is product of three billion years of evolution, and a miracle of harmony and complexity; and most of these will perish if we persist in our folly and greed.

Let us, for once, look beyond present pleasures, and acknowledge our duty to preserve a future world in which all forms of life can survive.

3.6 Our duty to future generations

Many traditional agricultural societies have an ethical code that requires them to preserve the fertility of the land for future generations. This recognition of a duty towards the distant future is in strong contrast to the shortsightedness of modern economists. For example, John Maynard Keynes has been quoted as saying “In the long run, we will all be dead”, meaning that we need not look that far ahead. By contrast, members of traditional societies recognize that their duties extend far into the distant future, since their descendants will still be alive.

Here is an ethical principle of the Native Americans: “Treat the earth well. It was not given to you by your parents. It was loaned to you by your children.” They also say: “We must protect the forests for our children, grandchildren, and children yet to be born. We must protect the forests for those who cannot speak for themselves, such as the birds, animals, fish and trees.”

In his book, “The Land of the Spotted Eagle”, the Lakota chief Luther Standing Bear (ca. 1834-1908) wrote: “The Lakota was a true lover of Nature. He loved the earth and all things of the earth... From Waken Tanka (the Great Spirit) there came a great unifying life force that flowered in and through all things: the flowers of the plains, blowing winds, rocks, trees, birds, animals, and was the same force that had been breathed into the first man. Thus all things were kindred and were brought together by the same Great Mystery.”

In some parts of Africa, a man who plans to cut down a tree offers a prayer of apology, telling the tree why necessity has forced him to harm it. This preindustrial attitude is something from which industrialized countries could learn. In industrial societies, land “belongs” to someone, and the owner has the “right” to ruin the land or to kill the communities of creatures living on it, if this happens to give some economic advantage, in much the same way that a Roman slave-owner was thought to have the “right” to kill his slaves. Preindustrial societies have a much less rapacious and much more custodial attitude towards the land and towards its non-human inhabitants.

On April 22, 2010, the World People’s Conference on Climate Change and the Rights of Mother Earth in Cochabamba, Bolivia, adopted a Universal Declaration of the Rights of Mother Earth.⁵ Contrast this expression of the deep ethical convictions of the world’s people with the cynical, money-centered results of various intergovernmental conferences on climate change!

⁵ <http://therightsofnature.org/universal-declaration/>

Our economic system is built on the premise that individuals act out of self-interest, and as things are today, they do so with a vengeance. There is no place in the system for thoughts about the environment and the long-term future. All that matters is the bottom line. The machine moves on relentlessly, exhausting non-renewable resources, turning fertile land into deserts, driving animal species into extinction, felling the last of the world's tropical rainforests, pumping greenhouse gasses into the atmosphere, and sponsoring TV programs that deny the reality of climate change, or other programs that extol the concept of never-ending industrial growth. But the economists, bankers, bribed politicians and corporation chiefs who destroy the earth today, are destroying the future for their own children, grandchildren and great-grandchildren. Does it make sense for them to saw off the branch on which they, like all of us, are sitting?

Recently an extremely grave danger to the long-term future of human civilization and the biosphere has become clear. The latest observations show that Arctic sea ice is melting far faster than was predicted by the IPCC. It now seems likely that the September Arctic sea ice will vanish by as early as 2016 or 2017. It will, of course, refreeze in the winters, but its average total mass will continue to rapidly decrease.

The rapid and non-linear vanishing of Arctic sea ice is due to a feedback loop involving albedo, i.e. the high reflectivity of white ice compared with dark sea water which absorbs most of the radiation that falls onto it. As Arctic sea ice disappears more radiation is absorbed, the Arctic temperature rises still further, still more ice melts, and so on in a vicious circle.

At present Arctic temperatures are roughly 4 degrees C higher than preindustrial levels, and this has led to increasingly rapid melting of the Greenland ice cap. It is now observed that during the summers, lakes of melted water form on the surface of Greenland's inland ice. These lakes feed rivers that run for some distance along the surface of the ice cap, but which ultimately fall through fissures to the bottom of the sheet, where they lubricate its flow. Through this mechanism, the Greenland ice cap is flowing more quickly and calving into massive icebergs much more rapidly than climate scientists expected.

Complete melting of the Greenland ice cap would raise ocean levels by 7 meters. Antarctic sea ice is also breaking up much more rapidly than expected. When it is totally gone, the disappearance of Antarctic sea ice would add another 7 meters to ocean levels, making a total of 14 meters. It is hard to predict how soon this will happen, but certainly within 1-3 centuries.

However, by far the most worrying threat to our long-term future comes from the danger of an out-of-control and exponentially accelerating feedback loop involving methane hydrates. When rivers carry organic matter into the ocean, it decays, forming methane, a powerful greenhouse gas. At the temperatures and pressures currently prevailing on ocean floors, the methane combines with water molecules to form stable crystals called methane hydrates. The amount of carbon stored in methane hydrates is immense: roughly 10,000 gigatons. By comparison, the amount of carbon emitted by human activities since preindustrial times is only 337 gigatons.

Geologists have observed that life on earth has experienced 5 major extinction events, the largest of which was the Permian-Triassic event, when 96 percent of all marine species

and 70 percent of all terrestrial vertebrates disappeared from the fossil record. Predictions based on current CO₂ emission rates predict that early in the 22nd century, global temperature increases will have reached 6 degrees C, the temperature that is thought to have initiated the Permian-Triassic extinction event. These dangers are eloquently discussed in a short, important and clear video prepared by Thom Hartmann and his coworkers. It is available on www.lasthours.org

Must there be a human-initiated 6th geological extinction event? Is it inevitable that the long-term future will witness the disappearance of human civilization and most of the plants and animals that are alive today? No! Absolutely not! It is only inevitable if we persist in our greed and folly. It is only inevitable if we continue to value money more than nature. It is only inevitable if we are afraid to question the authority of corrupt politicians. It is only inevitable if we fail to cooperate globally, and if we fail to develop a new economic system with both a social conscience and an ecological conscience.

We are living today in a time of acute crisis. We need to act with a sense of urgency never before experienced. We need to have great courage to meet an unprecedented challenge. We need to fulfil our duty to future generations

An excellent review of current climates science, entitled *We Are Destroying Our Life Support System* was published by Dahr Jamail on January 28, 2019. It is available on the following link: <https://truthout.org/articles/we-are-destroying-our-life-support-system/>

3.7 The urgent need for renewable energy

The transition to 100% renewable energy must take place within about a century because fossil fuels will become too rare and expensive to burn. But scientists warn that if the transition does not happen much faster than that, there is a danger that we may reach a tipping point beyond which feedback loops could take over and produce a catastrophic increase in global temperature.

Geological extinction events and runaway climate change

The melting of Arctic sea ice is taking place far more rapidly than was predicted by IPCC reports. David Wasdell, Director of the Apollo-Gaia Project, points out that the observed melting has been so rapid that within less than five years, the Arctic will be free of sea ice at the end of each summer. It will, of course continue to refreeze during the winters, but the thickness and extent of the winter ice will diminish.

It has also been observed that both the Greenland ice cap and the Antarctic ice shelves are melting much more rapidly than was predicted by the IPCC. Complete melting of both the Greenland ice cap and the Antarctic sea ice would raise ocean levels by 14 meters. It is hard to predict how fast this will take place, but certainly within 1-3 centuries.

Most worrying, however, is the threat that without an all-out effort by both developed and developing nations to immediately curb the release of greenhouse gases, climate change will reach a tipping point where feed-back loops will have taken over, and where it will

then be beyond the power of human action to prevent exponentially accelerating warming.

By far the most dangerous of these feedback loops involves methane hydrates or 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 much more potent than CO₂.

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

The worst consequences of runaway climate change will not occur within our own lifetimes. However, we have a duty to all future human generations, and to the plants and animals with which we share our existence, to give them a future world in which they can survive.

Is a shift to 100% renewable energy possible?

One answer to the question of whether a shift to 100 percent renewable energy is possible is that it has to happen during this century because fossil fuels are running out. Within a century or so they will be gone in the sense that they will be much too expensive to be burned. Therefore a shift to 100 % renewable energy has to happen within about a hundred years. The vitally important point is that if the shift does not happen quickly, if we do not leave most of our fossil fuels in the ground instead of burning them, we risk a climatic disaster of enormous proportions, perhaps comparable to the Permian-Triassic thermal maximum, during which 70% of terrestrial vertebrates and 93% of marine species became extinct. Thus the shift must happen, and will happen. But we must work with dedication, and a sense of urgency, to make it happen soon.

What are the forms of renewable energy?

The main forms of renewable energy now in use are wind power; hydropower; solar energy; biomass; biofuel; geothermal energy; and marine energy. In addition, there are a number of new technologies under development, such as artificial photosynthesis, cellulostic ethanol, and hydrogenation of CO₂.

⁶<https://www.youtube.com/watch?v=MVwmi7HCmSI>
<https://www.youtube.com/watch?v=AjZaFjXfLec>
<https://www.youtube.com/watch?v=m6pFDu7ILV4>



Figure 3.4: **Limanskaya Solar Power Station in the south-western region of Ukraine.** [CC BY-SA 3.0], Wikimedia Commons

The average global rate of use of primary energy is roughly 2 kilowatts per person. In North America, the rate is 12 kilowatts per capita, while in Europe, the figure is 6 kilowatts. In Bangladesh, it is only 0.2 kilowatts. This wide variation implies that considerable energy savings are possible, through changes in lifestyle, and through energy efficiency.

Solar energy

Biomass, wind energy, hydropower and wave power derive their energy indirectly from the sun, but in addition, various methods are available for utilizing the power of sunlight directly. These include photovoltaic panels, solar designs in architecture, solar systems for heating water and cooking, concentrating photovoltaic systems, and solar thermal power plants.

Solar photovoltaic cells are thin coated wafers of a semiconducting material (usually silicon). The coatings on the two sides are respectively charge donors and charge acceptors. Cells of this type are capable of trapping solar energy and converting it into direct-current electricity. The electricity generated in this way can be used directly (as it is, for example, in pocket calculators) or it can be fed into a general power grid. Alternatively it can be used to split water into hydrogen and oxygen. The gases can then be compressed and stored, or exported for later use in fuel cells. In the future, we may see solar photovoltaic arrays in sun-rich desert areas producing hydrogen as an export product.

The cost of manufacturing photovoltaic cells is currently falling at the rate of 3%-5% per year. The cost in 2006 was \$4.50 per peak Watt. Usually photovoltaic panels are warranted for a life of 20 years, but they are commonly still operational after 30 years or more.

Concentrating photovoltaic systems are able to lower costs still further by combining silicon solar cells with reflectors that concentrate the sun's rays. The most inexpensive type of concentrating reflector consists of a flat piece of aluminum-covered plastic material bent into a curved shape along one of its dimensions, forming a trough-shaped surface.



Figure 3.5: A solar thermal power plant. Arrays of heliostatic reflectors concentrate the sun’s rays onto molten salt in the tower. The plant produces electricity at night because the salt remains hot.

(Something like this shape results when we hold a piece of paper at the top and bottom with our two hands, allowing the center to sag.) The axis of the reflector can be oriented so that it points towards the North Star. A photovoltaic array placed along the focal line will then receive concentrated sunlight throughout the day.

Photovoltaic efficiency is defined as the ratio of the electrical power produced by a cell to the solar power striking its surface. For commercially available cells today, this ratio is between 9% and 14%. If we assume 5 hours of bright sunlight per day, this means that a photocell in a desert area near to the equator (where $1 \text{ kW}/\text{m}^2$ of peak solar power reaches the earth’s surface) can produce electrical energy at the average rate of $20\text{--}30 \text{ W}_e/\text{m}^2$, the average being taken over an entire day and night. (The subscript e means “in the form of electricity”. Energy in the form of heat is denoted by the subscript t , meaning “thermal”.) Thus the potential power per unit area for photovoltaic systems is far greater than for biomass. However, the mix of renewable energy sources most suitable for a particular country depends on many factors.

Wind energy

Wind parks in favorable locations, using modern wind turbines, are able to generate $10 \text{ MW}_e/\text{km}^2$ or $10 \text{ W}_e/\text{m}^2$. Often wind farms are placed in offshore locations. When they are on land, the area between the turbines can be utilized for other purposes, for example for pasturage. For a country like Denmark, with good wind potential but cloudy skies, wind turbines can be expected to play a more important future role than photovoltaics. Denmark is already a world leader both in manufacturing and in using wind turbines. The



Figure 3.6: **Rows of wind turbines.**

use of wind power is currently growing at the rate of 38% per year. In the United States, it is the fastest-growing form of electricity generation.

The location of wind parks is important, since the energy obtainable from wind is proportional to the cube of the wind velocity. We can understand this cubic relationship by remembering that the kinetic energy of a moving object is proportional to the square of its velocity multiplied by the mass. Since the mass of air moving past a wind turbine is proportional to the wind velocity, the result is the cubic relationship just mentioned.

Before the decision is made to locate a wind park in a particular place, the wind velocity is usually carefully measured and recorded over an entire year. For locations on land, mountain passes are often very favorable locations, since wind velocities increase with altitude, and since the wind is concentrated in the passes by the mountain barrier. Other favorable locations include shorelines and offshore locations on sand bars. This is because onshore winds result when warm air rising from land heated by the sun is replaced by cool marine air. Depending on the season, the situation may be reversed at night, and an offshore wind may be produced if the water is warmer than the land.

The cost of wind-generated electrical power is currently lower than the cost of electricity generated by burning fossil fuels. The “energy payback ratio” of a power installation is defined as the ratio of the energy produced by the installation over its lifetime, divided by the energy required to manufacture, construct, operate and decommission the installation. For wind turbines, this ratio is 17-39, compared with 11 for coal-burning plants. The construction energy of a wind turbine is usually paid back within three months.

Biomass

Biomass is defined as any energy source based on biological materials produced by photosynthesis - for example wood, sugar beets, rapeseed oil, crop wastes, dung, urban organic wastes, processed sewage, etc. Using biomass for energy does not result in the net emission of CO₂, since the CO₂ released by burning the material had previously been absorbed from the atmosphere during photosynthesis. If the biological material had decayed instead of being burned, it would have released the same amount of CO₂ as in the burning process.

Miscanthus is a grassy plant found in Asia and Africa. Some forms will also grow in Northern Europe, and it is being considered as an energy crop in the United Kingdom. *Miscanthus* can produce up to 18 dry tonnes per hectare-year, and it has the great advantage that it can be cultivated using ordinary farm machinery. The woody stems are very suitable for burning, since their water content is low (20-30%).

Jatropha is a fast-growing woody shrub about 4 feet in height, whose seeds can be used to produce diesel oil at the cost of about \$43 per barrel. The advantage of *Jatropha* is that it is a hardy plant, requiring very little fertilizer and water. It has a life of roughly 50 years, and can grow on wasteland that is unsuitable for other crops. The Indian State Railway has planted 7.5 million *Jatropha* shrubs beside its right of way. The oil harvested from these plants is used to fuel the trains.

For some southerly countries, honge oil, derived from the plant *Pongamia pinnata* may prove to be a promising source of biomass energy. Studies conducted by Dr. Udishi Shrinivasa at the Indian Institute of Sciences in Bangalore indicate that honge oil can be produced at the cost of \$150 per ton. This price is quite competitive when compared with other potential fuel oils.

Recent studies have also focused on a species of algae that has an oil content of up to 50%. Algae can be grown in desert areas, where cloud cover is minimal. Farm waste and excess CO₂ from factories can be used to speed the growth of the algae.

It is possible that in the future, scientists will be able to create new species of algae that use the sun's energy to generate hydrogen gas. If this proves to be possible, the hydrogen gas may then be used to generate electricity in fuel cells, as will be discussed below in the section on hydrogen technology. Promising research along this line is already in progress at the University of California, Berkeley.

Biogas is defined as the mixture of gases produced by the anaerobic digestion of organic matter. This gas, which is rich in methane (CH₄), is produced in swamps and landfills, and in the treatment of organic wastes from farms and cities. The use of biogas as a fuel is important not only because it is a valuable energy source, but also because methane is a potent greenhouse gas, which should not be allowed to reach the atmosphere. Biogas produced from farm wastes can be used locally on the farm, for cooking and heating, etc. When biogas has been sufficiently cleaned so that it can be distributed in a pipeline, it is known as "renewable natural gas". It may then be distributed in the natural gas grid, or it can be compressed and used in internal combustion engines. Renewable natural gas can also be used in fuel cells, as will be discussed below in the section on Hydrogen Technology.

Biofuels are often classified according to their generation. Those that can be used alternatively as food are called first-generation biofuels. By contrast, biofuels of the second generation are those that make use of crop residues or other cellulose-rich materials. Cellulose molecules are long chains of sugars, and by breaking the inter-sugar bonds in the chain using enzymes or other methods, the sugars can be freed for use in fermentation. In this way lignocellulosic ethanol is produced. The oil-producing and hydrogen-producing algae mentioned above are examples of third-generation biofuels. We should notice that growing biofuels locally (even first-generation ones) may be of great benefit to smallholders in developing countries, since they can achieve local energy self-reliance in this way.

Geothermal energy

The ultimate source of geothermal energy is the decay of radioactive nuclei in the interior of the earth. Because of the heat produced by this radioactive decay, the temperature of the earth's core is 4300 degrees C. The inner core is composed of solid iron, while the outer core consists of molten iron and sulfur compounds. Above the core is the mantle, which consists of a viscous liquid containing compounds of magnesium, iron, aluminum, silicon and oxygen. The temperature of the mantle gradually decreases from 3700 degrees C near the core to 1000 degrees C near the crust. The crust of the earth consists of relatively light solid rocks and it varies in thickness from 5 to 70 km.

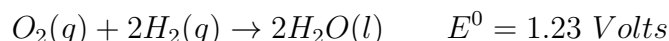
The outward flow of heat from radioactive decay produces convection currents in the interior of the earth. These convection currents, interacting with the earth's rotation, produce patterns of flow similar to the trade winds of the atmosphere. One result of the currents of molten conducting material in the interior of the earth is the earth's magnetic field. The crust is divided into large sections called "tectonic plates", and the currents of molten material in the interior of the earth also drag the plates into collision with each other. At the boundaries, where the plates collide or split apart, volcanic activity occurs. Volcanic regions near the tectonic plate boundaries are the best sites for collection of geothermal energy.

The entire Pacific Ocean is ringed by regions of volcanic and earthquake activity, the so-called Ring of Fire. This ring extends from Tierra del Fuego at the southernmost tip of South America, northward along the western coasts of both South America and North America to Alaska. The ring then crosses the Pacific at the line formed by the Aleutian Islands, and it reaches the Kamchatka Peninsula in Russia. From there it extends southward along the Kuril Island chain and across Japan to the Philippine Islands, Indonesia and New Zealand. Many of the islands of the Pacific are volcanic in nature. Another important region of volcanic activity extends northward along the Rift Valley of Africa to Turkey, Greece and Italy. In the Central Atlantic region, two tectonic plates are splitting apart, thus producing the volcanic activity of Iceland. All of these regions are very favorable for the collection of geothermal power.

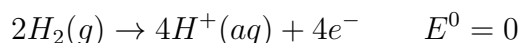
Hydrogen fuel cells

Electrolysis of water to produce hydrogen gas has been proposed as a method for energy storage in a future renewable energy system. For example, it might be used to store energy generated by photovoltaics in desert areas of the world. Compressed hydrogen gas could then be transported to other regions and used in fuel cells. Electrolysis of water and storage of hydrogen could also be used to solve the problem of intermittency associated with wind energy or solar energy.

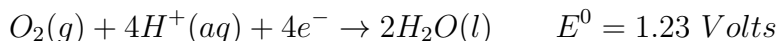
Fuel cells allow us to convert the energy of chemical reactions directly into electrical power. In hydrogen fuel cells, for example, the exact reverse of the electrolysis of water takes place. Hydrogen reacts with oxygen, and produces electricity and water, the reaction being



The arrangement of the a hydrogen fuel cell is such that the hydrogen cannot react directly with the oxygen, releasing heat. Instead, two half reactions take place, one at each electrode, as was just mentioned in connection with the electrolysis of water. In a hydrogen fuel cell, hydrogen gas produces electrons and hydrogen H^+ ions at one of the electrodes.



The electrons flow through the external circuit to the oxygen electrode, while the hydrogen ions complete the circuit by flowing through the interior of the cell (from which the hydrogen and oxygen molecules are excluded by semipermeable membranes) to the oxygen electrode. Here the electrons react with oxygen molecules and H^+ ions to form water.



In this process, a large part of the chemical energy of the reaction becomes available as electrical power.

The theoretical maximum efficiency of a heat engine operating between a cold reservoir at temperature T_C and a hot reservoir at T_H is $1 - T_C/T_H$, where the temperatures are expressed on the Kelvin scale. Since fuel cells are not heat engines, their theoretical maximum efficiency is not limited in this way. Thus it can be much more efficient to generate electricity by reacting hydrogen and oxygen in a fuel cell than it would be to burn the hydrogen in a heat engine and then use the power of the engine to drive a generator.

Hydrogen technologies are still at an experimental stage. Furthermore, they do not offer us a source of renewable energy, but only means for storage, transportation and utilization of energy derived from other sources. Nevertheless, it seems likely that hydrogen technologies will have great importance in the future.

Economic and political considerations

In our present situation, a rapid shift to renewable energy could present the world with many benefits. Ecological constraints and depletion of natural resources mean that industrial growth will very soon no longer be possible. Thus we will be threatened with economic

recession and unemployment. A rapid shift to renewable energy could provide the needed jobs to replace lost jobs in (for example) automobile production. Renewable energy is now competitive with fossil fuels, and thus it represents a huge investment opportunity.

On the other hand, fossil fuel companies have a vested interest in monetizing the assets that they own, as Thom Hartmann points out in the video mentioned at the start of this essay. Institute Professor Noam Chomsky of MIT also explains this difficulty very well.⁷

These considerations point to a fight that will have to be fought by the people of the world who are concerned about the long-term future of human civilization and the biosphere, against the vested interests of our oligarchic rulers. This fight will require wide public discussion of the dangers of runaway climate change. But at present, our corporate-controlled mass media refuse to touch the subject.

3.8 The United Nations Climate Summit

On Tuesday, the 23rd of September, 2014, Leonardo DiCaprio made a really excellent speech to the United Nations Climate Summit in New York.⁸

Delegates at the United Nations Climate Summit were shown images of the inspiring and heartfelt People's Climate March, which took place on Sunday, September 21st. The organizers of the march had expected 100,000 participants. In fact, more than 400,000 people came, and the march was unique in its artistic brilliance and its ethnic diversity. It was one of 2,600 events in 170 nations. The slogan of the march in New York was "To change everything, we need everyone", and in fact everyone came!⁹ The United Nations Climate Summit was certainly a success. Much was achieved And yet, much was missing from the results¹⁰

However, China and India are now the world's two largest emitters of CO₂, and they did not make firm commitments to abandon the burning of coal. In fact, these two countries will suffer greatly from climate change, perhaps already in the near future. The recent floods in Kashmir are a warning of what is to come. Summer temperatures in India may soon become so high that people without air conditioning will be unable to survive. In both China and India, summer water supplies will be threatened by the melting of Himalayan glaciers.

Throughout the world, people of all countries need to act with urgency to switch to an economy that aims at sustainability rather than endless consumption and growth, an

⁷ <http://www.youtube.com/watch?v=NCAsxphZoxE>

⁸ <https://www.youtube.com/watch?v=sRGVTK-AAvw>
<http://eruditio.worldacademy.org/author/john-scales-avery>

⁹ <https://www.youtube.com/watch?v=h5YaqcPEUNc>

¹⁰ <http://mashable.com/2014/09/24/united-nations-climate-summit-takeaways/>
<http://mashable.com/2014/09/23/un-climate-summit-country-promises-map/>
<tp://www.breitbart.com/Big-Peace/2014/09/23/>

UN-Demands-Stricter-CO2-Enforcement-But-Exempts-China

<http://www.asianews.it/news-en/>

China-and-India-snob-climate-summit-at-the-United-Nations-32232.html



Figure 3.7: The People's Climate March, New York, 2014. 400,000 people participated. Similar marches took place throughout the world.

economy based on renewable energy rather than fossil fuels, an economy devoted to life rather than to profits.

3.9 Climate change means lifestyle change

Scientists are unanimous in warning us that unless we very rapidly reduce CO₂ emissions, we risk passing a tipping point beyond which we will be powerless to prevent uncontrollable global warming. We risk a human-produced extinction event comparable to the Permian-Triassic thermal maximum, during which 96 percent of marine species and 70 percent of terrestrial vertebrates became extinct.¹¹

The excellent videos of Thom Hartmann and his co-workers tell us very clearly a fact of which the scientific community is very conscious, but which the mass media refuse to discuss. The fact is this:

Arctic seas are warming very rapidly, and they will soon be free of ice in the summers. The warming of Arctic seas and tundra threatens to release vast quantities of methane into the atmosphere by melting methane hydrates. This in turn threatens to warm the remainder of the world so much that methane hydrates in all offshore deposits will be destabilized. If this happens, the result will be a major extinction event, which will threaten

¹¹ <https://www.youtube.com/watch?v=k4LL1B3JfnY>
<https://www.youtube.com/watch?v=vZO2WQ-qK5c>

not only human civilization, but also much of the biosphere.¹²

It is not so surprising that our mass media do not give us a correct picture of these grave dangers to the future of our earth. The mainstream media are owned by oligarchic financial interests, including large coal and oil companies, which are desperately anxious cash in on their huge holdings of fossil fuels.

Despite silence and misinformation in the mass media, the general public is becoming, to some extent, aware of the grave dangers posed by out-of-control climate change. However, this does not seem to affect people's behavior. Professor Michael Klare discussed this strange split between awareness and behavior in a recent article:¹³

“Considering all the talk about global warming, peak oil, carbon divestment, and renewable energy”, Prof. Klare writes, “you’d think that oil consumption in the United States would be on a downward path. By now, we should certainly be witnessing real progress toward a post-petroleum economy. As it happens, the opposite is occurring. U.S. oil consumption is on an upward trajectory, climbing by 400,000 barrels per day in 2013 alone, and, if current trends persist, it should rise again both this year and next.”

“In other words, oil is back. Big time. Signs of its resurgence abound. Despite what you may think, Americans, on average, are driving more miles every day, not fewer, filling ever more fuel tanks with ever more gasoline, and evidently feeling ever less bad about it. The stigma of buying new gas-guzzling SUVs, for instance, seems to have vanished; according to CNN Money, nearly one out of three vehicles sold today is an SUV. As a result of all this, America’s demand for oil grew more than China’s in 2013, the first time that’s happened since 1999.”

There is a second reason why the mainstream media conspire to reassure their readers and viewers that it is fine to continue their usual lifestyles: This second reason is the fear of precipitating an economic recession. Such a recession is due to occur soon in the United States because of US overspending on war, using money borrowed from China, and because the petrodollar is threatened by BRICS agreements. However, the short-term profit motive ensures that the slave-like media continue to make us believe that all is well, and that economic growth can continue forever.

Undeniably, an economic recession will be extremely painful, but sooner or later it will certainly occur. On a finite planet, endlessly continued economic growth is a logical impossibility. Furthermore, it is exactly that growth which threatens to produce a 6th mass extinction event.

If we wish to save the long-term future of our beautiful earth for future generations of humans, and for the animals and plants with which we share the earth today, we must not only urgently develop all forms of renewable energy, but also we must quickly change our lifestyles. Renewables, such as wind power and solar cells are producing a rapidly increasing fraction of our energy needs, but this fraction is still very small, only 19 percent in 2014.

¹² <https://www.youtube.com/watch?v=m6pFDu7ILV4>
<https://www.youtube.com/watch?v=a9PshoYtoxo>
<https://www.youtube.com/watch?v=c3XpF1MvC8s>

¹³ <http://www.countercurrents.org/klare040914.htm>

What then must we do? We must develop a new economic system which will aim at long-run sustainability. Within such a system, the problem of unemployment can be addressed by shifting jobs to the task of building renewable energy infrastructure. Secondly, we must recognize that our usual lifestyles cannot be continued. We must limit our consumption to necessities; and we must travel only when absolutely necessary. If we do not make these changes, we will have lost the struggle for the future.

3.10 Will a disaster wake us up?

Disaster!

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!”¹⁴

The disasters continue: In recent weeks the drought has deepened in the southwestern part of the United States, and it has reached completely unprecedented severity.¹⁵ The drought will have consequences, not only for the United States, but also for people throughout the world who are dependent on exports of grain grown in that region. The pumping of water from the Ogallala Aquifer has traditionally been used to supply irrigation water to the region, but over the years, the aquifer has been seriously overdrawn, and soon it will be useless.¹⁶

Throughout the world, water shortages produced by a combination of climate change and falling water tables threaten the food security of large portions of the world’s population. At the same time, in other regions, climate change will produce more and more disastrous floods.

But are these disasters enough to wake us up to the grave dangers of runaway climate change? Or are we so addicted to the use of fossil fuels that we cannot give them up?

Is there a difference in the attitudes of ordinary people and those of corporate-controlled governments? It is certain that the fossil fuel giants are determined to convert their coal, oil and gas holdings into cash. But ordinary citizens are more responsible, as was shown by the massive popular demonstrations at COP 15 in 2009.

UN Secretary General Ban Ki-moon has invited heads of state and governments to a 2014 Climate Summit, which will take place in New York on 23 September, 2014. 400,000 ordinary people marched in New York on that day, to show their concern for the future of

¹⁴ <http://www.theguardian.com/environment/video/2012/oct/25/david-attenborough-climate-change-video>

¹⁵ <http://droughtmonitor.unl.edu/>

¹⁶ <http://www.countercurrents.org/cc170714.htm>
<http://www.informationclearinghouse.info/article39077.htm>

our planet, and to demonstrate how much they desire to give future generations of humans, animals and plants a world in which survival will be possible.

In order to prevent a tipping point, after which human efforts to prevent drastic temperature increases will become ineffective, it may be necessary for ordinary people to replace their oligarchic governments with true democracies.

3.11 Paris, India and coal

The MIT Technology Review recently published an important article entitled “India’s Energy Crisis”.¹⁷

The article makes alarming reading in view of the world’s urgent need to make a very rapid transition from fossil fuels to 100% renewable energy. We must make this change quickly in order to avoid a tipping point beyond which catastrophic climate change will be unavoidable.¹⁸

The MIT article states that “Since he took power in May, 2014, Prime Minister Narendra Modi has made universal access to electricity a key part of his administration’s ambitions. At the same time, he has pledged to help lead international efforts to limit climate change. Among other plans, he has promised to increase India’s total power generating capacity to 175 gigawatts, including 100 gigawatts of solar, by 2022. (That’s about the total power generation of Germany.)”

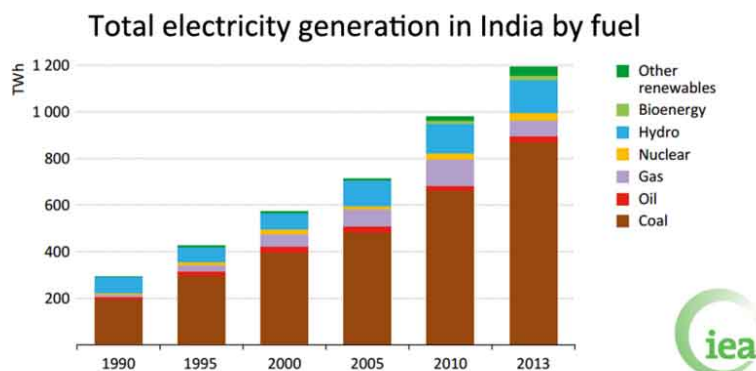
However India plans to expand its industrial economy, and to do this, it is planning to very much increase its domestic production and use of coal. The MIT article continues, pointing out that

“Such growth would easily swamp efforts elsewhere in the world to curtail carbon emissions, dooming any chance to head off the dire effects of global climate change. (Overall, the world will need to reduce its current annual emissions of 40 billion tons by 40 to 70 percent between now and 2050.) By 2050, India will have roughly 20 percent of the world’s population. If those people rely heavily on fossil fuels such as coal to expand the economy and raise their living standards to the level people in the rich world have enjoyed for the last 50 years, the result will be a climate catastrophe regardless of anything the United States or even China does to decrease its emissions. Reversing these trends will require radical transformations in two main areas: how India produces electricity, and how it distributes it.”

The Indian Minister of Power, Piyush Goyal, is an enthusiastic supporter of renewable energy expansion, but he also supports, with equal enthusiasm, the large-scale expansion of domestic coal production in India.

¹⁷<http://www.technologyreview.com/featuredstory/542091/indias-energy-crisis/>

¹⁸<https://www.youtube.com/watch?v=2bRrg96UtMc>
<https://www.youtube.com/watch?v=MVwmi7HCmSI>
<https://www.youtube.com/watch?v=AjZaFjXfLec>
<https://www.youtube.com/watch?v=MVwmi7HCmSI>



Meanwhile, the consequences of global warming are being felt by the people of India. For example, a recent heat wave killed over 1,400 people and melted asphalt streets.¹⁹

Have India's economic planners really thought about the long-term future? Have they considered the fact that drastic climate change could make India completely uninhabitable?

WE NEED SYSTEM CHANGE, NOT CLIMATE CHANGE! Civil society, excluded from the COP21 conference by the French government, carried banners with this slogan on the streets of Paris. They did so in defiance of tear-gas-using black-clad police. System change has been the motto for climate marches throughout the world. Our entire system is leading us towards disaster, and this includes both economic and governmental establishments. To save human civilization, the biosphere and the future, the people of the world must take matters into their own hands and change the system.²⁰

Our present situation is this: The future looks extremely dark because of human folly, especially the long-term future. The greatest threats are catastrophic climate change and thermonuclear war, but a large-scale global famine also has to be considered. All these threats are linked.

Inaction is not an option. We have to act with courage and dedication, even if the odds are against success, because the stakes are so high. The mass media could mobilize us to action, but they have failed in their duty. Our educational system could also wake us up and make us act, but it too has failed us. The battle to save the earth from human greed and folly has to be fought through non-violent action on the streets and in the alternative media.

¹⁹<https://www.rt.com/news/262641-india-heat-wave-killed/>

²⁰<http://www.commondreams.org/views/2015/12/11/we-are-out-time-we-need-leap>
<http://www.thenation.com/article/naomi-klein-sane-climate-policies-are-being-undermined-by-corporate-friendly-trade-deals/>
<http://www.commondreams.org/news/2015/12/08/liberte-not-just-word-klein-corbyn-call-mass-protest-cop21>
<http://www.truth-out.org/news/item/33982-the-cops-of-cop21-arrests-at-the-paris-climate-talks>
<http://www.truth-out.org/news/item/33961-climate-change-justice>
<http://www.countercurrents.org/avery280914.htm>



We need a new economic system, a new society, a new social contract, a new way of life. Here are the great tasks that history has given to our generation: We must achieve a steady-state economic system. We must restore democracy. We must decrease economic inequality. We must break the power of corporate greed. We must leave fossil fuels in the ground. We must stabilize and ultimately reduce the global population. We must eliminate the institution of war. And finally, we must develop a more mature ethical system to match our new technology.²¹

What are the links between the problems facing us? There is a link between climate change and war. We need to leave fossil fuels in the ground if we are to avoid catastrophic climate change. But nevertheless, the struggle for the world's last remaining oil and gas resources motivated the invasion of Iraq, and it now motivates the war in Syria. Both of these brutal wars have caused an almost indescribable amount of suffering.²²

ISIS runs on oil, and the unconditional support of Saudi Arabia by the West is due to greed for oil. Furthermore, military establishments are among the largest users of oil, and the largest greenhouse gas emitters. Finally, the nearly 2 trillion dollars that the world now spends on armaments and war could be used instead to speed the urgently needed transition to 100% renewable energy, and to help less-developed countries to face the consequences of climate change.

There are reasons for hope. Both solar energy and wind energy are growing at a phenomenal rate, and the transition to 100% renewable energy could be achieved within a very few decades if this growth is maintained. But a level playing field is needed. At present fossil fuel corporations receive half a trillion dollars each year in subsidies. Nuclear power generation is also highly subsidized (and also closely linked to the danger of nuclear war). If these subsidies were abolished, or better yet, used to encourage renewable energy development, the renewables could win simply by being cheaper.²³

We can also take inspiration from Pope Francis, whose humanitarian vision links the various problems facing us. Pope Francis also shows us what we can do to save the future, and to give both economics and government a social and ecological conscience.

None of us asked to be born in a time of crisis, but history has given great tasks to our generation. We must rise to meet the crisis. We must not fail in our duty to save the gifts of life and civilization that past generations have bequeathed to us. We must not fail in our duty future generations.

²¹<http://www.fredsakademiet.dk/library/need.pdf>

²²<http://www.truth-out.org/opinion/item/33991-end-war-ming-we-need-system-change-not-climate-change>

²³<http://eruditio.worldacademy.org/issue-5/article/urgent-need-renewable-energy>
<http://www.worldbank.org/en/news/feature/2012/11/18/Climate-change-report-warns-dramatically-warmer-world-this-century>
<https://www.youtube.com/watch?v=AjZaFjXfLec>
<https://www.youtube.com/watch?v=m6pFDu7ILV4>
<https://www.youtube.com/watch?v=MVwmi7HCmSI>
<http://therightsofnature.org/universal-declaration/>

3.12 The US and Brazil move towards fascism

The disastrous 2016 US election

In the United States, campaigns for the presidential election of 2016 might have been an occasion for a realistic discussion of the enormously important challenges which we now face, not only in the America, but also throughout the world.

Most thoughtful people agree that the two most important issues facing humanity today are the threat of catastrophic and uncontrollable climate change, and the threat of nuclear war. Each of these threatened disasters has the potential to destroy human civilization and much of the biosphere. But on the whole these vitally important issues were not discussed in an honest way in the mainstream media. Instead the campaign spectacle presented to us by the media was washed down into the murky depths of stupidity by rivers of money from the fossil fuel giants and the military industrial complex.

The Republican presidential candidates were almost single-voiced in denying the reality of climate change, and they were almost unanimously behind foreign policy options that would push the world to the brink of nuclear war.

Unless rapid action is taken, the world may soon pass a tipping point after which human efforts to avoid catastrophic climate change will be useless because feedback loops will have taken over. However, our present situation is by no means hopeless, because of the extremely rapid rate of growth of renewable energy. What can governments do to help? They can stop subsidizing the fossil fuel industry! Without massive fossil fuel subsidies, renewables would be the cheaper option, and economic forces alone would drive the urgently-needed transition to 100% renewable energy.

A report by RNE21, a global renewable energy policy network, states that “Global subsidies for fossil fuels remain high despite reform efforts. Estimates range from USD 550 billion (International Energy Agency) to USD 5.6 trillion per year (International Monetary Fund), depending on how ‘subsidy’ is defined and calculated.”

“Growth in renewable energy (and energy efficiency improvements) is tempered by subsidies to fossil fuels and nuclear power, particularly in developing countries. Subsidies keep conventional energy prices artificially low, which makes it more difficult for renewable energy to compete...”

“Creating a level playing field can lead to a more efficient allocation of financial resources, helping to strengthen to advance the development of energy efficiency and renewable energy technologies. Removing fossil fuel and energy subsidies globally would reflect more accurately the true cost of energy generation.”²⁴

There is, so to speak, an elephant in the room; but no one wants to talk about it. Everyone (with a very few exceptions) pretends not to see it. They pretend that it is not there. What is this metaphorical elephant? It is the Pentagon’s colossal budget, which is far too sacred a thing to be mentioned in an election campaign.

The size of this budget is almost beyond comprehension: 610 billion dollars per year.

²⁴<http://www.ren21.net/status-of-renewables/global-status-report/>



Figure 3.8: **Is this the person to whom we ought to entrust the future of our planet? When elected, Donald Trump not only pulled the United States out of the Paris Agreement; he also sabotaged the Environmental Protection Agency to such an extent that the carefully collected facts on climate change that the agency had accumulated had to be secretly saved by scientists to prevent their destruction by the Trump administration. Furthermore, Donald Trump’s administration not only subsidizes giant coal corporations. It also has sabotages renewable energy initiatives in the United States.**

This does not include nuclear weapons research, maintenance, cleanup and production, which are paid for by the Department of Energy. Nor does it include payments in pensions to military retirees and widows, nor interest on debt for past wars, nor the State Department’s financing foreign arms sales and military-related development assistance, nor special emergency grants for current wars. Nor are the expenses of the Department of Homeland Security included in the Pentagon’s budget, nor those of the CIA, nor the huge budget of NSA and other dark branches of the US government. One can only guess at the total figure if everything should be included, but it is probably well over a trillion dollars per year.

The hidden presence in the room is a trillion-dollar elephant. Perhaps we should include subsidies to fossil fuel giants. Then we would have a multi-trillion-dollar elephant. But it is too sacred to be mentioned. Cut Medicare! Cut pensions! Cut Social Security! Abolish food stamps! Sacrifice support for education! We are running out of money! (Meanwhile the elephant stands there, too holy to be seen.)

Against expectations, Donald Trump who, in the words of Michael Moore, is a “wretched,



Figure 3.9: When Senator Bernie Sanders began his campaign for the Democratic presidential nomination, few people believed that he could succeed. But as his campaign gained momentum, enormous crowds were attracted to his reformist speeches, and small individual donors supported his expenses. Although the crowds at Sanders' speeches were at least four times the size of those attending the rallies of other candidates, they were not reported in the mass media. Sanders' campaign was also sabotaged by the corporate-controlled Democratic National Committee. His huge popularity remains undimmed today, despite his loss in the 2016 primary. He advocates a social system for the United States similar to these which have made the Scandinavian countries leaders in both human development and human happiness indices.



Figure 3.10: Dr. Jill Stein was the Green Party’s presidential candidate in 2016. She was the only candidate who was willing to talk about the “elephant in the room” - the obscenely enormous military budget that consumed almost a trillion dollars that could otherwise have been used for social goals, health, education and infrastructure.

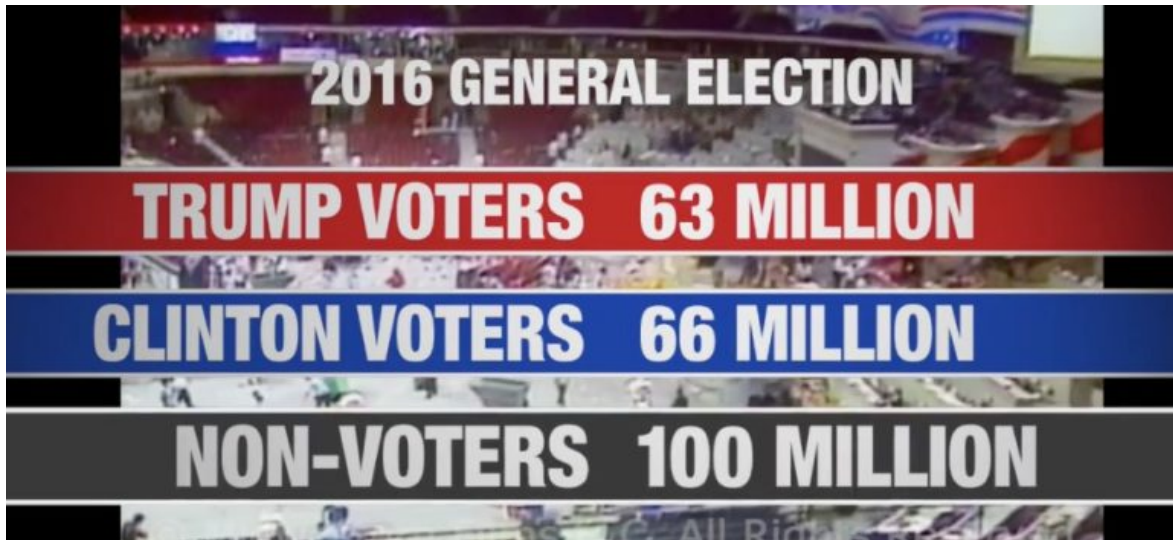


Figure 3.11: Disillusioned progressive voters who stayed at home were responsible for Trump's victory.

ignorant, dangerous part-time clown and full-time sociopath", was elected in 2016. What happened? Disillusioned by the way in which the immensely popular Senator Bernie Sanders was sabotaged by the media and by the Democratic National Committee, and despising Hillary Clinton for her involvement in US wars and Wall Street banks, many progressive voters stayed away from the polls. In their absence, Trump won narrowly. He lost the popular vote, but won the electoral vote. Today, the White House is a morass of dissension, erratic decisions and lies.

Jair Bolsonaro, the Trump of the Tropics

The newly elected President of Brazil, Jair Bolsonaro, has praised Pinochet, expressed support for torturers and called for political opponents to be shot, earning him the label of “the most misogynistic, hateful elected official in the democratic world”. Bolsonaro speaks nostalgically about the country’s 1964-1985 military dictatorship and has promised to fill his government with current and former military leaders. Here, in his own words, are some of his ideas:

On refugees: “The scum of the earth is showing up in Brazil, as if we didn’t have enough problems of our own to sort out.” (September 2015)

On gay people: “I would be incapable of loving a homosexual son. I’m not going to be a hypocrite: I’d rather my son died in an accident than showed up with some bloke with a moustache.” (June 2011)

On democracy and dictatorship: “You’ll never change anything in this country through voting. Nothing. Absolutely nothing. Unfortunately, things will only change when a civil war kicks off and we do the work the [military] regime didn’t. Killing some 30,000... Killing them! If a couple of innocents die, that’s OK.” (May 1999)

On human rights: “I’m in favour of torture.” (May 1999)

On women: “I said I wouldn’t rape you because you don’t deserve it.” (December 2014, to politician Maria do Rosário, repeating a comment first made to her in 2003).

Indigenous rights activists fear Bolsonaro’s avowed plan to wring riches from the Amazon - whether from expanding agriculture into indigenous lands, building roads and other infrastructure projects, or allowing mining on public lands - will unleash a tide of violence and environmental devastation.

“All indigenous communities are afraid right now,” says Felipe Milanez, professor of humanities at the Universidade Federal de Bahia. “There is a risk of brutal, violent attack.” Milanez fears that indigenous efforts to patrol and protect their own lands from outsiders, such as the Forest Guardians recently covered in *National Geographic* magazine, will be banned and persecuted.

“His economic project is to destroy the Amazon, to transform the Amazon into commodities for export,” Milanez says.

Human rights activists are concerned that a surge in violent land conflicts will accompany an increase in environmentally destructive development in the Amazon. “There is no doubt that devastation will spread in the region,” says Diogo Cabral, an attorney with the Sociedade Maranhense de Direitos Humanos. “At the same time, he aims to extinguish policies that protect human rights defenders in Brazil. Under Bolsonaro, human life will have no value.”



Figure 3.12: The indigenous peoples of the Amazon are the guardians of the lungs of Planet Earth. Within hours of taking office on 1 January, 2019, the Trump of the Tropics, aka the new President of Brazil, Jair Bolsonaro, launched an all-out assault against the Amazon rainforest and its indigenous communities yesterday, potentially paving the way for large scale deforestation by agricultural, mining and oil companies.

The indigenous peoples' website Mongabay ²⁵ states that “The potentially resulting wholesale deforestation could be a disaster to indigenous peoples, biodiversity, and even the regional and global climate.”

It adds: “Bolsonaro’s proposed Amazon policies, if carried out, could ultimately help dash the world’s hopes of achieving the global climate goals agreed to in Paris, a failure that could lead to climate chaos.”

Leading Brazilian researchers, from the National Institute of Space Research (INPE), have calculated that Bolsonaro’s policies could triple deforestation in the Amazon from present levels of 6,900 square kilometers (2,664 square miles) annually, to 25,600 square kilometers (9,884 square miles) per year by 2020.

3.13 Climate change denial

In a recent article, climate expert Dr. Andrew Glickson wrote: “The train has left the station and global heating is advancing toward +2 and then toward +4 degrees Celsius, as projected by the IPCC and in the words of Joachim Hans Schellnhuber, Germany’s chief climate scientist, signifies the breakdown of civilization. Largely ignored or watered down by much of the mainstream media, betrayed by most political parties, including those who used to regard climate change as “the greatest moral issue of our time”, the population continues to be distracted by bread and circuses. Nowadays even some of the Greens appear to consider plastic bags and the tampon tax as greater vote winners than the demise of the biosphere.”

Why did Professor Noam Chomsky call the US Republican Party “The most dangerous organization in the history of the world”? In the primary that preceded the 2016 presidential election, every single Republican candidate with a chance of being nominated was a climate change denier. All received amazingly generous checks from giant fossil fuel organizations. When elected, Donald Trump not only pulled the United States out of the Paris Agreement; he also sabotaged the Environmental Protection Agency to such an extent that the carefully collected facts on climate change that the agency had accumulated had to be secretly saved by scientists to prevent their destruction by the Trump administration. Furthermore, Donald Trump not only subsidizes giant coal corporations. He also has sabotages renewable energy initiatives in the United States.

3.14 The fossil fuel industry’s denial 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

²⁵<https://news.mongabay.com/2019/01/bolsonaro-hands-over-indigenous-land-demarcation-to-agriculture-ministry/?fbclid=IwAR3UG-jneDheuddVEWVcCrcWkK4bnnsdE1uIBMLlnLtS6zGqMmGSPxtgEzM>

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”²⁶, 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 articles²⁷ 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.²⁸ 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 Guardian²⁹ 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).”³⁰

²⁶www.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

²⁷<https://insideclimatenews.org/news/15092015/Exxons-own-research-confirmed-fossil-fuels-role-in-global-warming>

²⁸<https://insideclimatenews.org/news/18092015/exxon-confirmed-global-warming-consensus-in-1982-with-in-house-climate-models>

²⁹<https://www.theguardian.com/environment/climate-consensus-97-per-cent/2018/sep/19/shell-and-exxons-secret-1980s-climate-change-warnings>

³⁰See 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/>
<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>

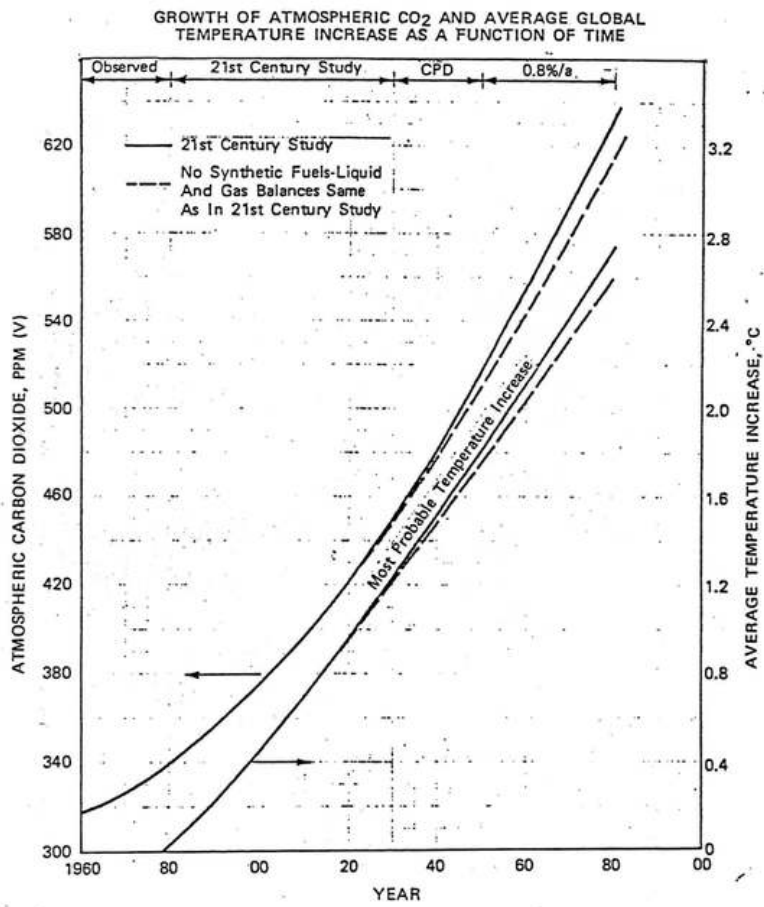


Figure 3.13: Exxon's 1982 internal projections of the future increase in carbon dioxide levels.

3.15 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 their 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. 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.

3.16 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 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 irre-

<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>



Figure 3.14: A firefighter battles fire in California. The world is currently 1 degree Centigrade warmer than preindustrial levels.

versible 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.

3.17 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.



Figure 3.15: 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.”

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.



Figure 3.16: 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.”

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 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^{3132 33 34} is given below,

³¹<https://www.youtube.com/watch?v=VFkQSGyeCWg>

³²<https://www.youtube.com/watch?v=0TYyBtb1PH4>

³³<https://www.youtube.com/watch?v=DdAOgNTxxt0>

³⁴<https://www.youtube.com/watch?v=pJ1HRGA8g10>



Figure 3.17: 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 3.18: 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.”

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 emergency 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.

Greta Thunberg's TED talk

In November, 2018, Greta Thunberg gave an impressively clear TEDx talk in Stockholm, the video of which was recently released.³⁵ Here is a transcript of the talk.

³⁵<https://www.dailykos.com/stories/2018/12/16/1819508/-A-Call-to-Action-on-Climate-Change-by-15-year-Old-Greta-Thunberg>

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 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.

3.18 The coal industry's heavy hand at COP24

After learning of the Trump Administration's plans to sponsor a pro-coal exhibition at COP24, May Boeve, Executive Director of 350.org, issued the following statement:

"Trump's COP24 coal convention is a disgraceful clown show. As the world transitions away from coal, oil, and gas, fossil fuel CEOs and their political puppets are trying to keep us hooked. Meanwhile, communities here at home - from California to Puerto Rico and more - are attempting to rebuild from devastating and worsening fires and storms.

"Last week's National Climate Assessment doubled down on IPCC warnings: the climate crisis is already here, and the costs are being paid for in our lives and livelihoods. Instead of propping up sunset industry, we should be investing in a Green New Deal that prioritizes frontline and coal-communities, nurtures a livable planet, and creates millions of good jobs in the process.

"Led by Indigenous Peoples, youth, and frontline communities, people across the US are already hard at work building real solutions to the climate crisis: from solar panels in the path of Keystone XL, to offshore wind, and a community-owned solar plant in Brooklyn.

In the face of a federal administration exploiting our health and safety, we need to pressure elected officials at all levels to take action at the scale of the crisis; that means stopping all fossil fuel projects and transitioning to 100% renewables for all.”

Coal was not only visible everywhere at COP24. It could literally be breathed in with the air. Smokestacks and coal plumes are visible from the spaceship-shaped conference center, and the Wujek coal mine is less than three miles away. And if you thought Poland would try to downplay its historical (and, well, current) reliance on coal, you’d be wrong: The booth for the town of Katowice, sitting right next to the official one for all of Poland, proudly touts coal. And not just a little coal - coal made into soap, coal made into earrings and other jewelry, coal under glass, coal in cages - lots and lots of coal.

“Every government in Poland is coal, coal,” Monika Sadkowska, a Warsaw-based climate activist, said. “The only strong worker union in Poland is mining. And every government is afraid of them.”

3.19 The 2019 Davos Economic Forum

Interviewed at the Davos Economic Forum at the end of January, 2019, Greta Thunberg said: “Some people say we are not doing enough to fight climate change. That is not true, because to not do enough, you have to do something, and the truth is that we are basically not doing anything.”

Speaking of the powerholders at Davos, she said: “They have known exactly what priceless values they have been sacrificing to continue making unimaginable amounts of money.

“I think it is very unfair that the older generations have done this to us and future generations... and that we will have to clean up after them. Young people need to realize that their future is at risk. They need to do something about that and get angry, and form that anger into action,” she said, insisting that when children speak up they can have a “huge impact”.



Figure 3.19: Greta Thunberg at the Davos Economic Forum in Switzerland, January 2019. Appearing among billionaires, corporate CEO's and heads of state like a new Joan of Arc, she called on decision-makers to fulfil their responsibilities to future generations.



Figure 3.20: An estimated 30,000 students participated in a school strike for climate action in Brussels. Such strikes have spread from Sweden to a number of other countries, such as Belgium, Germany, Poland and Australia.

Transcript of Greta's speech at Davos

Here is a transcript of remarks that Greta Thunberg made at Davos on Friday, January 25, 2019:

Our house is on fire. I am here to say, our house is on fire.

According to the IPCC (Intergovernmental Panel on Climate Change), 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%.

And please note that those numbers do not include the aspect of equity, which is absolutely necessary to make the Paris agreement work on a global scale. Nor does it include tipping points or feedback loops like the extremely powerful methane gas released from the thawing Arctic permafrost.

At places like Davos, people like to tell success stories. But their financial success has come with an unthinkable price tag. And on climate change, we have to acknowledge we have failed. All political movements in their present form have done so, and the media has failed to create broad public awareness.

But Homo sapiens have not yet failed.

Yes, we are failing, but there is still time to turn everything around. We can still fix this. We still have everything in our own hands. But unless we recognize the overall failures of our current systems, we most probably don't stand a chance.

We are facing a disaster of unspoken sufferings for enormous amounts of people. And now is not the time for speaking politely or focusing on what we can or cannot say. Now is the time to speak clearly.

Solving the climate crisis is the greatest and most complex challenge that *Homo sapiens* have ever faced. The main solution, however, is so simple that even a small child can understand it. We have to stop our emissions of greenhouse gases.

Either we do that or we don't.

You say nothing in life is black or white. But that is a lie. A very dangerous lie. Either we prevent 1.5C of warming or we don't. Either we avoid setting off that irreversible chain reaction beyond human control or we don't.

Either we choose to go on as a civilization or we don't. That is as black or white as it gets. There are no grey areas when it comes to survival.

We all have a choice. We can create transformational action that will safeguard the living conditions for future generations. Or we can continue with our business as usual and fail.

That is up to you and me.

Some say we should not engage in activism. Instead we should leave everything to our politicians and just vote for a change instead. But what do we do when there is no political will? What do we do when the politics needed are nowhere in sight?

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.



Adults keep saying: “We owe it to the young people to give them hope.” But I don’t want your hope. I don’t want you to be hopeful. I want you to panic. I want you to feel the fear I feel every day. And then I want you to act.

I want you to act as you would in a crisis. I want you to act as if our house is on fire. Because it is.

Suggestions for further reading

1. Ehrlich P-R (1995) *The scale of the human enterprise and biodiversity loss*, in *Extinction Rates*, eds Lawton JH, May RM (Oxford Univ Press, Oxford, UK), pp 214-226.
2. Dirzo R, et al. (2014) *Defaunation in the Anthropocene*. *Science* **345**:401-406.
3. Young HS, McCauley DJ, Galletti M, Dirzo R (2016) *Patterns, causes, and consequences of Anthropocene defaunation*. *Annu Rev Ecol Evol Syst* **47**:433-458.
4. World Wide Fund for Nature (2016) *Living Planet Report 2016. Risk and resilience in a new era*. (WWF International, Gland, Switzerland), 2017.
5. Maxwell SL, Fuller RA, Brooks TM, Watson JEM (2016) *Biodiversity: The ravages of guns, nets and bulldozers*. *Nature* **536**:143-145.
6. Laliberte AS, Ripple WJ (2004) *Range contractions of North American carnivores and ungulates*. *BioScience* **54**:123-138.
7. Worm B, Tittensor DP (2011) *Range contraction in large pelagic predators*. *Proc Natl Acad Sci USA* **108**:11942-11947.
8. Ripple WJ, et al. (2014) *Status and ecological effects of the world’s largest carnivores*. *Science* **343**:1241-1244.
9. Barnosky AD, et al. (2011) *Has the Earth’s sixth mass extinction already arrived?* *Nature* **471**:51-57.

10. Ceballos G, Garcia A, Ehrlich PR (2010) *The sixth extinction crisis: Loss of animal populations and species*. J. Cosmology **8**:1821-1831.
11. Ceballos G, et al. (2015) *Accelerated modern human-induced species losses: Entering the sixth mass extinction*. Sci Adv **1**:e1400253.
12. Wake DB, Vredenburg VT (2008) *Colloquium paper: Are we in the midst of the sixth mass extinction? A view from the world of amphibians*. Proc Natl Acad Sci USA **105**:11466-11473.
13. McCallum ML (2015) *Vertebrate biodiversity losses point to a sixth mass extinction*. Biol Conserv **24**:2497-2519.
14. Pimm SL, et al. (2014) *The biodiversity of species and their rates of extinction, distribution, and protection*. Science **344**:1246752.
15. McCauley DJ, et al. (2015) *Marine defaunation: Animal loss in the global ocean*. Science **347**:1255641.
16. Collen B, Böhm M, Kemp R, Baillie J (2012) *Spineless: Status and Trends of the World's Invertebrates* (Zoological Society of London, London). Red List
17. Daily G (1997) *Nature's Services: Societal Dependence on Natural Ecosystems*. (Island Press, Covello, CA).
18. Naeem S, Duffy JE, Zavaleta E (2012) *The functions of biological diversity in an age of extinction*. Science **336**:1401-1406.
19. Estes JA, et al. (2011) *Trophic downgrading of planet Earth*. Science **333**:301-306.
20. Brosi BJ, Briggs HM (2013) *Single pollinator species losses reduce floral fidelity and plant reproductive function*. Proc Natl Acad Sci USA **110**:13044-13048.
21. Briggs JC (2014) *Global biodiversity gain is concurrent with decreasing population sizes*. Biodiver J **5**:447-452.
22. Hooper DU, et al. (2012) *A global synthesis reveals biodiversity loss as a major driver of ecosystem change*. Nature **486**:105-108.
23. Ehrlich PR (2014) *The case against de-extinction: It's a fascinating but dumb idea*. Yale Environment 360 (Yale University, New Haven, CT). Available at bit.ly/1gAIuJF. Accessed JunStudiese 10, 2017.
24. Hobbs RJ, Mooney HA (1998) *Broadening the extinction debate: Population deletions and additions in California and Western Australia*. Conserv Biol **12**:271-283. Studies
25. Hughes JB, Daily GC, Ehrlich PR (1997) *Population diversity: Its extent and extinction*. Science **278**:689-692.
26. Ceballos G, Ehrlich PR (2002) *Mammal population losses and the extinction crisis*. Science **296**:904-907.
27. Gaston KJ, Fuller RA (2008) *Commonness, population depletion and conservation biology*. Trends Ecol Evol **23**:14-19.
28. International Union of Conservation of Nature (2015) *The IUCN Red List of Threatened Species, Version 2015.2* (IUCN, 2015). Available at www.iucnredlist.org. Accessed February 10, 2016. Revised January 10, 2017.
29. Durant SM, et al. (2017) *The global decline of cheetah *Acinonyx jubatus* and what it means for conservation*. Proc Natl Acad Sci USA **114**:528-533.

30. Henschel P, et al. (2014) *The lion in West Africa is critically endangered*. PLoS One **9**:e83500.
31. Challender D, et al. (2016) *On scaling up pangolin conservation*. Traffic Bulletin *28*: 19-21.
32. Fennessy J, et al. (2016) *Multi-locus analyses reveal four giraffe species instead of one*. Curr Biol **26**:2543-2549.
33. Butchart S, Dunn E (2003) *Using the IUCN Red List criteria to assess species with declining populations*. Conserv Biol **17**:1200-1202.
34. Gaston K, Blackburn T (2008) *Pattern and Process in Macroecology* (Blackwell Publishing, Hoboken, NJ). Red List
35. Thomas JA (2016) ECOLOGY. *Butterfly communities under threat*. Science *353*:216-218.
36. Régnier C, et al. (2015) *Mass extinction in poorly known taxa*. Proc Natl Acad Sci USA **112**:7761-7766.25.
37. Hughes JB, Daily GC, Ehrlich PR (1997) *Population diversity: Its extent and extinction*. Science **278**:689-692.
38. Ceballos G, Ehrlich PR (2002) *Mammal population losses and the extinction crisis*. Science **296**:904-907.
39. Cardinale BJ, et al. (2012) *Biodiversity loss and its impact on humanity*. Nature **486**: 59-67.
40. Hurlbert AH, Jetz W (2007) *Species richness, hotspots, and the scale dependence of range maps in ecology and conservation*. Proc Natl Acad Sci USA **104**:13384-13389.
41. Peterson AT, Navarro-Sigüenza AG, Gordillo A (2016) *Assumption- versus data-based approaches to summarizing species' ranges*. Conserv Biol, 10.1111/cobi.12801.
42. Martínez-Ramos M, Ortiz-Rodríguez I, Pinero D, Dirzo R, Sarukhán J (2016) *Humans disrupt ecological processes within tropical rainforest reserves*. Proc Natl Acad Sci USA **113**:5323-5328.
43. Camargo-Sanabria AA, Mendoza E, Guevara R, Martínez-Ramos M, Dirzo R (2015) *Experimental defaunation of terrestrial mammalian herbivores alters tropical rainforest understory diversity*. Proc Biol Sci **282**:20142580.
44. Petipas RH, Brody AK (2014) *Termites and ungulates affect arbuscular mycorrhizal richness and infectivity in a semiarid savanna*. Botany **92**:233-240.
45. Wardle DA, et al. (2004) *Ecological linkages between aboveground and belowground biota*. Science **304**:1629-1633.
46. Ceballos G, Ehrlich AH, Ehrlich PR (2015) *The Annihilation of Nature: Human Extinction of Birds and Mammals*, (Johns Hopkins Univ Press, Baltimore).
47. Knoll AH (2015) *Life on a Young Planet: The First Three Billion Years of Evolution on Earth*, (Princeton Univ Press, Princeton, NJ).
48. Barnosky AD, et al. (2014) *Introducing the scientific consensus on maintaining humanity's life support systems in the 21st century: Information for policy makers*. The Anthropocene Review **1**:78-109.
49. Ceballos G, Ehrlich PR, Soberón J, Salazar I, Fay JP (2005) *Global mammal conservation: What must we manage?* Science **309**:603-607.

50. Brown IL, Ehrlich PR (1980) *Population biology of the checkerspot butterfly, Euphydryas chalcedona structure of the Jasper Ridge colony*. *Oecologia* **47**:239-251.
51. Environmental Systems Research Institute (2011) *Release 10. Documentation Manual*, (Environmental Systems Research Institute, Redlands, CA).
52. Balling, R. C. 1988. *The climate impact of Sonoran vegetation discontinuity*. *Climate Change* **13**: 99-109.
53. Balling, R. C. 1991. *Impact of desertification on regional and global warming*. *Bulletin of the American Meteorological Society* **72**: 232-234.
54. Barigozzi, C. (ed.). 1986. *The Origin and Domestication of Cultivated Plants*. Amsterdam: Elsevier.
55. Botkin, D. B. 1989. *Science and the global environment*. In: D. B. Botkin et al., **Global Change**. New York: Academic Press, pp. 1-14.
56. Bryson, R. 1972. *Climate modification by air pollution*. In: N. Polunin (ed.), *The Environmental Future*. London: Macmillan, pp. 133-174.
57. Dregne, H. E., M. Kassas, and B. Rozanov. 1991. *A new assessment of the world status of desertification*. *Desertification Control Bulletin*, no. **20**: 6-18.
58. FAO (Food and Agriculture Organization). 1991. *Protection of land resources: Deforestation UNCED Prepcomm.*, 2nd session, Doc. A/CONF. 15/PC/27.
59. Hare, F. K. and L. A. J. Ogallo. 1993. *Climate Variation, Drought and Desertification*. WMO-No. 653. Geneva: WMO.
60. Houghton, J. T., B. A. Callander, and S. K. Varney (eds.). 1992. *Climate Change 1992. The Supplementary Report to the IPCC Scientific Assessment*. (Cambridge: Cambridge University Press.
61. Hulme, M. and M. Kelly. 1993. *Exploring the links between desertification and climate change*. *Environment* **35(6)**: 5-11, 39-45.
62. Jackson, R. D. and S. B. Idso. 1975. *Surface albedo and desertification*. *Science* **189**: 1012-1013.
63. Matthews, E. 1983. *Global vegetation and land use: New high-resolution databases for climatic studies*. *Journal of Climate and Meteorology* **22**: 474-487.
64. Schlesinger, W. H., et al. 1990. *Biological feedback in global desertification*. *Science* **247**: 1043-1048.
65. Turner, B. L., et al. 1990. *Two types of global environmental changes: Definitional and special-scale issues in their human dimensions*. *Global Environmental Change* **1**: 14-22.
66. UNESCO. 1960. *Medicinal plants of arid zones*. *Arid Zone Research* 13.
67. Vavilov, N. I. 1949. *The Origin, Variation, Immunity and Breeding of Cultivated Plants*. Waltham, Mass.: Chronica Botanical
68. T. Jackson, "Prosperity Without Growth: Economics for a Finite Planet", Earthscan, London, (2009).
69. A. Gore, "An Inconvenient Truth: The Planetary Emergency of Global Warming and What We Can Do About It", Rodale Books, New York, (2006).
70. P.R. Ehrlich and A.H. Ehrlich, "One With Nineveh: Politics, Consumption and the Human Future", Island Press, (2004).

71. N. Stern et al., "The Stern Review", (2006).
72. S. Connor, "Global Warming Past Point of No Return", *The Independent*, (116 September, 2005).
73. J. Patz et al., "Impact of Regional Climate Change on Human Health", *Nature*, (17 November, 2005).
74. L.R. Brown, "World on the Edge", W.W. Norton, New York, (2011)

Chapter 4

POPULATION STABILIZATION TO AVOID FAMINE

“Anyone who believes in indefinite growth in anything physical, on a physically finite planet, is either mad or an economist.”

Kenneth E. Boulding (1910-1993)

4.1 Population stabilization today

The phrase “developing countries” is more than a euphemism; it expresses the hope that with the help of a transfer of technology from the industrialized nations, all parts of the world can achieve prosperity. Some of the forces that block this hope have just been mentioned. Another factor that prevents the achievement of worldwide prosperity is population growth.

In the words of Dr. Halfdan Mahler, former Director General of the World Health Organization, “Country after country has seen painfully achieved increases in total output, food production, health and educational facilities and employment opportunities reduced or nullified by excessive population growth.”

The growth of population is linked to excessive urbanization, infrastructure failures and unemployment. In rural districts in the developing countries, family farms are often divided among a growing number of heirs until they can no longer be subdivided. Those family members who are no longer needed on the land have no alternative except migration to overcrowded cities, where the infrastructure is unable to cope so many new arrivals. Often the new migrants are forced to live in excrement-filled makeshift slums, where dysentery, hepatitis and typhoid are endemic, and where the conditions for human life sink to the lowest imaginable level. In Brazil, such shanty towns are called “favelas”.

If modern farming methods are introduced in rural areas while population growth continues, the exodus to cities is aggravated, since modern techniques are less labor-intensive and favor large farms. In cities, the development of adequate infrastructure requires time, and it becomes a hopeless task if populations are growing rapidly. Thus, population sta-

bilization is a necessary first step for development.

It can be observed that birth rates fall as countries develop. However, development is sometimes blocked by the same high birth rates that economic progress might have prevented. In this situation (known as the “demographic trap”), economic gains disappear immediately because of the demands of an exploding population.

For countries caught in the demographic trap, government birth control programs are especially important, because one cannot rely on improved social conditions to slow birth rates. Since health and lowered birth rates should be linked, it is appropriate that family-planning should be an important part of programs for public health and economic development.

A recent study conducted by Robert F. Lapham of Demographic Health Surveys and W. Parker Maudlin of the Rockefeller Foundation has shown that the use of birth control is correlated both with socio-economic setting and with the existence of strong family-planning programs. The implication of this study is that even in the absence of increased living standards, family-planning programs can be successful, provided they have strong government support.

China, the world’s most populous nation, has adopted the somewhat draconian policy of allowing only one child for families in living in towns and cities (35.9% of the population). Chinese leaders obtained popular support for their one-child policy by means of an educational program which emphasized future projections of diminishing water resources and diminishing cropland per person if population increased unchecked. Like other developing countries, China has a very young population, which will continue to grow even when fertility has fallen below the replacement level because so many of its members are contributing to the birth rate rather than to the death rate. China’s present population is 1.4 billion. Its projected population for the year 2025 is 1.6 billion. China’s one-child policy is supported by 75% of the country’s people, but the methods of enforcement are sometimes criticized, and it has led to a M/F sex ratio of 1.17/1.00. The natural baseline for the sex ratio ranges between 1.03/1.00 and 1.07/1.00.

Education of women and higher status for women are vitally important measures, not only for their own sake, but also because in many countries these social reforms have proved to be the key to lower birth rates. Religious leaders who oppose programs for the education of women and for family planning on “ethical” grounds should think carefully about the scope and consequences of the catastrophic global famine which will undoubtedly occur within the next 50 years if population is allowed to increase unchecked. Do these leaders really wish to be responsible for the suffering and death from starvation of hundreds of millions of people?

At the United Nations Conference on Population and Development, held in Cairo in September, 1994, a theme which emerged very clearly was that one of the most important keys to controlling the global population explosion is giving women better education and equal rights. These goals are desirable for the sake of increased human happiness, and for the sake of the uniquely life-oriented point of view which women can give us; but in addition, education and improved status for women have shown themselves to be closely connected with lowered birth rates. When women lack education and independent careers

outside the home, they can be forced into the role of baby-producing machines by men who do not share in the drudgery of cooking, washing and cleaning; but when women have educational, legal, economic, social and political equality with men, experience has shown that they choose to limit their families to a moderate size.

Sir Partha Dasgupta of Cambridge University has pointed out that the changes needed to break the cycle of overpopulation and poverty are all desirable in themselves. Besides education and higher status for women, they include state-provided social security for old people, provision of water supplies near to dwellings, provision of health services to all, abolition of child labor and general economic development.

4.2 Why are economists addicted to growth?

Economists (with a few notable exceptions) have long behaved as though growth were synonymous with economic health. If the gross national product of a country increases steadily by 4 percent per year, most economists express approval and say that the economy is healthy. If the economy could be made to grow still faster (they maintain), it would be still more healthy. If the growth rate should fall, economic illness would be diagnosed. However, it is obvious that on a finite Earth, neither population growth nor economic growth can continue indefinitely.

Today, as economic growth falters, the defects and injustices of our banking system have come sharply into focus, and light has also been thrown onto the much-too-cozy relationship between banking and government. The collapse of banks during the subprime mortgage crisis of 2008 and their subsequent bailout by means of the taxpayer's money can give us an insight into both phenomena - the faults of our banking system and its infiltration into the halls of government. The same can be said of the present national debt crisis in the Euro zone and elsewhere.

One feature of banking that cries out for reform is "fractional reserve banking", i.e. the practice whereby private banks keep only a tiny fraction of the money entrusted to them by their depositors, and lend out all the remaining amount. By doing so, the banks are in effect coining their own money and putting it into circulation, a prerogative that ought to be reserved for governments. Under the system of fractional reserve banking, profits from any expansion of the money supply go to private banks rather than being used by the government to provide social services. This is basically fraudulent and unjust; the banks are in effect issuing their own counterfeit money.

When the economy contracts instead of expanding, the effect of fractional reserve banking is still worse. In that case the depositors ask the banks for their money, which it is their right to do. But the banks do not have the money - they have lent it out, and thus they fail. However, the bankers have insured themselves against this eventuality by buying the votes of government officials. Thus the banks are bailed out and the taxpayers are left with the bill, as in the recent example in which the US Federal Reserve secretly gave 7.7 trillion of the taxpayers' dollars to bail out various banks.

4.3 Information-driven population growth

Today we are able to estimate the population of the world at various periods in history, and we can also make estimates of global population in prehistoric times. Looking at the data, we can see that the global population of humans has not followed an exponential curve as a function of time, but has instead followed a hyperbolic trajectory. At the time of Christ, the population of the world is believed to have been approximately 220 million. By 1500, the earth contained 450 million people, and by 1750, the global population exceeded 700 million. As the industrial and scientific revolution has accelerated, global population has responded by increasing at a break-neck speed: In 1930, the population of the world reached two billion; in 1958 three billion; in 1974 four billion; in 1988 five billion, and in 1999, six billion. Today, roughly a billion people are being added to the world's population every fourteen years.

As the physicist Murry Gell-Mann has pointed out, a simple mathematical curve which closely approximates the global population of humans over a period of several thousand years is a hyperbola of the form

$$P = \frac{190,000,000,000}{2025 - t}$$

Here P is the population and t is the year. How are we to explain the fact that the population curve is not an exponential? We can turn to Malthus for an answer: According to his model, population does not increase exponentially, except under special circumstances, when the food supply is so ample that the increase of population is entirely unchecked. Malthus gives us a model of culturally-driven population growth. He tells us that population increase tends to press against the limits of the food supply, and since these limits are culturally determined, population density is also culturally-determined. Hunter-gatherer societies need large tracts of land for their support; and in such societies, the population density is necessarily low. Pastoral methods of food production can support populations of a higher density. Finally, extremely high densities of population can be supported by modern agriculture. Thus, the hyperbolic curve, $P=C/(2025-t)$, where C is a constant, should be seen as describing the rapidly-accelerating growth of human culture, this being understood to include methods of food production.

If we look at the curve, $P=C/(2025-t)$, it is obvious that human culture has reached a period of crisis. The curve predicts that the world's population will rise to infinity in the year 2025, which of course is impossible. Somehow the actual trajectory of global population as a function of time must deviate from the hyperbolic curve, and in fact, the trajectory has already begun to fall away from the hyperbola. Because of the great amount of human suffering which may be involved, and the potentially catastrophic damage to the earth's environment, the question of how the actual trajectory of human population will come to deviate from the hyperbola is a matter of enormous importance. Will population overshoot the sustainable limit, and crash? Or will it gradually approach a maximum? In the case of the second alternative, will the checks which slow population growth be later marriage and family planning? Or will the grim Malthusian forces - famine, disease and

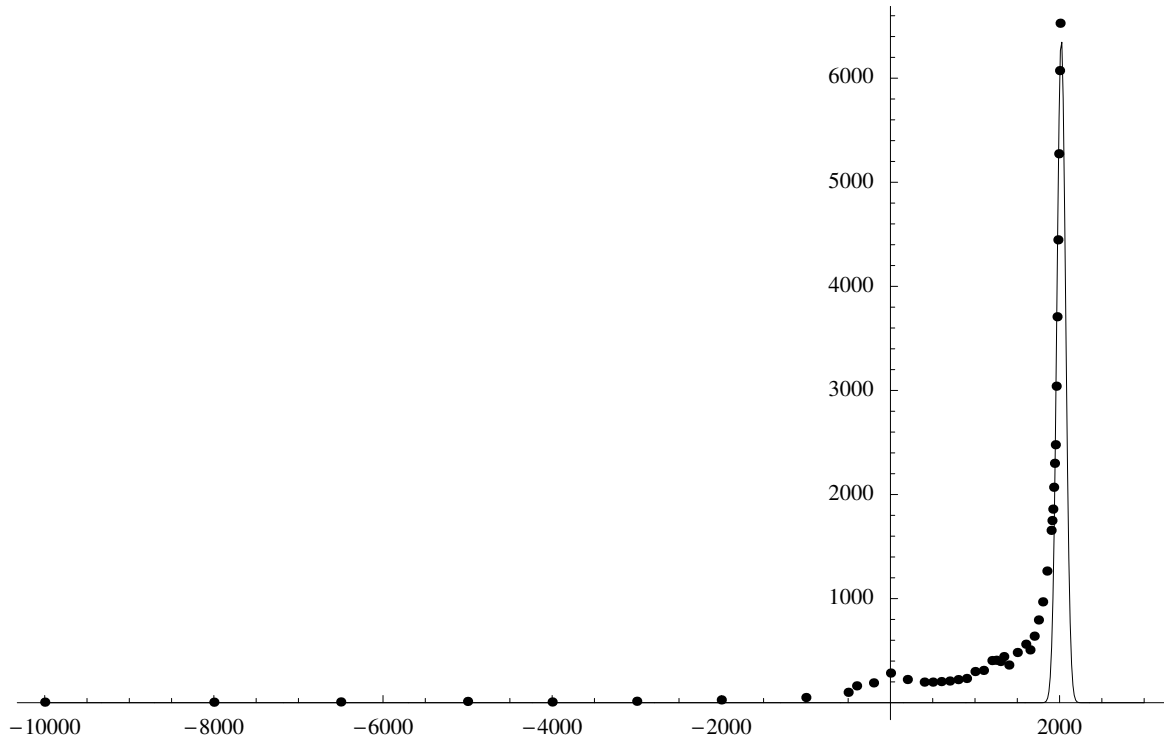


Figure 4.1: Population growth and fossil fuel use, seen on a time-scale of several thousand years. The dots are population estimates in millions from the US Census Bureau. Fossil fuel use appears as a spike-like curve, rising from almost nothing to a high value, and then falling again to almost nothing in the space of a few centuries. When the two curves are plotted together, the explosive rise of global population is seen to be simultaneous with, and perhaps partially driven by, the rise of fossil fuel use. This raises the question of whether the world's population is headed for a crash when the fossil fuel era has ended. (Author's own graph)

war - act to hold the number of humans within the carrying capacity of their environment?

We can anticipate that as the earth's human population approaches 10 billion, severe famines will occur in many developing countries. The beginnings of this tragedy can already be seen. It is estimated that roughly 30,000 children now die every day from starvation, or from a combination of disease and malnutrition.

An analysis of the global ratio of population to cropland shows that we have probably already exceeded the sustainable limit of population through our dependence on petroleum: Between 1950 and 1982, the use of cheap synthetic fertilizers increased by a factor of 8. Much of our present agricultural output depends on their use, but their production is expensive in terms of energy. Furthermore, petroleum-derived synthetic fibers have reduced the amount of cropland needed for growing natural fibers, and petroleum-driven tractors have replaced draft animals which required cropland for pasturage.

Also, petroleum fuels have replaced fuelwood and other fuels derived for biomass. The reverse transition, from fossil fuels back to renewable energy sources, will require a considerable diversion of land from food production to energy production. For example, 1.1 hectares are needed to grow the sugarcane required for each alcohol-driven Brazilian automobile. This figure may be compared with the steadily falling average area of cropland available to each person in the world: .24 hectares in 1950, .16 hectares in 1982.

As population increases, the cropland per person will continue to fall, and we will be forced to make still heavier use of fertilizers to increase output per hectare. Also marginal land will be used in agriculture, with the probable result that much land will be degraded through erosion and salination. Climate change will reduce agricultural output. The Hubbert peaks for oil and natural gas will occur within one or two decades, and the fossil fuel era will be over by the end of 21st century. Thus there is a danger that just as global population reaches the unprecedented level of 10 billion or more, the agricultural base for supporting it may suddenly collapse. Ecological catastrophe, possibly compounded by war and other disorders, could produce famine and death on a scale unprecedented in history - a disaster of unimaginable proportions, involving billions rather than millions of people.

The resources of the earth and the techniques of modern science can support a global population of moderate size in comfort and security; but the optimum size is undoubtedly smaller than the world's present population (see Chapter 4). Given a sufficiently small global population, renewable sources of energy can be found to replace disappearing fossil fuels. Technology may also be able to find renewable substitutes for many disappearing mineral resources for a global population of a moderate size. What technology cannot do, however, is to give a global population of 10 billion people the standard of living which the industrialized countries enjoy today.

What would Malthus tell us if he were alive today? Certainly he would say that we have reached a period of human history where it is vital to stabilize the world's population if catastrophic environmental degradation and famine are to be avoided. He would applaud efforts to reduce suffering by eliminating poverty, widespread disease, and war; but he would point out that, since it is necessary to stop the rapid increase of human numbers, it follows that whenever the positive checks to population growth are removed, it is absolutely necessary to replace them by preventive checks. Malthus' point of view became more broad



Figure 4.2: **The number of hectares of cropland available per person as a function of time.**

in the successive editions of his *Essay*; and if he were alive today, he would probably agree that family planning is the most humane of the preventive checks.

In Malthus' *Essay on the Principle of Population*, population pressure appears as one of the main causes of war; and Malthus also discusses many societies in which war is one of the the principle means by which population is reduced to the level of the food supply. Thus, his *Essay* contains another important message for our own times: If he were alive today, Malthus would also say that there is a close link between the two most urgent tasks which history has given to the 21st century - stabilization of the global population, and abolition of the institution of war.

In most of the societies which Malthus described, a clear causal link can be seen, not only between population pressure and poverty, but also between population pressure and war. As one reads his *Essay*, it becomes clear why both these terrible sources of human anguish saturate so much of history, and why efforts to eradicate them have so often met with failure: The only possible way to eliminate poverty and war is to reduce the pressure of population by preventive checks, since the increased food supply produced by occasional cultural advances can give only very temporary relief. Today, the links between population pressure, poverty, and war are even more pronounced than they were in the past, because the growth of human population has brought us to the absolute limits imposed by ecological constraints.

4.4 Biology and economics

Classical economists like Smith and Ricardo pictured the world as largely empty of human activities. According to the “empty-world” picture of economics, the limiting factors in the

production of food and goods are shortages of capital and labor. The land, forests, fossil fuels, minerals, oceans filled with fish, and other natural resources upon which human labor and capital operate, are assumed to be present in such large quantities that they are not limiting factors. In this picture, there is no naturally-determined upper limit to the total size of the human economy. It can continue to grow as long as new capital is accumulated, as long as new labor is provided by population growth, and as long as new technology replaces labor by automation.

Biology, on the other hand, presents us with a very different picture. Biologists remind us that if any species, including our own, makes demands on its environment which exceed the environment's carrying capacity, the result is a catastrophic collapse both of the environment and of the population which it supports. Only demands which are within the carrying capacity are sustainable. For example, there is a limit to regenerative powers of a forest. It is possible to continue to cut trees in excess of this limit, but only at the cost of a loss of forest size, and ultimately the collapse and degradation of the forest. Similarly, cattle populations may for some time exceed the carrying capacity of grasslands, but the ultimate penalty for overgrazing will be degradation or desertification of the land. Thus, in biology, the concept of the carrying capacity of an environment is extremely important; but in economic theory this concept has not yet been given the weight that it deserves.

The terminology of economics can be applied to natural resources: For example, a forest can be thought of as natural capital, and the sustainable yield from the forest as interest. Exceeding the biological carrying capacity then corresponds, in economic terms, to spending one's capital.

If it is to be prevented from producing unacceptable contrasts of affluence and misery within a society, the free market advocated by Adam Smith needs the additional restraints of ethical principles, as well as a certain amount of governmental regulation. Furthermore, in the absence of these restraints, it will destroy the natural environment of our planet.

There is much evidence to indicate that the total size of the human economy is rapidly approaching the absolute limits imposed by the carrying capacity of the global environment. For example, a recent study by Vitousek et. al. showed that 40 percent of the net primary product of landbased photosynthesis is appropriated, directly or indirectly, for human use. (The net primary product of photosynthesis is defined as the total quantity of solar energy converted into chemical energy by plants, minus the energy used by the plants themselves). Thus we are only a single doubling time away from 80 percent appropriation, which would imply a disastrous environmental degradation.

Another indication of our rapid approach to the absolute limits of environmental carrying capacity can be found in the present rate of loss of biodiversity. Biologists estimate that between 10,000 and 50,000 species are being driven into extinction each year as the earth's rainforests are destroyed.

The burning of fossil fuels and the burning of tropical rain forests have released so much carbon dioxide that the atmospheric concentration of this greenhouse gas has increased from a preindustrial value of 260 ppm to its present value: 380 ppm. Most scientists agree that unless steps are taken to halt the burning of rain forests and to reduce the use of fossil fuels, the earth's temperature will steadily rise during the coming centuries. This gradual

long-term climate change will threaten future agricultural output by changing patterns of rainfall. Furthermore, the total melting of the Arctic and Antarctic icecaps, combined with the thermal expansion of the oceans, threatens to produce a sea level rise of up to 12 meters. Although these are slow, long-term effects, we owe it to future generations to take steps now to halt global warming.

The switch from fossil fuels to renewable energy sources is vital not only because of the need to reduce global warming, but also because the earth's supply of fossil fuels is limited. A peak in the production and consumption of conventional petroleum is predicted within one or two decades. Such a peak in the use of any non-renewable natural resource is called a "Hubbert peak" after the oil expert Dr. M. King Hubbert. It occurs when reserves of the resource are approximately half exhausted. After that point, the resource does not disappear entirely, but its price increases steadily because supply fails to meet demand, and because of rising extraction costs. It is predicted that the Hubbert peak for both oil and natural gas will also occur within a few decades. The peak for oil may occur within the present decade. Thus, halfway through the 21st Century, oil and natural gas will become very expensive - perhaps so expensive that they will not be burned but will instead be reserved as starting points for chemical synthesis.

The reserves of coal are much larger, and at the present rate of use they would last for slightly more than two centuries. However, it seems likely that as petroleum is exhausted, coal will be converted into liquid fuels, as was done in Germany during World War II, and in South Africa during the oil embargo. Thus, in predicting a date for the end of the fossil fuel era, we ought to lump oil, natural gas and coal together. If we do so, we find the total supply has an energy content of 1260 terawatt-years. (1 terawatt is equal to 1,000,000,000,000 Watts). One finds in this way that if they are used at the present rate of 13 terawatts, fossil fuels will last about 100 years.

Resolute government intervention is needed to promote energy conservation measures and to bring about the switch from fossil fuels to renewable energy sources, such as biomass, photovoltaics, solar thermal power, wind and wave power, and hydropower. Both subsidies for renewable energy technologies, to help them get started, and taxes on fossil fuels will be needed. Changes in tax structure could also encourage smaller families, encourage resource conservation, or diminish pollution. In general, taxation should be used, not merely to raise money, but, more importantly, to guide the evolution of society towards humane and sustainable goals.

4.5 Loss of biodiversity

Agricultural monocultures

In modern agriculture it has become common to plant large regions with a single crop variety. For example, it is common to plant large regions with a single high-yield wheat variety. Monocultures of this kind offer farmers advantages of efficiency in the timing of planting and harvesting. With regard to pest and disease control, there may be short-term

advantages, but these have to be weighed against the threat of long-term disasters. In the great Irish Potato Famine of 1845-1849, the potato monoculture which had sustained Ireland's growing population was suddenly devastated by *Phytophthora infestans*, commonly called "potato blight". The result was a catastrophic famine that resulted in the death or emigration of much of Ireland's population.

In general, monocultures are vulnerable to plant disease. Thus the replacement of traditional varieties with the high-yield crops developed by the "Green Revolution" carries serious risks. Adjustment to climate change also requires genetic diversity. In general, a genetically diverse population is far better to adjust to environmental changes than a genetically homogeneous population. This being so, it is vital to preserve civilization's heritage of genetically diverse crops.

Deforestation and loss of biodiversity

The earth's tropical rain forests are rapidly being destroyed for the sake of new agricultural land. Tropical rain forests are thought to be the habitat of more than half of the world's species of plants, animals and insects; and their destruction is accompanied by an alarming rate of extinction of species. The Harvard biologist, E.O. Wilson, estimates that the rate of extinction resulting from deforestation in the tropics may now exceed 4,000 species per year - 10,000 times the natural background rate (*Scientific American*, September, 1989).

The enormous biological diversity of tropical rain forests has resulted from their stability. Unlike northern forests, which have been affected by glacial epochs, tropical forests have existed undisturbed for millions of years. As a result, complex and fragile ecological systems have had a chance to develop. Professor Wilson expresses this in the following words:

"Fragile superstructures of species build up when the environment remains stable enough to support their evolution during long periods of time. Biologists now know that biotas, like houses of cards, can be brought tumbling down by relatively small perturbations in the physical environment. They are not robust at all."

The number of species which we have until now domesticated or used in medicine is very small compared with the number of potentially useful species still waiting in the world's tropical rain forests. When we destroy them, we damage our future. But we ought to regard the annual loss of thousands of species as a tragedy, not only because biological diversity is potential wealth for human society, but also because every form of life deserves our respect and protection.

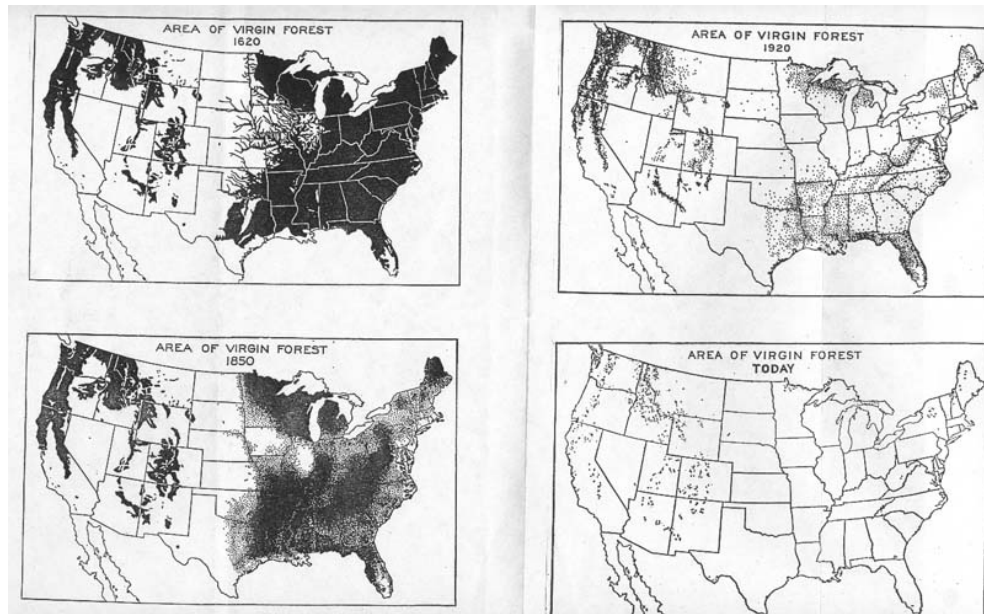


Figure 4.3: Deforestation in the United States between 1620 and the present.



Figure 4.4: Jungle burned for agriculture in southern Mexico.

4.6 Economics without growth

According to Adam Smith, the free market is the dynamo of economic growth. The true entrepreneur does not indulge in luxuries for himself and his family, but reinvests his profits, with the result that his business or factory grows larger, producing still more profits, which he again reinvests, and so on. This is indeed the formula for exponential economic growth.

Economists (with a few notable exceptions such as Aurelio Pecci and Herman Daly) have long behaved as though growth were synonymous with economic health. If the gross national product of a country increases steadily by 4% per year, most economists express approval and say that the economy is healthy. If the economy could be made to grow still faster (they maintain), it would be still more healthy. If the growth rate should fall, economic illness would be diagnosed. However, the basic idea of Malthus is applicable to exponential increase of any kind. It is obvious that on a finite Earth, neither population growth nor resource-using and pollution-generating economic growth can continue indefinitely.

A “healthy” economic growth rate of 4% per year corresponds to an increase by a factor of 50 in a century. (The reader is invited to calculate the factor of increase in five centuries. The answer is $50^5 = 312,500,000$.) No one can maintain that this type of growth is sustainable except by refusing to look more than a short distance into the future. Sooner or later (perhaps surprisingly soon) an entirely new form of economics will be needed - not the empty-world economics of Adam Smith, but what might be called “full-world economics”, or “steady-state economics”.

Economic activity is usually divided into two categories, 1) production of goods and 2) provision of services. It is the rate of production of goods that will be limited by the carrying capacity of the global environment. Services that have no environmental impact will not be constrained in this way. Thus a smooth transition to a sustainable economy will involve a shift of a large fraction the work force from the production of goods to the provision of services.

In his recent popular book *The Rise of the Creative Class*, the economist Richard Florida points out that in a number of prosperous cities - for example Stockholm - a large fraction of the population is already engaged in what might be called creative work - a type of work that uses few resources, and produces few waste products - work which develops knowledge and culture rather than producing material goods. For example, producing computer software requires few resources and results in few waste products. Thus it is an activity with a very small ecological footprint. Similarly, education, research, music, literature and art are all activities that do not weigh heavily on the carrying capacity of the global environment. Furthermore, cultural activities lead in a natural way to global cooperation and internationalism. Florida sees this as a pattern for the future, and maintains that everyone is capable of creativity. He visualizes the transition to a sustainable future economy as one in which a large fraction of the work force moves from industrial jobs to information-related work. Meanwhile, as Florida acknowledges, industrial workers feel uneasy and threatened by such trends.

The present use of resources by the industrialized countries is extremely wasteful. A

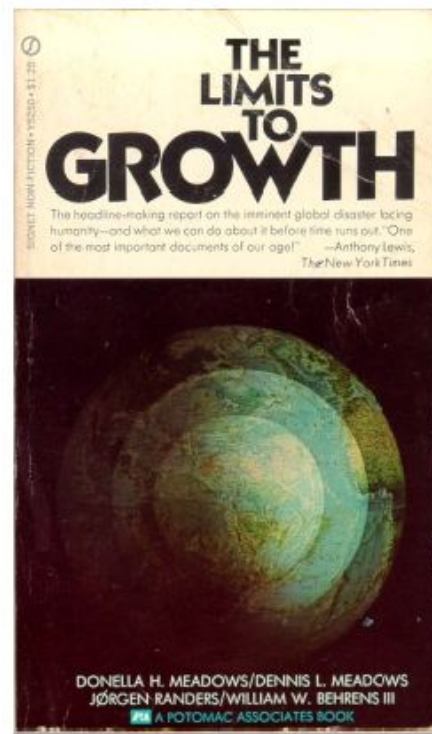


Figure 4.5: In 1968 Aurelio Pecci, Thorkil Kristensen and others founded the Club of Rome, an organization of economists and scientists devoted to studying the predicament of human society. One of the first acts of the organization was to commission an MIT study of future trends using computer models. The result was a book entitled “Limits to Growth”, published in 1972. From the outset the book was controversial, but it became a best-seller. It was translated into many languages and sold 30 million copies. The book made use of an exponential index for resources, i.e. the number of years that a resource would last if used at an exponentially increasing rate. Today the more accurate Hubbert Peak model is used instead to predict rate of use of a scarce resource as a function of time. Although the specific predictions of resource availability in “Limits to Growth” lacked accuracy, its basic thesis - that unlimited economic growth on a finite planet is impossible - was indisputably correct. Nevertheless the book was greeted with anger and disbelief by the community of economists, and these emotions still surface when it is mentioned. Perhaps part of this collective blindness was and is due to the polarization of opinion produced by the Cold War. In any case, the myth of unlimited growth has remained the central dogma of western economics.

growing national economy must, at some point, exceed the real needs of the citizens. It has been the habit of the developed countries to create artificial needs by means of advertising, in order to allow economies to grow beyond the point where all real needs have been met; but this extra growth is wasteful, and in the future it will be important not to waste the earth's diminishing supply of non-renewable resources.

Thus, the times in which we live present a challenge: We need a revolution in economic thought. We must develop a new form of economics, taking into account the realities of the world's present situation - an economics based on real needs and on a sustainable equilibrium with the environment, not on the thoughtless assumption that growth can continue forever.

Adam Smith was perfectly correct in saying that the free market is the dynamo of economic growth; but rapid growth of human population and economic activity have brought us, in a surprisingly short time, from the empty-world situation in which he lived to a full-world situation. 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. Full-world economics, the economics of the future, will no longer be able to rely on growth to give profits to stockbrokers or to solve problems of unemployment or to alleviate poverty. In the long run, growth of any kind is not sustainable (except perhaps growth of culture and knowledge); and we are now nearing the environmentally-imposed limits.

Transition to a sustainable economy

Like a speeding bus headed for a brick wall, the earth's rapidly-growing population of humans and its rapidly-growing resource-using and pollution-generating economic activity are headed for a collision with a very solid barrier - the carrying capacity of the global environment. As in the case of the bus and the wall, the correct response to the situation is to apply the brakes in time - but fear prevents us from doing this. What will happen if we slow down very suddenly? Will not many of the passengers be injured? Undoubtedly. But what will happen if we hit the wall at full speed? Perhaps it would be wise, after all, to apply the brakes!

The memory of the great depression of 1929 makes us fear the consequences of an economic slowdown, especially since unemployment is already a serious problem in many parts of the world. Although the history of the 1929 depression is frightening, it may nevertheless be useful to look at the measures which were used then to bring the global economy back to its feet. A similar level of governmental responsibility may help us to avoid some of the more painful consequences of the necessary transition from the economics of growth to steady-state economics.

In the United States, President Franklin D. Roosevelt was faced with the difficult problems of the depression during his first few years in office. Roosevelt introduced a number of special governmental programs, such as the WPA, the Civilian Construction Corps and the Tennessee Valley Authority, which were designed to create new jobs on projects directed towards socially useful goals - building highways, airfields, auditoriums, harbors, housing projects, schools and dams. The English economist John Maynard Keynes, (1883-1946),

provided an analysis of the factors that had caused the 1929 depression, and a theoretical justification of Roosevelt's policies.

The transition to a sustainable global society will require a similar level of governmental responsibility, although the measures needed are not the same as those which Roosevelt used to end the great depression. Despite the burst of faith in the free market which has followed the end of the Cold War, it seems unlikely that market mechanisms alone will be sufficient to solve problems of unemployment in the long-range future, or to achieve conservation of land, natural resources and environment.

The Worldwatch Institute, Washington D.C., lists the following steps as necessary for the transition to sustainability¹:

1. Stabilizing population
2. Shifting to renewable energy
3. Increasing energy efficiency
4. Recycling resources
5. Reforestation
6. Soil Conservation

All of these steps are labor-intensive; and thus, wholehearted governmental commitment to the transition to sustainability can help to solve the problem of unemployment.

In much the same spirit that Roosevelt (with Keynes' approval) used governmental powers to end the great depression, we must now urge our governments to use their powers to promote sustainability and to reduce the trauma of the transition to a steady-state economy. For example, an increase in the taxes on fossil fuels could make a number of renewable energy technologies economically competitive; and higher taxes on motor fuels would be especially useful in promoting the necessary transition from private automobiles to bicycles and public transportation. Tax changes could also be helpful in motivating smaller families.

The present economic recession offers us an opportunity to take steps towards the creation of a sustainable steady-state economic system. Government measures to avoid unemployment could at the same time shift the work force to jobs that promote sustainability, i.e., jobs in the areas listed by the Worldwatch Institute.

Governments already recognize their responsibility for education. In the future, they must also recognize their responsibility for helping young people to make a smooth transition from education to secure jobs. If jobs are scarce, work must be shared, in a spirit of solidarity, among those seeking employment; hours of work (and if necessary, living standards) must be reduced to insure a fair distribution of jobs. Market forces alone cannot achieve this. The powers of government are needed.

Population and goods per capita

In the distant future, the finite carrying capacity of the global environment will impose limits on the amount of resource-using and waste-generating economic activity that it will

¹L.R. Brown and P. Shaw, 1982.



Figure 4.6: Lester R. Brown, founder of the Worldwatch Institute, and for many years its President. He is now the leader of the Earth Policy Institute. His recent book, “Plan B”, gives important information about the ecological crisis now facing the world. It may be downloaded free of charge from the website of the Earth Policy Institute.

be possible for the world to sustain. The consumption of goods per capita will be equal to this limited total economic activity divided by the number of people alive at that time. Thus, our descendants will have to choose whether they want to be very numerous and very poor, or less numerous and more comfortable, or very few and very rich. Perhaps the middle way will prove to be the best.

Given the fact that environmental carrying capacity will limit the sustainable level of resource-using economic activity to a fixed amount, average wealth in the distant future will be approximately inversely proportional to population over a certain range of population values. Obviously, if the number of people is reduced to such an extent that it approaches zero, the average wealth will not approach infinity, since a certain level of population is needed to maintain a modern economy. However, if the global population becomes extremely large, the average wealth will indeed approach zero.

In the 1970's the equation $I = P \times A \times T$ was introduced in the course of a debate between Barry Commoner, Paul R. Ehrlich and John P. Holdren. Here I represents environmental impact, P is population, while A represents goods per capita, and T is an adjustable factor that depends on the technology used to produce the goods. The assertion of the previous paragraph can be expressed by solving for A and setting I equal to a constant: $A = I/(P \times T)$. In the distant future, the environmental impact I will not be allowed to increase, and therefore for a given value of T , A will be inversely proportional to P .

If the environmental impact I is broken up into several components, a few of them have historically fallen with increasing values of $A \times P$ because of diminishing T (thus exhibiting the *environmental Kuznets curve*). However, most components of I , such as energy, land and resource use, have historically increased with increasing $A \times P$.

4.7 China and India

Table 2.1 shows the population of China at the start of various dynasties. In 125 AD, at the start of the Eastern Han Dynasty, the population was 48,690,789. The precision of this figure is surprising, and it is perhaps the result of the strength of the central government of China even at that early date. As seen in Table 2.1 the population seems to have fallen again, probably to famine and war. Fear of these terrible Malthusian forces explains the Chinese preference for a strong central government. At the start of the Qing dynasty in the 17th century, the population of China began to increase rapidly, probably because of improved flood control and irrigation methods. By 1901. the population of China had reached 426,447,325.

Figure 2.19 shows the growth of Chinese population between 1960 and the present. China's population continues to increase, despite the government's one-child policy, and today the country has approximately 1.4 billion people. China's rate of population growth is currently only 0.59%.

The post-1949 Chinese government leaders at first viewed population growth as an asset. However, worries about falling water tables and the future availability of fresh



Figure 4.7: The one-child policy: A Chinese mother and her only child at a market in Jiayuguan.

water for agriculture, as well as the realization that rapid population growth would block economic development soon produced a policy switch; and the Chinese government began to strongly support both birth control and late marriage.

Since 1979, the Chinese government has advocated a one-child policy for both rural and urban areas. However, this policy admits many exceptions and has been most effective in cities, where the government is able to exert its power by giving apartments only to families with a single child. In 2016, the one-child policy began to be phased out.

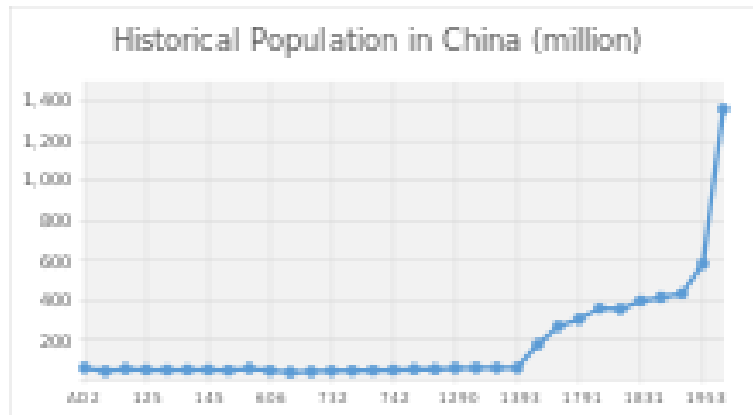


Figure 4.8: Historical estimates of China's population, in millions, from AD 2 until the present. After Ming and earlier period of Qing dynasty founded population moved around 100 million to 150 million until 1700s. In the period between 1749 and 1851, the population doubled in a century. During 1960-2015, the population doubled to nearly 1.4 billion .

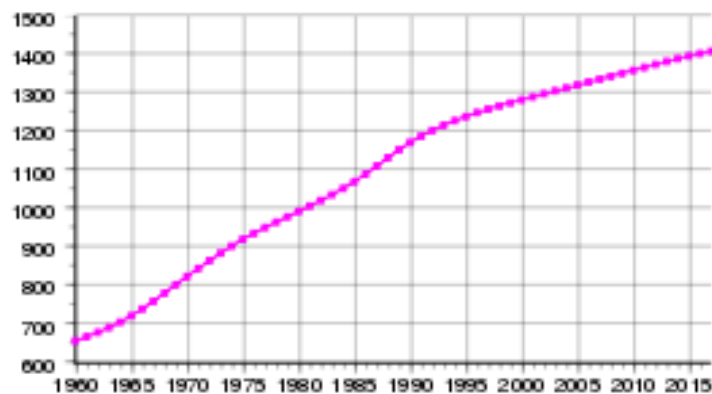


Figure 4.9: This graph shows the population growth of China, in billions, since 1960. Despite China's one-child policy, the country's population continues to grow because of exceptions to the policy and because so many young people are now reaching reproductive age.

Table 4.1: China's Dynastic Census Data

Dynasty	Date (AD)	Households	Population
Eastern Han	125	9,647,838	48,690,789
Western Jin	280	2,458,480	16,163,863
Tang	639	3,120,151	13,252,894
Song	1003	6,864,160	14,278,040
Ming	1398	10,699,399	58,323,933
Qing	1661	not recorded	58,323,933
Qing	1722	not recorded	103,053,992
Qing	1812	not recorded	333,700,560
Qing	1901	not recorded	426,447,325

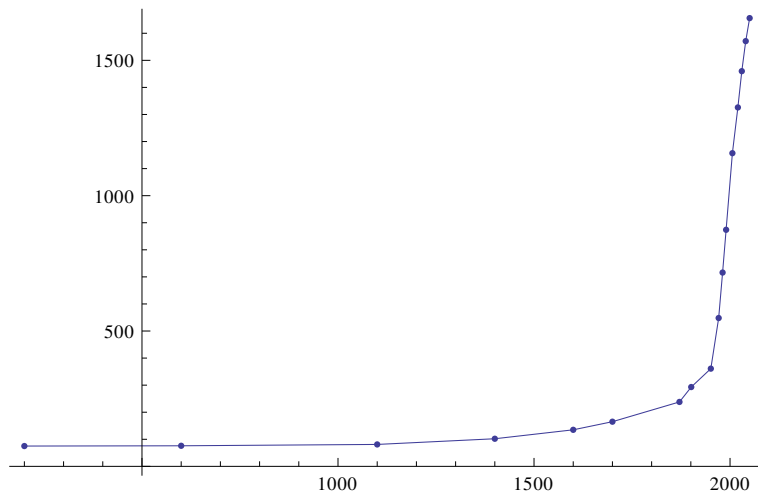


Figure 4.10: The historical and projected population of India as a function of time, from 200 AD to 2050, based on data from the Wikipedia article on *Demographics of India*. If the projections hold, there will be 1.4 billion people in India by 2050, making it the most populous country in the world. However, there is a danger that death rates may rise sharply because of famine and because of deaths due to rising temperatures.



Figure 4.11: This figure shows China’s economic growth rate in recent years. The doubling time for a quantity growing at the rate of 6.8% per year is only 11 years. This high rate of economic growth, compounded by China’s still-growing population, cannot continue without producing an ecological catastrophe, the beginnings of which can already be seen in China.

Table 4.2: **World Population in 2050 (in billions)**

Region	2000	2050	growth
Asia	3.73	5.26	41%
Africa	0.82	2.53	209%
Europe	0.73	0.72	-2%
Latin America	0.53	0.78	48%
North America	0.31	0.43	39%
Oceania	0.03	0.06	84%
World	6.14	9.77	60%

4.8 Population projections in Africa

Wikipedia's article on *Projections of Population Growth* states that "By 2070, the bulk of the world's population growth will take place in Africa: of the additional 2.4 billion people projected between 2015 and 2050, 1.3 billion will be added in Africa, 0.9 billion in Asia and only 0.2 billion in the rest of the world. Africa's share of global population is projected to grow from 16% in 2015 to 25% in 2050 and 39% by 2100, while the share of Asia will fall from 60% in 2015 to 54% in 2050 and 44% in 2100. The strong growth of the African population will happen regardless of the rate of decrease of fertility, because of the exceptional proportion of young people already living today. For example, the UN projects that the population of Nigeria will surpass that of the United States by 2050."

"During 2005-2050, twelve countries are expected to account for half of the world's projected population increase: India, China, United States, Indonesia, Nigeria, Pakistan, Brazil, Democratic Republic of the Congo, Ethiopia, Philippines, Mexico and Egypt, listed according to the size of their contribution to population growth."

The predictions shown in Table 2.2, especially the prediction that the population of Africa will be 2.53 billion people, raise some worrying questions. It seems likely that because of climate change, failure of the West African monsoon, desertification, and sale of African agricultural land to rich countries such China and Saudi Arabia, the food available to the people of Africa will diminish rather than increasing. Can the population of Africa really increase by 209% by 2050? Or will this be prevented by the terrible Malthusian forces of famine, disease and war? In some parts of Africa famine is already present.

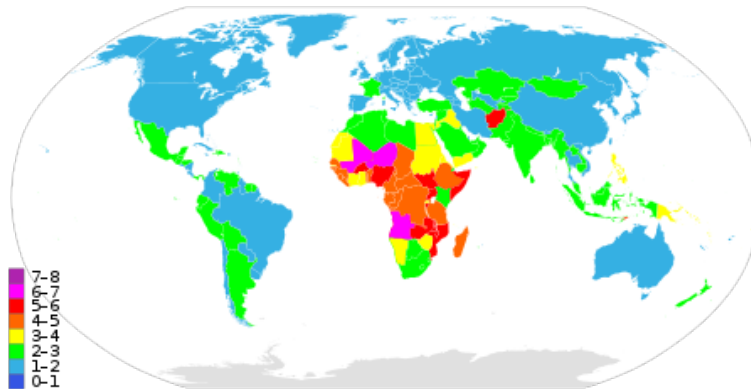


Figure 4.12: A map from the Wikipedia article showing global fertility rates in 2015. The highest fertility rates (purple, 7-8 children per woman-life) occur in Africa.

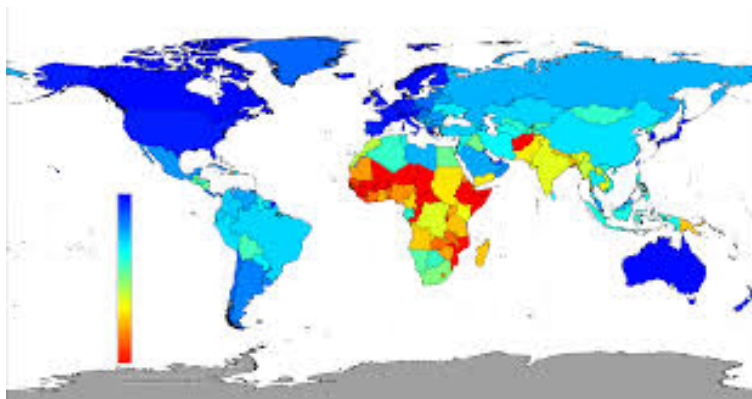


Figure 4.13: A map showing the human development index (HDI) in various parts of the world. The index is based on educational levels, life expectancy, and GDP per capita. It can be seen that regions of high fertility generally have low HDI values.

4.9 What is the future of megacities?

A transformation in cities is going on. Over 80% of the people on the planet today are living in cities. Over 100 new cities will be created within 25 years in China alone. Over 20 new Megacities will redefine the consumer marketplace and society. Most of these cities of over 8 million people each will be in the developing world. With the huge migration to cities of the global population, what challenges will these cities face? What are the opportunities and risks? How should global organizations prepare for the future of cities?

Transition Towns

The Transition Town Movement of today is a response to the end of the fossil fuel era and the threat of economic collapse. It can be thought of as a modern branch of the Cooperative Movement. In 2006, the Transition Town of Totnes in Devon, England was the first to use this name, which implied a transition from globalism, consumerism and growth to a sustainable, local and self-sufficient economy. The ideal was to produce locally all the necessary food for the town, and as much of other necessities as possible. In this way, the energy expenditures involved in transportation could be avoided.

Today there are more than a thousand Transition Towns and they are located in 43 countries. Many of them have local currencies which are legal tender within the town. If the pioneers of this movement are right in saying that this is the only sustainable model for the future, we may wonder whether mega-cities will be able to survive in the long-term future.²

²<https://en.wikipedia.org/wiki/Degrowth>
<http://commondreams.org/views/2015/07/31/we-are-all-greece>
<http://www.localfutures.org/>
<http://www.powells.com/biblio/7-9780871566430-2>

Table 4.3: The World's Largest Cities in 2016

Rank	Name	Country	Population
1	Tokyo	Japan	38,140,000
2	Shanghai	China	34,000,000
3	Jakarta	Indonesia	31,500,000
4	Delhi	India	27,200,000
5	Seoul	Korea	25,600,000
6	Guangzhou	China	25,000,000
7	Beijing	China	24,900,000
8	Manila	Philippines	24,100,000
9	Mumbai	India	23,900,000
10	New York City	United States	23,876,155
11	Shenzhen	China	23,300,000
12	Sao Paolo	Brazil	21,242,939



Figure 4.14: Totnes, Devon, England: a transition town.

4.10 The threat of a large-scale global famine

Unless efforts are made to stabilize and ultimately reduce global population, there is a serious threat that climate change, population growth, and the end of the fossil fuel era could combine to produce a large-scale famine by the middle of the 21st century.

As glaciers melt in the Himalayas and the Andes, depriving India, China and South America of summer water supplies; as sea levels rise, drowning fertile rice-growing regions of Southeast Asia; as droughts reduce the food production of North America and Southern Europe; as groundwater levels fall in China, India, the Middle East and the United States; and as high-yield modern agriculture becomes less possible because fossil fuel inputs are lacking, the 800 million people who are currently undernourished may not survive at all.

Energy inputs of agriculture

Modern agriculture has become highly dependent on fossil fuels, especially on petroleum and natural gas. This is especially true of production of the high-yield grain varieties introduced in the Green Revolution, since these require especially large inputs of fertilizers, pesticides and irrigation. Today, fertilizers are produced using oil and natural gas, while pesticides are synthesized from petroleum feedstocks, and irrigation is driven by fossil fuel energy. Thus agriculture in the developed countries has become a process where inputs of fossil fuel energy are converted into food calories.

Predictions of drought in the Stern Review

According to a report presented to the Oxford Institute of Economic Policy by Sir Nicholas Stern on 31 January, 2006, areas likely to lose up to 30% of their rainfall by the 2050's because of climate change include much of the United States, Brazil, the Mediterranean

region, Eastern Russia and Belarus, the Middle East, Southern Africa and Southern Australia. Meanwhile rainfall is predicted to increase up to 30% in Central Africa, Pakistan, India, Bangladesh, Siberia, and much of China.

Stern and his team point out that “We can... expect to see changes in the Indian monsoon, which could have a huge impact on the lives of hundreds of millions of people in India, Pakistan and Bangladesh. Most climate models suggest that the monsoon will change, although there is still uncertainty about exactly how. Nevertheless, small changes in the monsoon could have a huge impact. Today, a fluctuation of just 10% in either direction from average monsoon rainfall is known to cause either severe flooding or drought. A weak summer monsoon, for example, can lead to poor harvests and food shortages among the rural population - two-thirds of India’s almost 1.1 billion people. Heavier-than-usual monsoon downpours can also have devastating consequences...”

In some regions, melting of glaciers can be serious from the standpoint of dry-season water supplies. For example, melts from glaciers in the Hindu Kush and the Himalayas now supply much of Asia, including China and India, with a dry-season water supply. Complete melting of these glacial systems would cause an exaggerated runoff for a few decades, after which there would be a drying out of some of the most densely populated regions of the world.

Ocean current changes and failure of monsoons

It is expected that climate change will affect ocean currents, and hence also affect monsoon rainfall. We are already experiencing a diversion of the Gulf Stream due to southward currents of cold water from melting ice in the Arctic. This has caused what is known as the *North Atlantic Anomaly*. While most regions of the world are experiencing rising temperatures, the North Atlantic and several northern European countries are exceptions to this rule, and have cooled. Complete failure of the Gulf Stream would lead to much colder temperatures in Europe.

Changes in ocean currents have already lead to the failure of the West African Monsoon, and this has already produced severe food insecurity in West Africa.

In the future, climate-changed ocean currents may lead to failures of monsoons in South-east Asia, and thus damage the food supply of almost two billion people.

Falling water tables around the world

Under many desert areas of the world are deeply buried water tables formed during glacial periods when the climate of these regions was wetter. These regions include the Middle East and large parts of Africa. Water can be withdrawn from such ancient reservoirs by deep wells and pumping, but only for a limited amount of time.

In oil-rich Saudi Arabia, petroenergy is used to drill wells for ancient water and to bring it to the surface. Much of this water is used to irrigate wheat fields, and this is done to such an extent that Saudi Arabia exports wheat. The country is, in effect, exporting its ancient heritage of water, a policy that it may, in time, regret. A similarly short-sighted project

is Muammar Qaddafi's enormous pipeline, which will bring water from ancient sub-desert reservoirs to coastal cities.

In the United States, the great Ogallala aquifer is being overdrawn. This aquifer is an enormous stratum of water-saturated sand and gravel under-lying parts of northern Texas, Oklahoma, New Mexico, Kansas, Colorado, Nebraska, Wyoming and South Dakota. The average thickness of the aquifer is about 70 meters. The rate of water withdrawal from the aquifer exceeds the rate of recharge by a factor of eight.

Thus we can see that in many regions, the earth's present population is living on its inheritance of water, rather than its income. This fact, coupled with rapidly increasing populations and climate change, may contribute to a very serious food crisis partway through the 21st century.

4.11 Reforming our food and agricultural systems

The medical journal *The Lancet* recently published a report which aimed at changing the diets of people throughout the world. The commission which produced the report brought together 37 experts in agriculture, environmental sustainability, human health, and political science from 16 countries. Over three years, they developed the "planetary health diet," which aims to address the global food system's devastating environmental impact as well as mass malnutrition.

"The food we eat and how we produce it determines the health of people and the planet, and we are currently getting this seriously wrong," declared Tim Lang, a co-author of the EAT-Lancet Commission and professor at City, University of London. "We need a significant overhaul, changing the global food system on a scale not seen before in ways appropriate to each country's circumstances."

"To be healthy," he explained, "diets must have an appropriate calorie intake and consist of a variety of plant-based foods, low amounts of animal-based foods, unsaturated rather than saturated fats, and few refined grains, highly processed foods, and added sugars."

"Humanity now poses a threat to the stability of the planet," co-lead commissioner Johan Rockström of the Stockholm Resilience Center told the *Guardian*. "[This requires] nothing less than a new global agricultural revolution."

Here are some of the commission's recommendations:

1. Seek international and national commitment to shift toward healthy diets that feature more plant-based foods - including fruits, vegetables, nuts, seeds, and whole grains - and less animal products.
2. Reorient agricultural priorities from producing high quantities of food to producing healthy food that nurtures human health and supports environmental sustainability.



Figure 4.15: **We should eat more vegetables, fruits, whole grains and nuts, while consuming much less meat and dairy products. Beef is especially damaging to the global environment.**

3. Sustainably intensify food production to increase high-quality output with a series of reforms that include becoming a net carbon sink from 2040 forward to align with the goals of the Paris climate agreement.
4. Strong and coordinated governance of land and oceans, including by implementing a "Half Earth" strategy for biodiversity conservation.
5. At least halve food losses and waste, in line with the U.N. Sustainable Development Goals (SDGs), on both the production side and the consumption side.

Here are some excerpts from a 16 January 2019 article in *The Guardian* by Damian Cammeron:

Globally, the diet requires red meat and sugar consumption to be cut by half, while vegetables, fruit, pulses and nuts must double. But in specific places the changes are stark. North Americans need to eat 84% less red meat but six times more beans and lentils. For Europeans, eating 77% less red meat and 15 times more nuts and seeds meets the guidelines.

The diet is a "win-win", according to the scientists, as it would save at least 11 million people a year from deaths caused by unhealthy food, while preventing the collapse of the natural world that humanity depends upon. With 10 billion people expected to live on Earth by 2050, a continuation of today's unsustainable diets would inevitably mean even greater health problems and severe global warming.



Unhealthy diets are the leading cause of ill health worldwide, with 800 million people currently hungry, 2 billion malnourished and further 2 billion people overweight or obese. The world's science academies recently concluded that the food system is broken. Industrial agriculture is also devastating the environment, as forests are razed and billions of cattle emit climate-warming methane.

Future agriculture

When the major glaciers in the Himalayas have melted, they will no longer be able to give India and China summer water supplies; rising oceans will drown much agricultural land; and aridity will reduce the output of many regions that now produce much of the world's grain. Falling water tables in overdrawn aquifers, and loss of topsoil will add to the problem. We should be aware of the threat of a serious global food crisis in the 21st century if we are to have a chance of avoiding it.

The term *ecological footprint* was introduced by William Rees and Mathis Wackernagel in the early 1990's to compare demands on the environment with the earth's capacity to regenerate. In 2015, humanity used environmental resources at such a rate that it would take 1.6 earths to renew them. In other words, we have already exceeded the earth's carrying capacity. Since eliminating the poverty that characterizes much of the world today will require more resources per capita, rather than less. it seems likely that in the era beyond fossil fuels, the optimum global population will be considerably less than the present population of the world.

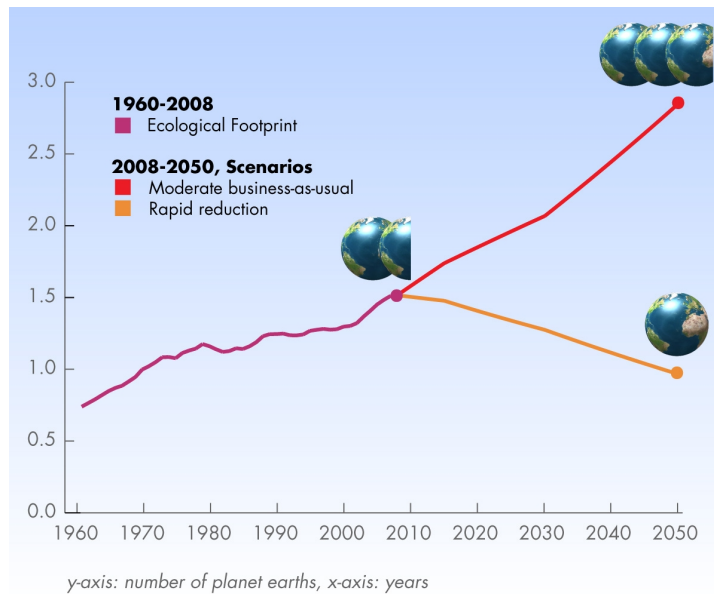


Figure 4.16: **Our present trajectory is completely unsustainable. If we follow it, then by 2050 it would take almost three earths to regenerate our demands on resources.** Source: footprintnetwork.org

Limitations on cropland

In 1944 the Norwegian-American plant geneticist Norman Borlaug was sent to Mexico by the Rockefeller Foundation to try to produce new wheat varieties that might increase Mexico's agricultural output. Borlaug's dedicated work on this project was spectacularly successful. He remained with the project for 16 years, and his group made 6,000 individual crossings of wheat varieties to produce high-yield disease-resistant strains.

In 1963, Borlaug visited India, bringing with him 100 kg. of seeds from each of his most promising wheat strains. After testing these strains in Asia, he imported 450 tons of the Lerma Rojo and Sonora 64 varieties: 250 tons for Pakistan and 200 for India. By 1968, the success of these varieties was so great that school buildings had to be commandeered to store the output. Borlaug's work began to be called a "Green Revolution". In India, the research on high-yield crops was continued and expanded by Prof. M.S. Swaminathan and his co-workers. The work of Green Revolution scientists, such Norman Borlaug and M.S. Swaminathan, has been credited with saving the lives of as many as a billion people.

Despite these successes, Borlaug believes that the problem of population growth is still a serious one. "Africa and the former Soviet republics", Borlaug states, "and the Cerrado, are the last frontiers. After they are in use, the world will have no additional sizable blocks of arable land left to put into production, unless you are willing to level whole forests, which you should not do. So, future food-production increases will have to come from higher yields. And though I have no doubt that yields will keep going up, whether they can go up enough to feed the population monster is another matter. Unless progress with



Figure 4.17: Forests are the lungs of our planet. They convert CO_2 into organic material and thus remove it from the atmosphere. It is therefore vitally important to protect existing forests and to plant new ones.

agricultural yields remains very strong, the next century will experience human misery that, on a sheer numerical scale, will exceed the worst of everything that has come before.”

With regard to the prospect of increasing the area of cropland, a report by the United Nations Food and Agricultural Organization (Provisional Indicative World Plan for Agricultural Development, FAO, Rome, 1970) states that “In Southern Asia,... in some countries of Eastern Asia, in the Near East and North Africa... there is almost no scope for expanding agricultural area... In the drier regions, it will even be necessary to return to permanent pasture the land that is marginal and submarginal for cultivation. In most of Latin America and Africa south of the Sahara, there are still considerable possibilities for expanding cultivated areas; but the costs of development are high, and it will often be more economical to intensify the utilization of areas already settled.” Thus there is a possibility of increasing the area of cropland in Africa south of the Sahara and in Latin America, but only at the cost of heavy investment and at the additional cost of destruction of tropical rain forests.

Rather than an increase in the global area of cropland, we may encounter a future loss of cropland through soil erosion, salination, desertification, loss of topsoil, depletion of minerals in topsoil, urbanization and failure of water supplies. In China and in the Southwestern part of the United States, water tables are falling at an alarming rate. The Ogallala aquifer (which supplies water to many of the plains states in the central and southern parts of the United States) has a yearly overdraft of 160%.

In the 1950's, both the U.S.S.R and Turkey attempted to convert arid grasslands into wheat farms. In both cases, the attempts were defeated by drought and wind erosion, just as the wheat farms of Oklahoma were overcome by drought and dust in the 1930's. If irrigation of arid lands is not performed with care, salt may be deposited, so that the land is ruined for agriculture. This type of desertification can be seen, for example, in some parts of Pakistan. Another type of desertification can be seen in the Sahel region of Africa, south of the Sahara. Rapid population growth in the Sahel has led to overgrazing, destruction of trees, and wind erosion, so that the land has become unable to support even its original population.

Especially worrying is a prediction of the International Panel on Climate Change concerning the effect of global warming on the availability of water: According to Model A1 of the IPCC, global warming may, by the 2050's, have reduced by as much as 30% the water available in large areas of world that now a large producers of grain.

Added to the agricultural and environmental problems, are problems of finance and distribution. Famines can occur even when grain is available somewhere in the world, because those who are threatened with starvation may not be able to pay for the grain, or for its transportation. The economic laws of supply and demand are not able to solve this type of problem. One says that there is no "demand" for the food (meaning demand in the economic sense), even though people are in fact starving.³

Energy-dependence of modern agriculture

A very serious problem with Green Revolution plant varieties is that they require heavy inputs of pesticides, fertilizers and irrigation. Because of this, the use of high-yield varieties contributes to social inequality, since only rich farmers can afford the necessary inputs. Monocultures, such as the Green Revolution varieties may also prove to be vulnerable to future epidemics of plant diseases, such as the epidemic that caused the Irish Potato Famine in 1845. Even more importantly, pesticides, fertilizers and irrigation all depend on the use of fossil fuels. One must therefore ask whether high agricultural yields can be maintained in the future, when fossil fuels are expected to become prohibitively scarce and expensive.

Modern agriculture has become highly dependent on fossil fuels, especially on petroleum and natural gas. This is especially true of production of the high-yield grain varieties introduced in the Green Revolution, since these require especially large inputs of fertilizers, pesticides and irrigation. Today, fertilizers are produced using oil and natural gas, while pesticides are synthesized from petroleum feedstocks, and irrigation is driven by fossil fuel energy. Thus agriculture in the developed countries has become a process where inputs of

³<http://www.independent.co.uk/environment/climate-change/society-will-collapse-by-2040-due-to-catastrophic-food-shortages-says-study-10336406.html>
<http://www.truth-out.org/news/item/32131-the-new-climate-normal-abrupt-sea-level-rise-and-predictions-of-civilization-collapse>
<http://www.commondreams.org/views/2015/08/13/dignity-democracy-and-food-interview-frances-moore-lappe>

Energy

- Modern agriculture is heavily dependent on **non-renewable energy sources**, especially petroleum.
- The continued use of these non-renewable energy sources cannot be sustained indefinitely.
- In sustainable agricultural systems, there is reduced reliance on non-renewable energy sources and a substitution of **renewable sources** to the extent that is economically feasible e.g. **biofuel**

fossil fuel energy are converted into food calories.

The ratio of the fossil fuel energy inputs to the food calorie outputs depends on how many energy-using elements of food production are included in the accounting. David Pimental and Mario Giampietro of Cornell University estimated in 1994 that U.S. agriculture required 0.7 kcal of fossil fuel energy inputs to produce 1.0 kcal of food energy. However, this figure was based on U.N. statistics that did not include fertilizer feedstocks, pesticide feedstocks, energy and machinery for drying crops, or electricity, construction and maintenance of farm buildings. A more accurate calculation, including these inputs, gives an input/output ratio of approximately 1.0. Finally, if the energy expended on transportation, packaging and retailing of food is included, Pimental and Giampietro found that the input/output ratio for the U.S. food system was approximately 10, and this figure did not include energy used for cooking.

The Brundtland Report's estimate of the global potential for food production assumes "that the area under food production can be around 1.5 billion hectares (3.7 billion acres - close to the present level), and that the average yields could go up to 5 tons of grain equivalent per hectare (as against the present average of 2 tons of grain equivalent)." In other words, the Brundtland Report assumes an increase in yields by a factor of 2.5. This would perhaps be possible if traditional agriculture could everywhere be replaced by energy-intensive modern agriculture using Green Revolution plant varieties. However, Pimental and Giampietro's studies show that modern energy-intensive agricultural techniques cannot be maintained after fossil fuels have been exhausted or after their use has been discontinued to avoid catastrophic climate change.

At the time when the Brundtland Report was written (1987), the global average of

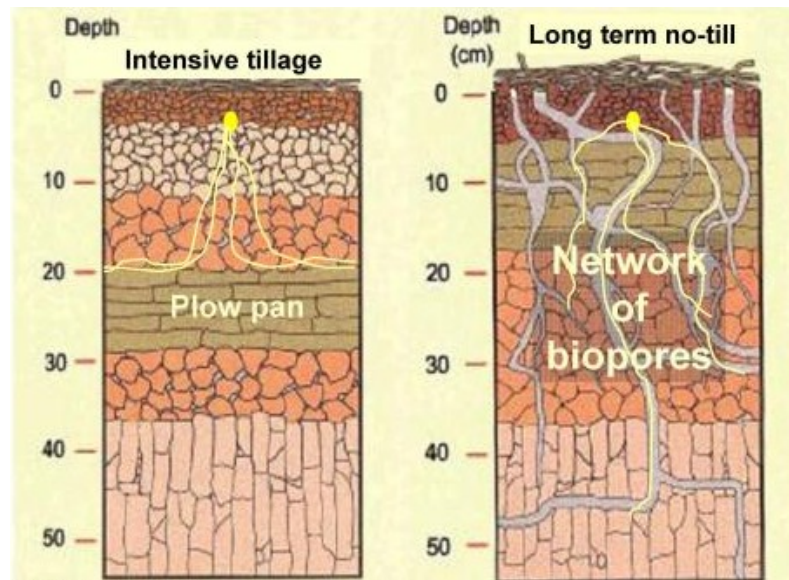


Figure 4.18: Recent research on No-Till Agriculture points to many benefits that could result from this practice, especially higher CO₂ content in the topsoil.

2 tons of grain equivalent per hectare included much higher yields from the sector using modern agricultural methods. Since energy-intensive petroleum-based agriculture cannot be continued in the post-fossil-fuel era, future average crop yields will probably be much less than 2 tons of grain equivalent per hectare.

The 1987 global population was approximately 5 billion. This population was supported by 3 billion tons of grain equivalent per year. After fossil fuels have been exhausted, the total world agricultural output is likely to be considerably less than that, and therefore the population that it will be possible to support sustainably will probably be considerably less than 5 billion, assuming that our average daily per capita use of food calories remains the same, and assuming that the amount of cropland and pasturage remains the same (1.5 billion hectares cropland, 3.0 billion hectares pasturage).

The Brundtland Report points out that “The present (1987) global average consumption of plant energy for food, seed and animal feed amounts to 6,000 calories daily, with a range among countries of 3,000-15,000 calories, depending on the level of meat consumption.” Thus there is a certain flexibility in the global population that can survive on a given total agricultural output. If the rich countries were willing to eat less meat, more people could be supported.⁴

⁴<http://www.truth-out.org/news/item/32354-environmentalists-sue-epa-over-dead-zone-in-gulf-of-mexico>

Effects of climate change on agriculture

a) The effect of temperature increase

There is a danger that when climate change causes both temperature increases and increased aridity in regions like the US grain belt, yields will be very much lowered. Of the three main grain types (corn, wheat and rice) corn is the most vulnerable to the direct effect of increases in temperature. One reason for this is the mechanism of pollination of corn: A pollen grain lands on one end of a corn-silk strand, and the germ cell must travel the length of the strand in order to fertilize the kernel. At high temperatures, the corn silk becomes dried out and withered, and is unable to fulfill its biological function. Furthermore, heat can cause the pores on the underside of the corn leaf to close, so that photosynthesis stops.

According to a study made by Mohan Wali and coworkers at Ohio State University, the photosynthetic activity of corn increases until the temperature reaches 20°C. It then remains constant until the temperature reaches 35°C, after which it declines. At 40°C and above, photosynthesis stops altogether.

Scientists in the Phillipines report that the pollination of rice fails entirely at 40°C, leading to crop failures. Wheat yields are also markedly reduced by temperatures in this range.⁵

b) The effect of decreased rainfall

According to the Stern Report, some of the major grain-producing areas of the world might loose up to 30% of their rainfall by 2050. These regions include much of the United States, Brazil, the Mediterranean region, Eastern Russia and Belarus, the Middle East, Southern Africa and Australia. Of course possibilities for agriculture may simultaneously increase in other regions, but the net effect of climate change on the world's food supply is predicted to be markedly negative.

c) Unsustainable use of groundwater

It may seem surprising that fresh water can be regarded as a non-renewable resource. However, groundwater in deep aquifers is often renewed very slowly. Sometimes renewal requires several thousand years. When the rate of withdrawal of groundwater exceeds the rate of renewal, the carrying capacity of the resource has been exceeded, and withdrawal of water becomes analogous to mining a mineral. However, it is more serious than ordinary mining because water is such a necessary support for life.

In many regions of the world today, groundwater is being withdrawn faster than it can be replenished, and important aquifers are being depleted. In China, for example, groundwater levels are falling at an alarming rate. Considerations of water supply in relation to population form the background for China's stringent population policy. At a recent lecture, Lester Brown of the Worldwatch Institute was asked by a member of the audience to name the resource for which shortages would most quickly become acute. Most of the audience expected him to name oil, but instead he replied "water".

⁵<http://ecowatch.com/2015/08/03/heat-wave-iran/>

Lester Brown then cited China's falling water table. He predicted that within decades, China would be unable to feed itself. He said that this would not cause hunger in China itself: Because of the strength of China's economy, the country would be able to purchase grain on the world market. However Chinese purchases of grain would raise the price, and put world grain out of reach of poor countries in Africa. Thus water shortages in China will produce famine in parts of Africa, Brown predicted.

Under many desert areas of the world are deeply buried water tables formed during glacial periods when the climate of these regions was wetter. These regions include the Middle East and large parts of Africa. Water can be withdrawn from such ancient reservoirs by deep wells and pumping, but only for a limited amount of time.

In oil-rich Saudi Arabia, petroenergy is used to drill wells for ancient water and to bring it to the surface. Much of this water is used to irrigate wheat fields, and this is done to such an extent that Saudi Arabia exports wheat. The country is, in effect, exporting its ancient heritage of water, a policy that it may, in time, regret. A similarly short-sighted project is Muammar Qaddafi's enormous pipeline, which will bring water from ancient sub-desert reservoirs to coastal cities.

In the United States, the great Ogallala aquifer is being overdrawn. This aquifer is an enormous stratum of water-saturated sand and gravel under-lying parts of northern Texas, Oklahoma, New Mexico, Kansas, Colorado, Nebraska, Wyoming and South Dakota. The average thickness of the aquifer is about 70 meters. The rate of water withdrawal from the aquifer exceeds the rate of recharge by a factor of eight.

Thus we can see that in many regions, the earth's present population is living on its inheritance of water, rather than its income. This fact, coupled with rapidly increasing populations and climate change, may contribute to a very serious food crisis partway through the 21st century.

d) Glacial melting and summer water supplies

The summer water supplies of both China and India are threatened by the melting of glaciers. The Gangotri glacier, which is the principle glacier feeding India's great Ganges River, is reported to be melting at an accelerating rate, and it could disappear within a few decades. If this happens, the Ganges could become seasonal, flowing only during the monsoon season. Chinese agriculture is also threatened by disappearing Himalayan glaciers, in this case those on the Tibet-Quinghai Plateau. The respected Chinese glaciologist Yao Tandong estimates that the glaciers feeding the Yangtze and Yellow Rivers are disappearing at the rate of 7% per year.⁶

The Indus and Mekong Rivers will be similarly affected by the melting of glaciers. Lack of water during the summer season could have a serious impact on the irrigation.

Mature forests contain vast amounts of sequestered carbon, not only in their trees, but also in the carbon-rich soil of the forest floor. When a forest is logged or burned to make way for agriculture, this carbon is released into the atmosphere.

⁶<http://www.commondreams.org/news/2015/08/04/global-glaciers-melting-three-times-rate-20th-century>

One fifth of the global carbon emissions are at present due to destruction of forests. This amount is greater than the CO₂ emissions for the world's transportation systems. An intact forest pumps water back into the atmosphere, increasing inland rainfall and benefiting agriculture. By contrast, deforestation, for example in the Amazonian rainforest, accelerates the flow of water back into the ocean, thus reducing inland rainfall. There is a danger that the Amazonian rainforest may be destroyed to such an extent that the region will become much more dry. If this happens, the forest may become vulnerable to fires produced by lightning strikes. This is one of the feedback loops against which the Stern Report warns: the drying and burning of the Amazonian rainforest may become irreversible, greatly accelerating climate change, if destruction of the forest proceeds beyond a certain point.

e) Erosion of topsoil.

Besides depending on an adequate supply of water, food production also depends on the condition of the thin layer of topsoil that covers the world's croplands. This topsoil is being degraded and eroded at an alarming rate: According to the World Resources Institute and the United Nations Environment Programme, "It is estimated that since World War II, 1.2 billion hectares... has suffered at least moderate degradation as a result of human activity. This is a vast area, roughly the size of China and India combined." This area is 27% of the total area currently devoted to agriculture. The report goes on to say that the degradation is greatest in Africa. The risk of topsoil erosion is greatest when marginal land is brought into cultivation, since marginal land is usually on steep hillsides which are vulnerable to water erosion when wild vegetation is removed.

David Pimental and his associates at Cornell University pointed out in 1995 that "Because of erosion-associated loss of productivity and population growth, the per capita food supply has been reduced over the past 10 years and continues to fall. The Food and Agricultural Organization reports that the per capita production of grains which make up 80% of the world's food supply, has been declining since 1984...During the past 40 years nearly one-third of the world's cropland (1.5 billion hectares) has been abandoned because of soil erosion and degradation. Most of the replacement has come from marginal land made available by removing forests. Agriculture accounts for 80% of the annual deforestation."

Topsoil can also be degraded by the accumulation of salt when irrigation water evaporates. The worldwide area of irrigated land has increased from 8 million hectares in 1800 to more than 100 million hectares today. This land is especially important to the world food supply because it is carefully tended and yields are large in proportion to the area. To protect this land from salination, it should be irrigated in such a way that evaporation is minimized.

Finally cropland with valuable topsoil is being be lost to urban growth and highway development, a problem that is made more severe by growing populations and by economic growth.

Every year, more than 100,000 square kilometers of rain forest are cleared and burned, an area which corresponds to that of Switzerland and the Netherlands combined. Almost half of the world's tropical forests have already been destroyed. Ironically, the land thus

cleared often becomes unsuitable for agriculture within a few years. Tropical soils may seem to be fertile when covered with luxuriant vegetation, but they are usually very poor in nutrients because of leeching by heavy rains. The nutrients which remain are contained in the vegetation itself; and when the forest cover is cut and burned, the nutrients are rapidly lost.

Often the remaining soil is rich in aluminum oxide and iron oxide. When such soils are exposed to oxygen and sun-baking, a rock-like substance called Laterite is formed.

Secret land purchases in Africa

According to a report released by the Oakland Institute, in 2009 alone, hedge funds bought or leased nearly 60 million hectares of land in Africa, an area the size of France.

As populations increase, and as water becomes scarce, China, and other countries, such as Saudi Arabia are also buying enormous tracts of agricultural land, not only in Africa, but also in other countries.

These land purchases are very often kept secret from the local populations by corrupt governments.⁷

Some conclusions

There is a danger that just as global population reaches the unprecedented level of 9 billion or more, the agricultural base for supporting it may suddenly collapse. Ecological catastrophe, possibly compounded by war and other disorders, could produce famine and death on a scale unprecedented in history, a disaster of unimaginable proportions, involving billions rather than millions of people.

The resources of the earth and the techniques of modern science can support a global population of moderate size in comfort and security; but the optimum size is undoubtedly smaller than the world's present population. Given a sufficiently small global population, renewable sources of energy can be found to replace disappearing fossil fuels. Technology may also be able to find renewable substitutes for many disappearing mineral resources for a global population of moderate size. What technology cannot do, however, is to give a global population of 9 billion people the standard of living which the industrialized countries enjoy today.

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).pro Simon and Schuster, (1990).

⁷<http://www.latimes.com/world/asia/la-fg-china-foreign-farmland-20140329-story.html>
<http://www.bbc.com/news/world-africa-13688683>

4. P.R. Ehrlich and A.H. Ehrlich, *Healing the Planet: Strategies for Resolving the Environmental Crisis*, Addison-Wesley, (1991).
5. P.R. Ehrlich and A.H. Ehrlich, *Betrayal of Science and Reason: How Anti-Environmental Rhetoric Threatens our Future*, Island Press, (1998).
6. P.R. Ehrlich and A.H. Ehrlich, *One With Nineveh: Politics, Consumption and the Human Future*, Island Press, (2004).
7. 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).
8. P.R. Ehrlich, *The Population Bomb*, Sierra/Ballentine, New York, (1972).
9. P.R. Ehrlich, A.H. Ehrlich and J. Holdren, *Human Ecology*, W.H. Freeman, San Francisco, (1972).
10. P.R. Ehrlich, A.H. Ehrlich and J. Holdren, *Ecoscience: Population, Resources, Environment*, W.H. Freeman, San Francisco, (1977)
11. P.R. Ehrlich and A.H. Ehrlich, *Extinction*, Victor Gollancz, London, (1982).
12. 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).
13. D.H. Meadows et al., *Beyond the Limits. Confronting Global Collapse and Envisioning a Sustainable Future*, Chelsea Green Publishing, Post Mills, Vermont, (1992).
14. 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).
15. A. Peccei and D. Ikeda, *Before it is Too Late*, Kodansha International, Tokyo, (1984).
16. A. Peccei, *The Human Quality*, Pergamon Press, Oxford, (1977).
17. A. Peccei, *One Hundred Pages for the Future*, Pergamon Press, New York, (1977).
18. V.K. Smith, ed., *Scarcity and Growth Reconsidered*, Johns Hopkins University Press, Baltimore, (1979).
19. R. Costanza, ed., *Ecological Economics: The Science and Management of Sustainability*, Colombia University Press, New York, (1991).
20. IPCC, Intergovernmental Panel on Climate Change, *Climate Change 2001: The Scientific Basis*, (2001).
21. N. Stern et al., *The Stern Review*, www.sternreview.org.uk, (2006).
22. T.M. Swanson, ed., *The Economics and Ecology of Biodiversity Decline: The Forces Driving Global Change*, Cambridge University Press, (1995).
23. P.M. Vitousek, H.A. Mooney, J. Lubchenco and J.M. Melillo, *Human Domination of Earth's Ecosystems*, *Science*, **277**, 494-499, (1997).
24. P.M. Vitousek, P.R. Ehrlich, A.H. Ehrlich and P.A. Matson, *Human Appropriation of the Products of Photosynthesis*, *Bioscience*, *34*, 368-373, (1986).
25. D. King, *Climate Change Science: Adapt, Mitigate or Ignore*, *Science*, **303** (5655), pp. 176-177, (2004).
26. S. Connor, *Global Warming Past Point of No Return*, *The Independent*, (116 September, 2005).
27. D. Rind, *Drying Out the Tropics*, *New Scientist* (6 May, 1995).

28. J. Patz et al., *Impact of Regional Climate Change on Human Health*, Nature, (17 November, 2005).
29. M. McCarthy, *China Crisis: Threat to the Global Environment*, The Independent, (19 October, 2005).
30. L.R. Brown, *The Twenty-Ninth Day*, W.W. Norton, New York, (1978).
31. N. Myers, *The Sinking Ark*, Pergamon, New York, (1972).
32. N. Myers, *Conservation of Tropical Moist Forests*, National Academy of Sciences, Washington D.C., (1980).
33. National Academy of Sciences, *Energy and Climate*, NAS, Washington D.C., (1977).
34. W. Ophuls, *Ecology and the Politics of Scarcity*, W.H. Freeman, San Francisco, (1977).
35. E. Eckholm, *Losing Ground: Environmental Stress and World Food Prospects*, W.W. Norton, New York, (1975).
36. E. Eckholm, *The Picture of Health: Environmental Sources of Disease*, New York, (1976).
37. Economic Commission for Europe, *Air Pollution Across Boundaries*, United Nations, New York, (1985).
38. G. Hagman and others, *Prevention is Better Than Cure*, Report on Human Environmental Disasters in the Third World, Swedish Red Cross, Stockholm, Stockholm, (1986).
39. G. Hardin, "The Tragedy of the Commons", *Science*, December 13, (1968).
40. K. Newland, *Infant Mortality and the Health of Societies*, Worldwatch Paper 47, Worldwatch Institute, Washington D.C., (1981).
41. D.W. Orr, *Ecological Literacy*, State University of New York Press, Albany, (1992).
42. E. Pestel, *Beyond the Limits to Growth*, Universe Books, New York, (1989).
43. D.C. Pirages and P.R. Ehrlich, *Ark II: Social Responses to Environmental Imperatives*, W.H. Freeman, San Francisco, (1974).
44. Population Reference Bureau, *World Population Data Sheet*, PRM, 777 Fourteenth Street NW, Washington D.C. 20007, (published annually).
45. R. Pressat, *Population*, Penguin Books Ltd., (1970).
46. M. Rechcigl (ed.), *Man/Food Equation*, Academic Press, New York, (1975).
47. J.C. Ryan, *Life Support: Conserving Biological Diversity*, Worldwatch Paper 108, Worldwatch Institute, Washington D.C., (1992).
48. J. Shepard, *The Politics of Starvation*, Carnegie Endowment for International Peace, Washington D.C., (1975).
49. B. Stokes, *Local Responses to Global Problems: A Key to Meeting Basic Human Needs*, Worldwatch Paper 17, Worldwatch Institute, Washington D.C., (1978).
50. L. Timberlake, *Only One Earth: Living for the Future*, BBC/ Earthscan, London, (1987).
51. UNEP, *Environmental Data Report*, Blackwell, Oxford, (published annually).
52. UNESCO, *International Coordinating Council of Man and the Biosphere*, MAB Report Series No. 58, Paris, (1985).

53. United Nations Fund for Population Activities, *A Bibliography of United Nations Publications on Population*, United Nations, New York, (1977).
54. United Nations Fund for Population Activities, *The State of World Population*, UNPF, 220 East 42nd Street, New York, 10017, (published annually).
55. United Nations Secretariat, *World Population Prospects Beyond the Year 2000*, U.N., New York, (1973).
56. J. van Klinken, *Het Dierde Punte*, Uitgiversmaatschappij J.H. Kok-Kampen, Netherlands (1989).
57. B. Ward and R. Dubos, *Only One Earth*, Penguin Books Ltd., (1973).
58. WHO/UNFPA/UNICEF, *The Reproductive Health of Adolescents: A Strategy for Action*, World Health Organization, Geneva, (1989).
59. E.O. Wilson, *Sociobiology*, Harvard University Press, (1975).
60. E.O. Wilson (ed.), *Biodiversity*, National Academy Press, Washington D.C., (1988).
61. E.O. Wilson, *The Diversity of Life*, Allen Lane, The Penguin Press, London, (1992).
62. G. Woodwell (ed.), *The Earth in Transition: Patterns and Processes of Biotic Impoverishment*, Cambridge University Press, (1990).
63. World Resources Institute (WRI), *Global Biodiversity Strategy*, The World Conservation Union (IUCN), United Nations Environment Programme (UNEP), (1992).
64. World Resources Institute, *World Resources 200-2001: People and Ecosystems: The Fraying Web of Life*, WRI, Washington D.C., (2000).
65. D.W. Pearce and R.K. Turner, *Economics of Natural Resources and the Environment*, Johns Hopkins University Press, Baltimore, (1990).
66. P. Bartelmus, *Environment, Growth and Development: The Concepts and Strategies of Sustainability*, Routledge, New York, (1994).
67. H.E. Daly and K.N. Townsend, (editors), *Valuing the Earth. Economics, Ecology, Ethics*, MIT Press, Cambridge, Massachusetts, (1993)
68. C. Flavin, *Slowing Global Warming: A Worldwide Strategy*, Worldwatch Paper 91, Worldwatch Institute, Washington D.C., (1989).
69. S.H. Schneider, *The Genesis Strategy: Climate and Global Survival*, Plenum Press, (1976).
70. WHO/UNFPA/UNICEF, *The Reproductive Health of Adolescents: A Strategy for Action*, World Health Organization, Geneva, (1989).
71. World Commission on Environment and Development, *Our Common Future*, Oxford University Press, (1987).
72. W. Jackson, *Man and the Environment*, Wm. C. Brown, Dubuque, Iowa, (1971).
73. T. Berry, *The Dream of the Earth*, Sierra Club Books, San Francisco, (1988).
74. T.M. Swanson, ed., *The Economics and Ecology of Biodiversity Decline: The Forces Driving Global Change*, Cambridge University Press, (1995).
75. John Fielden, *The Curse of the Factory System*, (1836).
76. A. Smith, *The Theory of Moral Sentiments...* (1759), ed. D.D. Raphael and A.L. MacPhie, Clarendon, Oxford, (1976).
77. A. Smith, *An Inquiry into the Nature and Causes of the Wealth of Nations* (1776), Everyman edn., 2 vols., Dent, London, (1910).

78. Charles Knowlton *The Fruits of Philosophy, or The Private Companion of Young Married People*, (1832).
79. John A. Hobson, *John Ruskin, Social Reformer*, (1898).
80. E. Pease, *A History of the Fabian Society*, Dutton, New York, (1916).
81. G. Claeys, ed., *New View of Society, and other writings by Robert Owen*, Penguin Classics, (1991).
82. W. Bowden, *Industrial Society in England Towards the End of the Eighteenth Century*, MacMillan, New York, (1925).
83. G.D. Cole, *A Short History of the British Working Class Movement*, MacMillan, New York, (1927).
84. P. Deane, *The First Industrial Revolution*, Cambridge University Press, (1969).
85. Marie Boaz, *Robert Boyle and Seventeenth Century Chemistry*, Cambridge University Press (1958).
86. J.G. Crowther, *Scientists of the Industrial Revolution*, The Cresset Press, London (1962).
87. R.E. Schofield, *The Lunar Society of Birmingham*, Oxford University Press (1963).
88. L.T.C. Rolt, *Isambard Kingdom Brunel*, Arrow Books, London (1961).
89. J.D. Bernal, *Science in History*, Penguin Books Ltd. (1969).
90. Bertrand Russell, *The Impact of Science on Society*, Unwin Books, London (1952).
91. Wilbert E. Moore, *The Impact of Industry*, Prentice Hall (1965).
92. Charles Morazé, *The Nineteenth Century*, George Allen and Unwin Ltd., London (1976).
93. Carlo M. Cipolla (editor), *The Fontana Economic History of Europe*, Fontana/Collins, Glasgow (1977).
94. Martin Gerhard Geisbrecht, *The Evolution of Economic Society*, W.H. Freeman and Co. (1972).
95. P.N. Stearns, *The Industrial Revolution in World History*, Westview Press, (1998).
96. E.P. Thompson, *The Making of the English Working Class*, Penguin Books, London, (1980).
97. N.J. Smelser, *Social Change and the Industrial Revolution: An Application of Theory to the British Cotton Industry*, University of Chicago Press, (1959).
98. D.S. Landes, *The Unbound Prometheus: Technical Change and Industrial Development in Western Europe from 1750 to the Present, 2nd ed.*, Cambridge University Press, (2003).
99. S. Pollard, *Peaceful Conquest: The Industrialization of Europe, 1760-1970*, Oxford University Press, (1981).
100. M. Kranzberg and C.W. Pursell, Jr., eds., *Technology in Western Civilization*, Oxford University Press, (1981).
101. M.J. Daunton, *Progress and Poverty: An Economic and Social History of Britain, 1700-1850*, Oxford University Press, (1990).
102. L.R. Berlanstein, *The Industrial Revolution and Work in 19th Century Europe*, Routledge, (1992).

103. J.D. Bernal, *Science and Industry in the 19th Century*, Indiana University Press, Bloomington, (1970).
104. P.A. Brown, *The French Revolution in English History*, 2nd edn., Allen and Unwin, London, (1923).
105. E. Burke, *Reflections on the Revolution in France and on the Proceedings of Certain Societies in London Relative to that Event...*, Dent, London, (1910).
106. J.B. Bury, *The Idea of Progress*, MacMillan, New York, (1932).
107. I.R. Christie, *Stress and Stability in Late Eighteenth Century Britain; Reflections on the British Avoidance of Revolution* (Ford Lectures, 1983-4), Clarendon, Oxford, (1984).
108. H.T. Dickenson, *Liberty and Property, Political Ideology in Eighteenth Century Britain*, Holmes and Meier, New York, (1977).
109. W. Eltis, *The Classical Theory of Economic Growth*, St. Martin's, New York, (1984).
110. E. Halévy, *A History of the English People in the Nineteenth Century*, (transl. E.I. Watkin), 2nd edn., Benn, London, (1949).
111. E. Halévy, *The Growth of Philosophic Radicalism*, (transl. M. Morris), new edn., reprinted with corrections, Faber, London, (1952).
112. W. Hazlitt, *The Complete Works of William Hazlitt*, ed. P.P. Howe, after the edition of A.R. Walker and A. Glover, 21 vols., J.M. Dent, London, (1932).
113. W. Hazlitt, *A Reply to the Essay on Population by the Rev. T.R. Malthus...*, Longman, Hurst, Rees and Orme, London, (1807).
114. R. Heilbroner, *The Worldly Philosophers: The Lives, Times and Ideas of the Great Economic Thinkers*, 5th edn., Simon and Schuster, New York, (1980).
115. R.K. Kanth, *Political Economy and Laissez-Faire: Economics and Ideology in the Ricardian Era*, Rowman and Littlefield, Totowa N.J., (1986).
116. J.M. Keynes, *Essays in Biography*, in *The Collected Writings of John Maynard Keynes*, MacMillan, London, (1971-82).
117. F. Knight, *University Rebel: The Life of William Frend, 1757-1841*, Gollancz, London (1971).
118. M. Lamb, and C. Lamb, *The Works of Charles and Mary Lamb*, ed. E.V. Lucas, 7 vols., Methuen, London, (1903).
119. A. Lincoln, *Some Political and Social Ideas of English Dissent, 1763-1800*, Cambridge University Press, (1938).
120. D. Locke, *A Fantasy of Reason: The Life and Thought of William Godwin*, Routledge, London, (1980).
121. J. Locke, *Two Treatises on Government. A Critical Edition with an Introduction and Apparatus Criticus*, ed. P. Laslett, Cambridge University Press, (1967).
122. J. Macintosh, *Vindicae Gallicae. Defense of the French Revolution and its English Admirers against the Accusations of the Right Hon. Edmund Burke...*, Robinson, London, (1791).
123. J. Macintosh, *A Discourse on the Study of the Law of Nature and of Nations*, Caldell, London, (1799).

124. T. Paine, *The Rights of Man: being an Answer to Mr. Burke's Attack on The French Revolution*, Jordan, London, part I (1791), part II (1792).
125. H.G. Wells, *Anticipations of the Reaction of Mechanical and Scientific Progress on Human Life and Thought*, Chapman and Hall, London, (1902).
126. B. Wiley, *The Eighteenth Century Background: Studies of the Idea of Nature in the Thought of the Period*, Chatto and Windus, London, (1940).
127. G.R. Morrow, *The Ethical and Economic Theories of Adam Smith: A Study in the Social Philosophy of the 18th Century*, Cornell Studies in Philosophy, **13**, 91-107, (1923).
128. H.W. Schneider, ed., *Adam Smith's Moral and Political Philosophy*, Harper Torchbook edition, New York, (1948).
129. F. Rosen, *Classical Utilitarianism from Hume to Mill*, Routledge, (2003).
130. J.Z. Muller, *The Mind and the Market: Capitalism in Western Thought*, Anchor Books, (2002).
131. J.Z. Muller, *Adam Smith in His Time and Ours: Designing the Decent Society*, Princeton University Press, (1995).
132. S. Hollander, *The Economics of Adam Smith*, University of Toronto Press, (19773).
133. K. Haakonssen, *The Cambridge Companion to Adam Smith*, Cambridge University Press, (2006).
134. K. Haakonssen, *The Science of a Legeslator: The Natural Jurisprudence of David Hume and Adam Smith*, Cambridge University Press, (1981).
135. I. Hont and M. Ignatieff, *Wealth and Virtue: The Shaping of Political Economy in the Scottish Enlightenment*, Cambridge University Press, (1983).
136. I.S. Ross, *The Life of Adam Smith*, Clarendon Press, Oxford, (1976).
137. D. Winch, *Adam Smith's Politics: An Essay in Historiographic Revision*, Cambridge University Press, (1979).

Chapter 5

THE GREEN NEW DEAL

5.1 Alexandria Ocasio-Cortez and the Green New Deal

Alexandra Ocasio-Cortez (born in 1989) won a stunning victory in the Democratic Party primary election of June 26, 2018. Although outspent by a factor of 18 to 1 by her opponent (Democratic Caucus Chair, Joseph Crowley), she won the primary by 57% to 42%. Her campaign contributions came from small individual donors, while his came in large blocks, from corporations. Ocasio-Cortez calls for the United States to transition by 2035 to an electrical grid running on 100% renewable-energy production and end the use of fossil fuels. She calls healthcare “a human right”, and says: “Almost every other developed nation in the world has universal healthcare. It’s time the United States catch up to the rest of the world in ensuring all people have real healthcare coverage that doesn’t break the bank”.

The Guardian called her victory “one of the biggest upsets in recent American political history”, and Senator Bernie Sanders commented “She took on the entire local Democratic establishment in her district and won a very strong victory. She demonstrated once again what progressive grassroots politics can do”. The lesson that the US Democratic Party must learn from this is that in order to overthrow Donald Trump’s openly racist and climate-change-denying Republican Party, they must free themselves from the domination of corporate oligarchs, and instead stand for honest government and progressive values.

Even before taking her place in the US House of Representatives, with its newly-won Democratic majority, Alexandria Ocasio-Cortez became the leader of a campaign for a Green New Deal. This program takes its inspiration from the massive Federal government program by which Franklin Delano Roosevelt ended the depression of the 1930’s. FDR’s New Deal built dams, planted forests, and in general to create much needed infrastructure, while at the same time addressing the problem of unemployment by providing jobs. Wikipedia describes FDR’s New Deal as follows:

“The New Deal was a series of programs, public work projects, financial reforms and regulations enacted by President Franklin D. Roosevelt in the United States between 1933 and 1936. It responded to needs for relief, reform and recovery from the Great Depression. Major federal programs included the Civilian Conservation Corps (CCC), the Civil Works

Administration (CWA), the Farm Security Administration (FSA), the National Industrial Recovery Act of 1933 (NIRA) and the Social Security Administration (SSA). They provided support for farmers, the unemployed, youth and the elderly. The New Deal included new constraints and safeguards on the banking industry and efforts to re-inflate the economy after prices had fallen sharply. New Deal programs included both laws passed by Congress as well as presidential executive orders during the first term of the presidency of Franklin D. Roosevelt. The programs focused on what historians refer to as the ‘3 Rs’: relief for the unemployed and poor, recovery of the economy back to normal levels and reform of the financial system to prevent a repeat depression.”

Alexandria Ocasio-Cortez believes that the climate emergency that the world now faces is a much more severe emergency than the great depression. Indeed, if quick action is not taken immediately, the long-term effects of catastrophic climate change pose existential threats to human civilization and the biosphere. Therefore she advocates a massive governmental program to create renewable energy infrastructure. Such a program, like FDR’s New Deal, would simultaneously solve the problem of unemployment. Money for the program could be taken from the Pentagon’s obscenely bloated budget. Ocasio-Cortez has also proposed a 70% income tax for the ultra-wealthy.

According to a January 24 2019 article by Robert R. Raymond, “When polled, 92 percent of registered Democratic voters say they support the Green New Deal. But perhaps more importantly, a full 81 percent of all registered voters support it - a number that includes both Republicans and Democrats.”¹

House Speaker Nancy Pelosi is facing criticism from some climate activists for failing to back a Green New Deal. Last week Pelosi announced the formation of a new Select Committee on the Climate Crisis, headed by long-standing Florida Congressman Kathy Castor. But the committee is far weaker than what backers of a Green New Deal had envisioned. The committee will not have subpoena power or the power to draft legislation. We speak with Varshini Prakash, founder of the Sunrise Movement, a youth-led climate group that has occupied and lobbied at congressional offices, risking arrest to demand adoption of the Green New Deal and bold climate leadership. Here is the transcript of a January 7, 2019 program made by Amy Goodman of Democracy Now:

AMY GOODMAN: For more, we go to Boston, where we’re joined by Varshini Prakash. She’s founder of Sunrise Movement, the youth-led climate group that’s occupied and lobbied at congressional offices, including Nancy Pelosi’s last month, with the woman we just heard, Alexandria Ocasio-Cortez. People risked arrest to demand adoption of the Green New Deal and bold climate leadership.

Varshini Prakash, welcome to Democracy Now! Talk about what has been proposed. You know, when Nancy Pelosi did that historic gaveling-in, with the children and grandchildren of congressmembers, as well as her own, in her speech she called out the Select Committee on the Climate Crisis. What do you think works about that committee, and what are you disappointed by?

¹<https://truthout.org/articles/the-democratic-party-is-further-to-the-right-than-most-voters/>

VARSHINI PRAKASH: Sure. Well, what we saw last week was - we were very glad to see that Nancy Pelosi mentioned the climate crisis in her address, but calling it a crisis and an existential threat and treating it like one are two very different things. So, essentially, Nancy Pelosi is reviving a 10-year-old committee, the Select Committee for the Climate Crisis, but we find that it's actually woefully and inexcusably short - falls short of what we need in this moment in terms of climate ambition in this crucial juncture in history.

Namely, it falls short in three ways, some of which you already mentioned. It doesn't include anything about creating a draft, sort of a blueprint, for a plan for a Green New Deal over the next year, ahead of the next presidential election. It doesn't include any provision that actually bars people who are taking money from oil and gas executives and lobbyists, who are jeopardizing my generation's future, from sitting on the committee, something that, frankly, we find to be a conflict of interest. And thirdly, it doesn't include any power to subpoena, which actually renders this committee less powerful than the one we had even a decade ago.

So we were feeling really disappointed that Nancy Pelosi had failed to follow the leadership of the 45 members of Congress, including some of the freshest faces of the Democratic Party - Alexandria Ocasio-Cortez, Rashida Tlaib, Ilhan Omar, Ayanna Pressley, Joe Ne-guse, so many more - in calling for a select committee for a Green New Deal. And we've seen the hurricanes get bigger. We've seen fires level entire cities and towns. We've seen people struggling to breathe clean air and drink fresh water, fresh and clean water, and are not seeing the Democratic Party step up with the level of climate ambition that we actually need, that has been mandated by UN climate scientists.

AMY GOODMAN: Last week, Congressmember Ocasio-Cortez tweeted, "In DC + even in our own party, it's apparently too controversial to ask that we keep oil+gas co's away from enviro policy." Your response, Varshini?

VARSHINI PRAKASH: Absolutely. I mean, putting somebody who takes oil and gas money on a committee to stop the climate crisis is akin to pouring oil on a fire and expecting to put it out. We're talking about a fundamental conflict of interest. People who are taking money from the corporations and individuals who have spent the last 50 years misinforming the public on the science, misleading the public on the science willfully, and buying out politicians on both sides of the aisles - for sure the GOP, but also a large number of Democrats - should not be having a seat at the table in crafting and holding these public hearings and informing the public about the severity of the crisis and building the consensus around the solutions to do it. We'd be hard-pressed to really support somebody to sit on this committee who hasn't taken the No Fossil Fuel Money Pledge, which is why we have been acting - why we have pushed and been pushing for Representative Kathy Castor to take the pledge.

AMY GOODMAN: Did you want Congressmember Ocasio-Cortez to head this committee?

VARSHINI PRAKASH: Sure. We definitely think it would be a positive if Alexandria Ocasio-Cortez were able to participate and push this committee in some way. But frankly, we are seeing that our options, through institutional means, through this committee, are not really going to happen in the ways that we wanted. So we're actually looking at not just pushing this Select Committee on a Climate Crisis to be better and push for the real solutions to the climate crisis, what UN climate scientists are saying unprecedented levels of change to our economy and our society over the next 12 years; we actually are realizing that need to take this fight to a Green New Deal beyond the Beltway and to the American people.

AMY GOODMAN: Pelosi's office said they'd meet with you. Have they?

VARSHINI PRAKASH: Yes, we met with them prior to the announcement about the select committee.

AMY GOODMAN: And what came out of that discussion?

VARSHINI PRAKASH: Well, largely, they said they were supportive of our aims, and then created the Select Committee for a Climate Crisis. So it feels a little bit - a bit of a contradiction to say that they're on our same page but not to include any of the clear demands and provisions that we had asked for previously. It's clear that the Select Committee for the Climate Crisis is largely going to be a number of public hearings or information gathering. And, frankly, the time to raise awareness about the crisis is over.

And at this point in history, we need to start developing the plans to actually confront the crisis and lay the groundwork. We're clear that we're not going to be able to ramrod legislation through in the 116th Congress. That's obvious, with a Trump administration that is completely bought and sold by fossil fuel executives and a climate-denying Senate. But we can start to lay the groundwork in these next two years for what an actual plan might look like. And that is an opportunity that Democrats are missing right now.

AMY GOODMAN: You did not get your demand for fossil fuel-funded lawmakers not to serve on the committee. Will you protest those or highlight those that are chosen for this committee?

VARSHINI PRAKASH: Well, we definitely.

AMY GOODMAN: Will you ask that they stop accepting that money?

VARSHINI PRAKASH: Absolutely. I think we will ask every single member on this committee to reject oil and gas contributions, oil and gas executive and lobbyist contributions, and prioritize the health and well-being of our democracy, our society and our climate instead.



Figure 5.1: Alexandria Ocasio-Cortez. At 29 she is the youngest woman ever to be elected to the US House of Representatives.

AMY GOODMAN: Varshini Prakash, I want to thank you for being with us, founder of the Sunrise Movement, speaking to us from Boston.



Figure 5.2: The Green New Deal advocated by Ocasio-Cortez proposes to use jobs creating renewable energy infrastructure to ensure full employment, in a manner analogous to Roosevelt's New Deal.



Figure 5.3: Members of the Sunrise movement in the office of House Majority Leader Nancy Pelosi, protesting against her lack of support for the Green New Deal.



Naomi Klein on the urgency of the Green New Deal

A recent article by journalist Naomi LaChance describes a meeting at the Sanders Institute (founded by Senator Bernie Sanders and his wife Jane) at which the famous author and activist Naomi Klein and others spoke about the scope and urgency of the Green New Deal. Here are some excerpts from the article:

Progressive journalist and activist Naomi Klein urged sweeping change that tackles the climate crisis, capitalism, racism and economic inequality in tandem on Friday in Burlington, Vt. If that seems challenging, add the fact that the clock is ticking² and there might not be another chance.

“We need to have started yesterday”, Klein said at the three-day Sanders Institute Gathering on a panel moderated by environmental activist Bill McKibben. “What all of us who follow the science know is that we just can’t lose these four years”, she said, referring to the presidency of climate change denier Donald Trump. The conference, organized by the think tank founded by Vermont Sen. Bernie Sanders’ wife, Jane, is aimed at forming bold progressive agendas for the future.

Progressives are looking to incoming Democratic New York Rep. Alexandria Ocasio-Cortez for leadership as she galvanizes a grassroots effort by the youth-led climate change group Sunrise Movement³ to reduce fossil fuel dependence. Eighteen members of Congress support the idea of creating a House select committee to look at making a realistic plan by January 2020.

²<https://www.theguardian.com/environment/2018/oct/08/global-warming-must-not-exceed-15c-warns-landmark-un-report>

³<https://www.truthdig.com/articles/will-democrats-back-a-green-new-deal/>



Figure 5.4: Award-winning author Naomi Klein, speaking at the Sanders Institute in January, 2019.

Uniting for a Green New Deal

Here are excerpts from an article entitled “Uniting for a Green New Deal”, by Margaret Flowers and Kevin Zeese. It was published on January 15, 2019.

Support is growing in the United States for a Green New Deal. Though there are competing visions for what that looks like, essentially, a Green New Deal includes a rapid transition to a clean energy economy, a jobs program and a stronger social safety net.

We need a Green New Deal for many reasons, most obviously the climate crisis and growing economic insecurity. Each new climate report describes the severe consequences of climate change with increasing alarm and the window of opportunity for action is closing. At the same time, wealth inequality is also growing. Paul Bucheit writes that more than half of the population in the United States is suffering from poverty.

The Green New Deal provides an opportunity for transformational changes, not just reform, but changes that fundamentally solve the crises we face. This is the time to be pushing for a Green New Deal at all levels, in our towns and cities, states and nationally.

The idea of a Green New Deal seems to have arisen in early 2007 when the Green New Deal Group started meeting to discuss it, specifically as a plan for the United Kingdom. They published their report in July 2008. In April 2009, the United Nations Environmental Program also issued a plan for a global Green New Deal.

In the United States, Barack Obama included a Green New Deal in his 2008 presidential campaign and conservative Thomas Friedman started talking about it in 2007. Howie Hawkins, a Green Party gubernatorial candidate in New York, campaigned on a Green New Deal starting in 2010. Listen to our interview with Hawkins about how we win the Green New Deal on Clearing the FOG. Jill Stein campaigned on it during her presidential runs in 2012 and 2016, as have many Green Party candidates.

Alexandria Ocasio Cortez (AOC), who ran for Congress as a Democrat and won in 2018, has made the Green New Deal a major priority. With the backing of the Sunrise Movement, AOC pushed for a congressional committee tasked with developing a Green New Deal and convinced dozens of members of Congress to support it. Speaker of the House Nancy Pelosi sidelined that idea by creating a climate committee headed by Kathy Castor, which has no mandate to do anything and lacks the power to write legislation and issue subpoenas. Now the Sunrise Movement is planning a tour to build support for the Green New Deal. At each stop they will provide organizing tools to make the Green New Deal a major issue in the 2020 election season.

This week, more than 600 organizations, mostly environmental groups, sent a letter to Congress calling on it to take climate change seriously and design a plan to end dependence on fossil fuels, a transition to 100% clean energy by 2035, create jobs and more. Indigenous leaders are also organizing to urge Congress to pass a Green New Deal that is “Indigenized,” meaning it prioritizes input from and the inclusion of Indigenous Peoples.



5.2 Roosevelt's original New Deal

In the United States, President Franklin D. Roosevelt was faced with the difficult problems of the depression during his first few years in office. Roosevelt introduced a number of special governmental programs, such as the WPA, the Civilian Construction Corps and the Tennessee Valley Authority, which were designed to create new jobs on projects directed towards socially useful goals - building highways, airfields, auditoriums, harbors, housing projects, schools and dams. The English economist John Maynard Keynes, (1883-1946), provided an analysis of the factors that had caused the 1929 depression, and a theoretical justification of Roosevelt's policies.

The transition to a sustainable global society will require a similar level of governmental responsibility, although the measures needed are not the same as those which Roosevelt used to end the great depression. Despite the burst of faith in the free market which has followed the end of the Cold War, it seems unlikely that market mechanisms alone will be sufficient to solve problems of unemployment in the long-range future, or to achieve conservation of land, natural resources and environment.



Figure 5.5: Franklin D. Roosevelt (1882-1945) with his dog Fala and Ruthie Bie at Hilltop in 1941. Roosevelt served as President of the United States from 1933 to 1945, and was starting his 4th term when he died. Although crippled by polio, he managed to convey an image of dynamism and confidence.

5.3 Keynesian economics

In December, 1933, Keynes wrote to Franklin D. Roosevelt: “Dear Mr. President, You have made yourself the Trustee for those in every country who seek to mend the evils of our condition by reasoned experiment within the framework of the existing social system. If you fail, rational change will be gravely prejudiced throughout the world, leaving orthodoxy and revolution to fight it out. But if you succeed, new and bolder methods will be tried everywhere, and we may date the first chapter of a new economic era from your accession to office...”

“...Thus as the prime mover in the first stage of the technique of recovery I lay overwhelming emphasis on the increase of national purchasing power resulting from governmental expenditure which is financed by Loans and not by taxing present incomes. Nothing else counts in comparison with this. In a boom inflation can be caused by allowing unlimited credit to support the excited enthusiasm of business speculators. But in a slump governmental Loan expenditure is the only sure means of securing quickly a rising output at rising prices. That is why war has always caused intense industrial activity. In the past orthodox finance has regarded war as the only legitimate excuse for creating employment by governmental expenditure. You, Mr. President, having cast off such fetters, are free to engage in the interests of peace and prosperity the technique which hitherto has only been allowed to serve the purposes of war and destruction.”

John Maynard Keynes (1883-1946), the author of this letter to Roosevelt, was the son of the Cambridge University economist and logician, Neville Keynes. After graduating from Eton and studying economics at King’s College, Cambridge, Keynes spent a few years as a civil servant in the India Office. In 1909, he returned to Cambridge as a Fellow of King’s College. He became a member of the “Bloomsbury Group”, a collection of intellectual friends that included Virginia and Leonard Woolf, E.M. Forster, Clive and Vanessa Bell, Duncan Grant, Lytton Strachy, Roger Fry, and Bertrand Russell. In 1911, Keynes became the editor of the *Economic Journal*, a position that he retained almost until the end of his life.

In 1918, Keynes married the Russian ballerina Lydia Lopokova. They met at a party given by the Sitwells. Lydia was struggling to learn English, and one of her more interesting remarks was, “I dislike being in the country in August because my legs get so bitten by barristers”. To everyone’s surprise, Lydia proved to be the perfect wife for Keynes, encouraging his wide range of cultural interests. He and Lydia did much to develop the Cambridge Arts Theatre. Lydia maintained her interest in the ballet, although she no longer danced professionally. Visitors to the couple’s house occasionally heard formidable thumpings from an upper room, and they realized that Lydia was practicing.

During World War I, Keynes worked in the British Treasury, helping to find ways to finance the war. In 1919, he was sent to the peace conference at Versailles as a representative of the Treasury. Keynes recognized the disastrous economic consequences that would follow from the Treaty of Versailles, and returning to Cambridge, he wrote *The Economic Consequences of the Peace* (1919). “It is an extraordinary fact”, Keynes wrote, “that the fundamental problems of a Europe starving and disintegrating before their eyes, was the

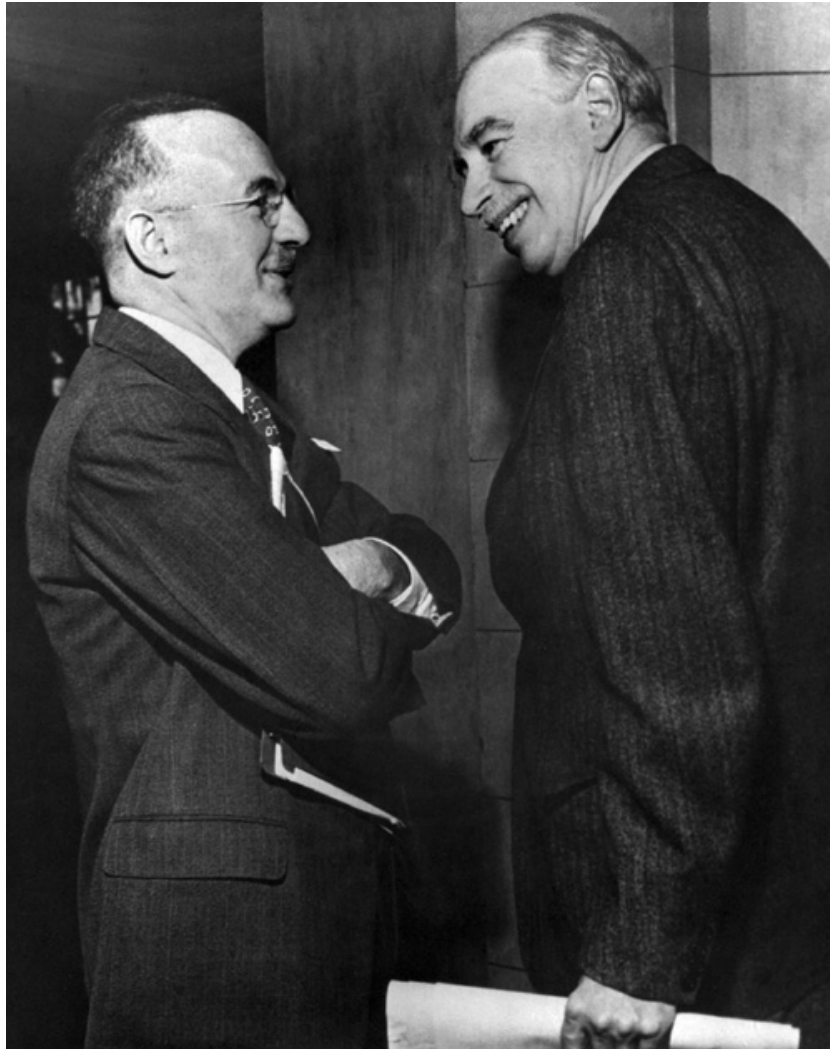


Figure 5.6: John Maynard Keynes (right) with Harry Dexter White at the Bretton Woods Conference. Keynes was an extremely tall man - 6 feet and 6 inches tall, i.e. 198 cm. Heart problems caused his early death.

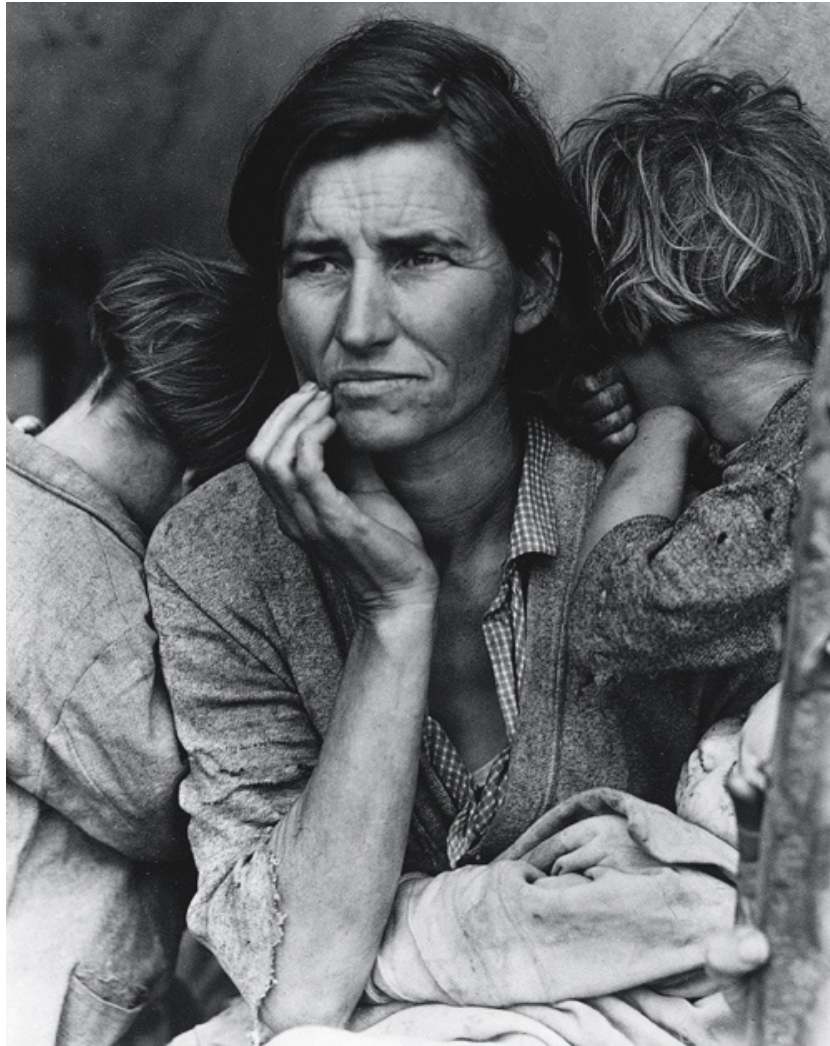


Figure 5.7: **Migrant Mother**, a photograph by Dorothea Lange, shows a destitute pea picker in California in 1936, during the Great Depression.

one question in which it was impossible to arouse the interest of the [Council of] Four.”

The book became a best seller and was very influential in shaping public opinion, both in England and in the United States. In his book, Keynes predicted that the reparations imposed against Germany at Versailles would cause economic ruin. He advocated instead a loan system to rebuild postwar Europe. The plan advocated by Keynes was similar to the Marshall Plan that followed World War II. Had it been put into effect in 1919, it might have prevented the Second World War.

In 1936, Keynes published his magnum opus, *General Theory of Employment, Interest and Money*. In this book, he provided a theoretical explanation for the fact that the great depression showed no tendency to right itself, as well as arguments for governmental interventions to counter business cycles and to produce full employment. Once again, Keynes

had written a best-seller. His *General Theory* proved to be one of the most influential books on economics ever written.

Keynes rebelled against the ideas of the classical economists, who believed that if let entirely alone, the world economy would correct itself. The classical economists recommended that, to end the depression, labor unions should be made illegal, minimum wages and long-term wage contracts abolished, and government spending curtailed (to restore business confidence). Then, they maintained, wages would fall, businessmen would hire more workers, and full employment and production would be restored. One reason for the popularity of the *General Theory* was that everyone knew the recommendations of the classical economists were bad policies. Now Keynes showed why these bad policies were also bad economics.

Keynes pointed out that a fall in wages would produce a fall in purchasing power, and hence a fall in aggregate demand. Producers would then be less able to sell their products. Thus Keynes believed that falling wages would deepen the depression, rather than ending it.

Part of Keynes' skepticism towards classical economics had to do with his criticisms of the short-term version of Say's Law, on which classical economics was based. In Chapter 2, we mentioned that Jean-Baptiste Say (1767-1832) believed a general glut to be impossible, since wages for the production of goods could be used by society to buy back its aggregate production. "A glut", Say wrote, "can take place only when there are too many means of production applied to one kind of product, and not enough to another."

Say considered the influence of the money supply on this process to be negligible, and he believed that the problem could be analyzed from the standpoint of barter. Say believed that no one would keep money for long. Having obtained money in a transaction, he believed, people would immediately spend it again. Thus Say did not worry about the problem of excessive saving that bothered both Malthus and Hobson.

"It is not the abundance of money", Say wrote, "but the abundance of other products in general that facilitates sales... Money performs no more than the role of a conduit in this double exchange. When the exchanges have been completed, it will be found that one has paid for products with products."

"It is worthwhile to remark", Say continued, "that a product is no sooner created than it, from that instant, affords a market for other products to the full extent of its value. When the producer has put the finishing hand to his product, he is most anxious to sell it immediately, lest its value should diminish in his hands. Nor is he less anxious to dispose of the money he may get for it; for the value of money is also perishable. But the only way to get rid of money is in the purchase some product or other. Thus the mere circumstance of creation of one product immediately opens a vent for other products."

Keynes disagreed with these conclusions in several respects. First of all, he did not believe, like Say, that the money supply played a negligible role in determining economic activity. Secondly he did not agree that the producer who has received money for his goods is necessarily "anxious to dispose of the money". As a recession deepens, the value of money in terms of goods increases, and therefore it is rational to keep money, hoping to get more goods for it at a later time. Whether it is more rational to keep money or to

spend it immediately depends on the phase of the business cycle, Keynes pointed out.

In James Mill's version, Say's Law states that "supply creates its own demand". Keynes reversed this, and maintained in a depression, the fault may be on the demand side, i.e., "demand creates supply", rather than the reverse. It is true that during the great depression, many people were in need; but need does not constitute demand in the economic sense unless it is combined with purchasing power.

Keynes (like Malthus and Hobson) believed that excessive saving could be a serious problem, capable of causing a "general glut" or depression. By excessive saving, he meant saving beyond planned investment, a condition that could be caused by falling consumer demand, overinvestment in previous years, or lack of business confidence. The classical economists believed that excessive saving would be corrected by falling interest rates. Keynes did not believe that interest rates would respond quickly enough to perform this corrective function. Instead, Keynes believed, excessive savings would be in the end corrected by the fall in aggregate income which characterizes a recession or depression. The economy would reach a new equilibrium at low levels of employment, income, investment and production. This new, undesirable equilibrium would not be self-correcting. (By calling his theory a *General Theory*, Keynes meant that he treated not only the full-employment equilibrium, but also other types of equilibria.)

Keynes believed that active government fiscal and monetary policy could be effective in combating cycles of inflation and depression. *Fiscal policy* is defined as policy regarding government expenditure, while *monetary policy* means governmental policy with respect to the money supply. Keynes advocated a counter-cyclical use of these two tools, i.e. he believed that government spending and expansionist monetary policy should be used to combat recessions and depressions, while the opposite policies should be used to cool an economy whenever it became overheated.

Keynes visited Roosevelt in Washington in 1934. Roosevelt liked him, but found his theories overly mathematical. Nevertheless Keynes ideas influenced Roosevelt's policies, especially in 1937, when a new dip in the economy occurred. Over the years, Keynes' advocacy of counter-cyclical governmental intervention has become widely accepted, especially by social-democratic governments in Europe.

The New Deal measures inaugurated by Roosevelt were only partially effective in producing full employment. The reason that they were only partially successful was that although they were designed to help business get restarted, they were viewed with hostility by the business community. This hostility prevented Roosevelt from using fiscal policy on a large enough scale to produce full employment. Also, because businessmen felt uneasy with the new political climate, business investment remained sluggish.

One of the conclusions of Keynes' *General Theory* was that investment by expanding businesses is essential to keep an economy from contracting. This conclusion is worrying, because in the future, exponential expansion of business activity will gradually become less and less possible. Thus we can visualize a future need for governmental intervention to prevent a depression.

During World War II, Keynes advice on how to finance the war effort was sought by the British government. He did as much as he could, but his activity was limited by increasing

heart problems. At the end of the war, Keynes represented England at the Breton Woods Conference, which established the World Bank and the International Monetary Fund. He received many honors - for example, he became Lord Keynes. However, his health remained unstable, and in 1946 he died of a heart attack. His life and work had produced a permanent change from the *laissez faire* economics of Adam Smith to an era of recognized governmental responsibility.

5.4 Reserve indices of non-renewable resources

W. David Menzie (Chief of the Minerals Information Team of the U.S. Geological Survey) testified to a committee of the U.S. House of Representatives in 2006 that global reserves of copper are approximately 470 million tons. He also stated that world consumption of copper in 2000 was 14.9 million tons per year, but that it is increasing at 3.1% per year and is expected to reach 27 Mt/y by 2020. Menzie predicted that most of this increase will be in the developing countries. For example, China's use of copper is expected to increase from 2 Mt/y in 2000 to 5.6 Mt/y in 2020, while for India, the increase will be from 0.4 Mt/y to 1.6 Mt/y.

At the 2000 rate of use, global copper reserves will be exhausted in 31 years, while if used at a higher rate, the reserves will last for a shorter time. It is predicted that a Hubbert peak will occur for copper, analogous to the Hubbert peaks for petroleum and natural gas. Thus, copper will not disappear entirely, but there will be a date when the production of copper will reach a maximum and afterward decline because of rising prices.

The reserve index of a metal is defined as the size of its reserves divided by the current annual rate of production. Today, many metals have reserve indices between 10 years and 100 years. These include indium, tantalum, gold, bismuth, silver, cadmium, cobalt, arsenic, tungsten, molybdenum, tin, nickel, lead, zinc, and copper, while magnesium and iron have reserve indices of approximately 100 years⁴.

Future exploration may increase the size of known reserves of metals; and future advances in technology may also make it possible to use lower grade ores. However, we must remember that the extraction of metals from their ores requires much energy. In the long-term future, energy will probably not be available for the production of (for example) iron, steel, and aluminum on the scale that we know today. Thus, recycling will assume great importance.

5.5 The transition from growth to a steady state - minimizing the trauma

According to Adam Smith, the free market is the dynamo of economic growth. The true entrepreneur does not indulge in luxuries for himself and his family, but reinvests his profits,

⁴Craig, J.R., Vaugn, D.J. and Skinner, B.J., *Resources of the Earth: Origin, Use and Environmental Impact, Third Edition*, page 64.

with the result that his business or factory grows larger, producing still more profits, which he again reinvests, and so on. This is indeed the formula for exponential economic growth.

Economists (with a few notable exceptions) have long behaved as though growth were synonymous with economic health. If the gross national product of a country increases steadily by 4% per year, most economists express approval and say that the economy is healthy. If the economy could be made to grow still faster (they maintain), it would be still more healthy. If the growth rate should fall, economic illness would be diagnosed. However, the basic idea of Malthus is applicable to exponential increase of any kind. It is obvious that on a finite Earth, neither population growth nor economic growth can continue indefinitely.

A “healthy” economic growth rate of 4% per year corresponds to an increase by a factor of 50 in a century, by a factor of 2500 in two centuries, and by a factor of 125,000 in three centuries. No one can maintain that this type of growth is sustainable except by refusing to look more than a short distance into the future.

But *why* do most economists cling so stubbornly and blindly to the concept of growth? Why do they refuse to look more than a few years into the future? We can perhaps understand this strange self-imposed myopia by remembering some of David Ricardo’s ideas: One of his most important contributions to economic theory was his analysis of rents. Ricardo considered the effects of economic expansion; and he concluded that as population increased, marginally fertile land would be forced into cultivation. The price of grain would be determined by the cost of growing it on inferior land; and the owners of better land would be able to pocket a progressively larger profit as worse and worse land was forced into use by the demands of a growing population. Ricardo’s analysis of rents for agricultural land has various generalizations; for example, a growing population also puts pressure on land used for building cities, and profits can be gained by holding such land, or through the ownership of houses in growing cities. In general, in a growing economy, investments are likely to be rewarded. In a stationary or contracting economy, the stock market may crash.

Considerations like those just discussed make it easy to understand why economists are biased in favor of growth. However, we are now entering a period where biological and physical constraints will soon put an end to economic growth.

Instead of burning our tropical forests, it might be wise for us to burn our books on growth-oriented economics! An entirely new form of economics is needed today - not the empty-world economics of Adam Smith, but what might be called “full-world economics”, or “steady-state economics”.

The present use of resources by the industrialized countries is extremely wasteful. A growing national economy must, at some point, exceed the real needs of the citizens. It has been the habit of the developed countries to create artificial needs by means of advertising, in order to allow economies to grow beyond the point where all real needs have been met; but this extra growth is wasteful, and in the future it will be important not to waste the earth’s diminishing supply of non-renewable resources.

Thus, the times in which we live present a challenge: We need a revolution in economic thought. We must develop a new form of economics, taking into account the realities of

the world's present situation - an economics based on real needs and on a sustainable equilibrium with the environment, not on the thoughtless assumption that growth can continue forever.

Adam Smith was perfectly correct in saying that the free market is the dynamo of economic growth; but exponential growth of human population and economic activity have brought us, in a surprisingly short time, from the empty-world situation in which he lived to a full-world situation. 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. Full-world economics, the economics of the future, will no longer be able to rely on growth to give profits to stockbrokers or to solve problems of unemployment or to alleviate poverty. In the long run, growth of any kind is not sustainable; and we are now nearing its sustainable limits.

Like a speeding bus headed for a brick wall, the earth's rapidly-growing population of humans and its rapidly-growing economic activity are headed for a collision with a very solid barrier - the carrying capacity of the global environment. As in the case of the bus and the wall, the correct response to the situation is to apply the brakes in time - but fear prevents us from doing this. What will happen if we slow down very suddenly? Will not many of the passengers be injured? Undoubtedly. But what will happen if we hit the wall at full speed? Perhaps it would be wise, after all, to apply the brakes!

The memory of the great depression of 1929 makes us fear the consequences of an economic slowdown, especially since unemployment is already a serious problem in many parts of the world. Although the history of the 1929 depression is frightening, it may nevertheless be useful to look at the measures which were used then to bring the global economy back to its feet. A similar level of governmental responsibility may help us to avoid some of the more painful consequences of the necessary transition from the economics of growth to steady-state economics.

5.6 The transition to a sustainable economy

The Worldwatch Institute, Washington D.C., lists the following steps as necessary for the transition to sustainability⁵:

1. Stabilizing population
2. Shifting to renewable energy
3. Increasing energy efficiency
4. Recycling resources
5. Reforestation
6. Soil Conservation

⁵L.R. Brown and P. Shaw, 1982.



Figure 5.8: **A reforestation project in Burkina Faso. Projects such as this may help the world to achieve sustainability, while simultaneously helping to solve problems of unemployment.**

All of these steps are labor-intensive; and thus, wholehearted governmental commitment to the transition to sustainability can help to solve the problem of unemployment.

In much the same spirit that Roosevelt (with Keynes' approval) used governmental powers to end the great depression, we must now urge our governments to use their powers to promote sustainability and to reduce the trauma of the transition to a steady-state economy. For example, an increase in the taxes on fossil fuels could make a number of renewable energy technologies economically competitive; and higher taxes on motor fuels would be especially useful in promoting the necessary transition from private automobiles to bicycles and public transportation. Tax changes could also be helpful in motivating smaller families.

Governments already recognize their responsibility for education. In the future, they must also recognize their responsibility for helping young people to make a smooth transition from education to secure jobs. If jobs are scarce, work must be shared, in a spirit of solidarity, among those seeking employment; hours of work (and if necessary, living standards) must be reduced to insure a fair distribution of jobs. Market forces alone cannot achieve this. The powers of government are needed.

Economic activity is usually divided into two categories, 1) production of goods and 2) provision of services. It is the rate of production of goods that will be limited by the carrying capacity of the global environment. Services that have no environmental impact will not be constrained in this way. Thus a smooth transition to a sustainable economy will involve a shift of a large fraction the work force from the production of goods to the

provision of services.

In his recent popular book *The Rise of the Creative Class*, the economist Richard Florida points out that in a number of prosperous cities - for example Stockholm - a large fraction of the population is already engaged in what might be called creative work - a type of work that uses few resources, and produces few waste products - work which develops knowledge and culture rather than producing material goods. For example, producing computer software requires few resources and results in few waste products. Thus it is an activity with a very small ecological footprint. Similarly, education, research, music, literature and art are all activities that do not weigh heavily on the carrying capacity of the global environment. Florida sees this as a pattern for the future, and maintains that everyone is capable of creativity. He visualizes the transition to a sustainable future economy as one in which a large fraction of the work force moves from industrial jobs to information-related work. Meanwhile, as Florida acknowledges, industrial workers feel uneasy and threatened by such trends.

5.7 Population and goods per capita

In the distant future, the finite carrying capacity of the global environment will impose limits on the amount of resource-using and waste-generating economic activity that it will be possible for the world to sustain. The consumption of goods per capita will be equal to this limited total economic activity divided by the number of people alive at that time. Thus, our descendants will have to choose whether they want to be very numerous and very poor, or less numerous and more comfortable, or very few and very rich. Perhaps the middle way will prove to be the best.

Given the fact that environmental carrying capacity will limit the sustainable level of resource-using economic activity to a fixed amount, average wealth in the distant future will be approximately inversely proportional to population over a certain range of population values.⁶

5.8 Entropy and economics

We urgently need to shift quickly from fossil fuels to renewable energy if we are to avoid a tipping point after which human efforts to avoid catastrophic climate change will be futile because feedback loops will have taken over. The dangerous methane hydrate feedback loop is discussed in an excellent short video made by Thom Hartmann and the Leonardo DiCaprio Foundation.⁷

⁶Obviously, if the number of people is reduced to such an extent that it approaches zero, the average wealth will not approach infinity, since a certain level of population is needed to maintain a modern economy. However, if the global population becomes extremely large, the average wealth will indeed approach zero.

⁷<https://www.youtube.com/watch?v=sRGVTK-AAvw>
<http://lasthours.org/>

Celebrated author and activist Naomi Klein has emphasized the link between need for economic reform and our urgent duty to address climate change.⁸

Rebel economist Prof. Tim Jackson discusses the ways in which our present economic system has failed us, and the specific reforms that are needed. In one of his publications, he says: “The myth of growth has failed us. It has failed the two billion people who still live on 2 dollars a day. It has failed the fragile ecological systems on which we depend for survival. It has failed, spectacularly, in its own terms, to provide economic stability and secure people’s livelihood.”⁹

What is entropy?

Entropy is a quantity, originally defined in statistical mechanics and thermodynamics. It is a measure of the statistical probability of any state of a system: The greater the entropy, the greater the probability. The second law of thermodynamics asserts that entropy of the universe always increases with time. In other words, the universe as a whole is constantly moving towards states of greater and greater probability.

For any closed system, the same is true. Such systems move in time towards states of greater and greater probability. However, the earth, with its biosphere, is not a closed system. The earth constantly receives an enormous stream of light from the sun. The radiation which we receive from the sun brings us energy that can be used to perform work, and in physics this is called “free energy”. Because of this flood of incoming sunlight, plants, animals and humans are able to create structures which from a statistical point of view are highly unlikely.

The disorder and statistical probability of the universe is constantly increasing, but because the earth is not a closed system, we are able to create local order, and complex, statistically improbable structures, like the works of Shakespeare, the Mona Lisa and the Internet. The human economy is driven by the free energy which we receive as income from the sun. Money is, in fact, a symbol for free energy, and free energy might be thought of as “negative entropy”. There is also a link between free energy and information.¹⁰

Human society as a superorganism, with the global economy as its digestive system

A completely isolated human being would find it as difficult to survive for a long period of time as would an isolated ant or bee or termite. Therefore it seems correct to regard human society as a superorganism. In the case of humans, the analog of the social insects’ nest is the enormous and complex material structure of civilization. It is, in fact, what we

⁸<http://thischangeseverything.org/naomi-klein/>
<http://www.theguardian.com/profile/naomiklein>

⁹<http://www.theguardian.com/sustainable-business/rio-20-tim-jackson-leaders-green-economy?newsfeed=true>

<http://www.theguardian.com/sustainable-business/consumerism-sustainability-short-termism>
¹⁰<http://www.amazon.com/Information-Theory-And-Evolution-Edition/dp/9814401234>

call the human economy. It consists of functioning factories, farms, homes, transportation links, water supplies, electrical networks, computer networks and much more.

Almost all of the activities of modern humans take place through the medium of these external “exosomatic” parts of our social superorganism. The terms “exosomatic” and “endosomatic” were coined by the American scientist Alfred Lotka (1880-1949). A lobster’s claw is endosomatic; it is part of the lobster’s body. The hammer used by a human is exosomatic, like a detachable claw. Lotka spoke of “exosomatic evolution”, including in this term not only cultural evolution but also the building up of the material structures of civilization.

The economy associated with the human superorganism “eats” resources and free energy. It uses these inputs to produce local order, and finally excretes them as heat and waste. The process is closely analogous to food passing through the alimentary canal of an individual organism. The free energy and resources that are the inputs of our economy drive it just as food drives the processes of our body, but in both cases, waste products are finally excreted in a degraded form.

Almost all of the free energy that drives the human economy came originally from the sun’s radiation, the exceptions being geothermal energy which originates in the decay of radioactive substances inside the earth, and tidal energy, which has its origin in the slowing of the motions of the earth-moon system. However, since the start of the Industrial Revolution, our economy has been using the solar energy stored in of fossil fuels. These fossil fuels were formed over a period of several hundred million years. We are using them during a few hundred years, i.e., at a rate approximately a million times the rate at which they were formed.

The present rate of consumption of fossil fuels is more than 13 terawatts and, if used at the present rate, fossil fuels would last less than a century. However, because of the very serious threats posed by climate change, human society would be well advised to stop the consumption of coal, oil and natural gas well before that time.

The rate of growth of of new renewable energy sources is increasing rapidly. These sources include small hydro, modern biomass, solar, wind, geothermal, wave and tidal energy. There is an urgent need for governments to set high taxes on fossil fuel consumption and to shift subsidies from the petroleum and nuclear industries to renewables. These changes in economic policy are needed to make the prices of renewables more competitive.

The shock to the global economy that will be caused by the end of the fossil fuel era will be compounded by the scarcity of other non-renewable resources, such as metals. While it is true (as neoclassical economists emphasize) that “matter and energy can neither be created nor destroyed”, free energy can be degraded into heat, and concentrated deposits of minerals can be dispersed. Both the degradation of free energy into heat and the dispersal of minerals involve increases of entropy.

Frederick Soddy

One of the first people to call attention to the relationship between entropy and economics was the English radiochemist Frederick Soddy (1877-1956). Soddy won the Nobel Prize for

Chemistry in 1921 for his work with Ernest Rutherford demonstrating the transmutation of elements in radioactive decay processes. His concern for social problems then led him to a critical study of the assumptions of classical economics. Soddy believed that there is a close connection between free energy and wealth, but only a very tenuous connection between wealth and money.

Soddy was extremely critical of the system of “fractional reserve banking” whereby private banks keep only a small fraction of the money that is entrusted to them by their depositors and lend out the remaining amount. He pointed out that this system means that the money supply is controlled by the private banks rather than by the government, and also that profits made from any expansion of the money supply go to private corporations instead of being used to provide social services. Fractional reserve banking exists today, not only in England but also in many other countries. Soddy’s criticisms of this practice cast light on the subprime mortgage crisis of 2008 and the debt crisis of 2011.

As Soddy pointed out, real wealth is subject to the second law of thermodynamics. As entropy increases, real wealth decays. Soddy contrasted this with the behavior of debt at compound interest, which increases exponentially without any limit, and he remarked:

“You cannot permanently pit an absurd human convention, such as the spontaneous increment of debt [compound interest] against the natural law of the spontaneous decrement of wealth [entropy]”. Thus, in Soddy’s view, it is a fiction to maintain that being owed a large amount of money is a form of real wealth.

Frederick Soddy’s book, “Wealth, virtual wealth and debt: The solution of the economic paradox”, published in 1926 by Allen and Unwin, was received by the professional economists of the time as the quixotic work of an outsider. Today, however, Soddy’s common-sense economic analysis is increasingly valued for the light that it throws on the problems of our fractional reserve banking system, which becomes more and more vulnerable to failure as economic growth falters.¹¹

Currency reform, and nationalization of banks

Frederick Soddy was writing at a time when England’s currency was leaving the gold standard, and in order to replace this basis for the currency, he proposed an index system. Soddy’s index was to be based on a standard shopping basket containing household items, such as bread, milk, potatoes and so on. If the price of the items in the basket rose, more currency would be issued by the nationalized central bank. If the price fell, currency would be withdrawn.

Nationalization of banks was proposed by Soddy as a means of avoiding the evils of the fractional reserve banking system. Today we see a revival of the idea of nationalized banks, or local user-owned cooperative banks. The Grameen Bank, founded by Prof. Muhammad Yunus, pioneered the idea of socially-motivated banks for the benefit poor people who would ordinarily be unable to obtain loans. The bank and its founder won a Nobel Peace

¹¹www.fadedpage.com/link.php?file=20140873-a5.pdf
<http://human-wrongs-watch.net/2015/07/08/debt-slavery/>



Figure 5.9: Prof. Muhammad Yunus, founder of the Grameen Bank. The bank and its founder shared a Nobel Peace Prize for their work. Prof. Yunus continues to work with businesses which aim at fulfilling social needs rather than at profit for stockholders. Source: www.grameen-info.org

Prize in 2006.¹²

Nicholas Georgescu-Roegen

The incorporation of the idea of entropy into economic thought also owes much to the mathematician and economist Nicholas Georgescu-Roegen (1906-1994), the son a Romanian army officer. Georgescu-Roegen's talents were soon recognized by the Romanian school system, and he was given an outstanding education in mathematics, which later contributed to his success and originality as an economist.

Between 1927 and 1930 the young Georgescu studied at the Institute de Statistique in Paris, where he completed an award-winning thesis: "On the problem of finding out the cyclical components of phenomena". He then worked in England with Karl Pearson from 1930 to 1932, and during this period his work attracted the attention of a group of economists who were working on a project called the Harvard Economic Barometer. He received a Rockefeller Fellowship to join this group, but when he arrived at Harvard, he

¹²<http://www.grameen-info.org/history/>
<http://www.ibtimes.com/greece-drawing-contingency-plans-nationalize-banks-bring-parallel-currency-report-1868830>
<http://www.quora.com/Why-were-banks-nationalized-in-India>
<http://www.bloomberg.com/news/articles/2015-01-28/greek-bank-investors-hammered-as-3-day-slump-wipes-12-billion>
<http://www.armstrongeconomics.com/archives/30531>
<https://en.wikipedia.org/wiki/Nationalization>
<http://www.theguardian.com/world/2015/jul/23/beppe-grillo-calls-for-nationalisation-of-italian-banks-and-exit-from-euro>
<http://dissentvoice.org/2015/07/whats-wrong-with-our-monetary-system-and-how-to-fix-it/>

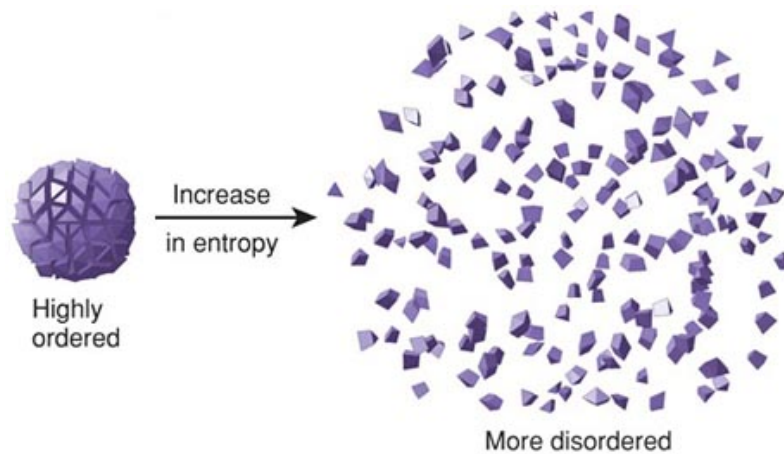


Figure 5.10: According to the second law of thermodynamics, the entropy of the universe constantly increases. Increase of entropy corresponds to increase of disorder, and also to increase of statistical probability. Living organisms on the earth are able to achieve a high degree of order and highly improbable structures because the earth is not a closed system. It constantly receives free energy (i.e. energy capable of doing work) from the sun, and this free energy can be thought of as carrying thermodynamic information, or “negative entropy”. Source: flowchainsensel.wordpress.co,

found that the project had been disbanded.

In desperation, Georgescu-Roegen asked the economist Joseph Schumpeter for an appointment to his group. Schumpeter’s group was in fact a remarkably active and interesting one, which included the future Nobel laureate Wassely Leontief; and there followed a period of intense intellectual activity during which Georgescu-Roegen became an economist.

Despite offers of a permanent position at Harvard, Georgescu-Roegen returned to his native Romania in the late 1930’s and early 1940’s in order to help his country. He served as a member of the Central Committee of the Romanian National Peasant Party. His experiences at this time led to his insight that economic activity involves entropy. He was also helped to this insight by Borel’s monograph on Statistical Mechanics, which he had read during his Paris period.

Georgescu-Roegen later wrote: “The idea that the economic process is not a mechanical analogue, but an entropic, unidirectional transformation began to turn over in my mind long ago, as I witnessed the oil wells of the Ploesti field of both World Wars’ fame becoming dry one by one, and as I grew aware of the Romanian peasants’ struggle against the deterioration of their farming soil by continuous use and by rains as well. However it was the new representation of a process that enabled me to crystallize my thoughts in describing the economic process as the entropic transformation of valuable natural resources (low entropy) into valueless waste (high entropy).”

After making many technical contributions to economic theory, Georgescu-Roegen returned to this insight in his important 1971 book, “The Entropy Law and the Economic



Figure 5.11: **Wind, solar, and biomass are three emerging renewable sources of energy. Wind turbines in a rapeseed field in Sandesneben, Germany. Author: Jürgen from Sandesneben, Germany, Wikimedia Commons**

Process” (Harvard University Press), where he outlines his concept of bioeconomics. In a later book, “Energy and Economic Myths” (Pergamon Press, New York, 1976), he offered the following recommendations for moving towards a bioeconomic society:

1. The complete prohibition of weapons production, thereby releasing productive forces for more constructive purposes;
2. Immediate aid to underdeveloped countries;
3. Gradual decrease in population to a level that could be maintained only by organic agriculture;
4. Avoidance, and strict regulation if necessary, of wasteful energy use;
5. Abandon our attachment to “extravagant gadgetry”;
6. “Get rid of fashion”;
7. Make goods more durable and repairable; and
8. Cure ourselves of workaholic habits by re-balancing the time spent on work and leisure, a shift that will become incumbent as the effects of the other changes make themselves felt.

Georgescu-Roegen did not believe that his idealistic recommendations would be adopted, and he feared that human society is headed for a crash.

Limits to Growth: A steady-state economy

Nicholas Georgescu-Roegen’s influence continues to be felt today, not only through his own books and papers but also through those of his students, the distinguished economists Herman E. Daly and Kozo Mayumi, who for many years have been advocating a steady-state economy. As they point out in their books and papers, it is becoming increasingly apparent



Figure 5.12: The distinguished economist Herman E. Daly represents the ideas of Nicholas Goergiescu-Roegen today, eloquently advocating a steady state economic system. He is the recipient of the Right Livelihood Award (sometimes called the Alternative Nobel Prize). Source: Center for the Advancement of the Steady State Economy

that unlimited economic growth on a finite planet is a logical impossibility. However, it is important to distinguish between knowledge, wisdom and culture, which can and should continue to grow, and growth in the sense of an increase in the volume of material goods produced. It is growth in the latter sense that is reaching its limits.

Daly describes our current situation as follows: “The most important change in recent times has been the growth of one subsystem of the Earth, namely the economy, relative to the total system, the ecosphere. This huge shift from an ‘empty’ to a ‘full’ world is truly ‘something new under the sun’... The closer the economy approaches the scale of the whole Earth, the more it will have to conform to the physical behavior mode of the Earth... The remaining natural world is no longer able to provide the sources and sinks for the metabolic throughput necessary to sustain the existing oversized economy, much less a growing one. Economists have focused too much on the economy’s circulatory system and

have neglected to study its digestive tract.”¹³

In the future, the only way that we can avoid economic collapse is to build a steady-state economy. There exists much literature on how this can be achieved, and these writings ought to become a part of the education of all economists and politicians.

¹³<http://dalynews.org/learn/blog/>
<http://steadystate.org/category/herman-daly/>
<https://www.youtube.com/watch?v=EN5esbvAt-w>
<https://www.youtube.com/watch?v=wIR-VsXtM4Y>
<http://www.imf.org/external/pubs/ft/survey/so/2015/car031315a.htm>

Suggestions for further reading

1. R.L. Heilbroner, *The Worldly Philosophers, 5th edition*, Simon and Schuster, (1980).
2. R. Harrod, *Life of John Maynard Keynes*, Harcourt, Brace, New York, (1951).
3. J.M. Keynes, *Economic Consequences of the Peace*, Harcourt, Brace, New York, (1920).
4. J.M. Keynes, *Essays in Persuasion*, Harcourt, Brace, New York, (1951).
5. J.M. Keynes, *The General Theory of Employment, Interest and Money*, Harcourt, Brace, New York, (1964).
6. R. Lekachman, *The Age of Keynes*, Random House, New York, (1966).
7. R. Florida, *The Rise of the Creative Class*, Basic Books, (2002).
8. H.E. Daly, *Steady-State Economics: The Economics of Biophysical Equilibrium and Moral Growth*, W.H. Freeman, San Francisco, (1977).
9. H.E. Daly, *Steady-State Economics*, Island Press, Washington D.C., (1991).
10. H.E. Daly, *Economics, Ecology and Ethics: Essays Towards a Steady-State Economy*, W.H. Freeman, San Francisco, (1980).
11. H.E. Daly, *For the Common Good*, Beacon Press, Boston, (1989).
12. Aspen Institute for Humanistic Studies, Program in International Affairs, *The Planetary Bargain*, Aspen, Colorado, (1975).
13. W. Berry, *Home Economics*, North Point Press, San Francisco, (1987).
14. L.R. Brown, *Building a Sustainable Society*, W.W. Norton, (1981).
15. L.R. Brown, and P. Shaw, *Six Steps to a Sustainable Society*, Worldwatch Paper 48, Worldwatch Institute, Washington D.C., (1982).
16. E. Eckholm, *Planting for the Future: Forestry for Human Needs*, Worldwatch Paper 26, Worldwatch Institute, Washington D.C., (1979).
17. R. Goodland, H. Daly, S. El Serafy and B. von Droste (editors), *Environmentally Sustainable Economic Development: Building on Brundtland*, UNESCO, Paris, (1991).
18. F. Hirsch, *Social Limits to Growth*, Harvard University Press, Cambridge, (1976).
19. W. Leontief, et al., *The Future of the World Economy*, Oxford University Press, (1977).
20. M. Lipton, *Why Poor People Stay Poor*, Harvard University Press, (1977).
21. J. McHale, and M.C. McHale, *Basic Human Needs: A Framework for Action*, Center for Integrative Studies, Huston, (1977).
22. D.L. Meadows, *Alternatives to Growth*, Ballinger, Cambridge, (1977).
23. D.H. Meadows, *The Global Citizen*, Island Press, Washington D.C., (1991).
24. D.L. Meadows, and D.H. Meadows (editors), *Toward Global Equilibrium*, Wright-Allen Press, Cambridge, Mass., (1973).
25. L.W. Milbrath, *Envisioning a Sustainable Society*, State University of New York Press, Albany, (1989).
26. R.E. Miles, *Awakening from the American Dream: The Social and Political Limits to Growth*, Universe Books, New York, (1976).
27. S. Postel, and L. Heise, *Reforesting the Earth*, Worldwatch Paper 83, Worldwatch Institute, Washington D.C., (1988).

28. M. Sagoff, *The Economy of the Earth*, Cambridge University Press, (1988).
29. E.F. Schumacher, *Small is Beautiful: Economics As If People Mattered*, Harper and Row, New York, (1973).
30. World Bank, *World Development Report*, Oxford University Press, New York, (published annually).
31. G.P. Zachary, *A 'Green Economist' Warns Growth May Be Overrated*, The Wall Street Journal, June 25, (1996).
32. H.E. Daly, *Sustainable Growth - An Impossibility Theorem*, *Development*, **3**, 45-47, (1990).
33. H.E. Daly and K.N. Townsend, (editors), *Valuing the Earth. Economics, Ecology, Ethics*, MIT Press, Cambridge, Massachusetts, (1993)
34. T. Jackson, *Material Concerns: Pollution, Profit and the Quality of Life*, Routledge, (2004).
35. T. Jackson, *Motivating Sustainable Consumption*, Report to the Sustainable Development Research Network, January (2005).
36. T. Jackson, *The Earthscan Reader in Sustainable Consumption*, Earthscan, (2006).
37. J.S. Avery, *Information Theory and Evolution, 2nd Edition*, World Scientific, (2012).
38. A.J. Lotka, *Elements of Mathematical Biology*, Dover, (1956).
39. E.O. Wilson *Sociobiology: The New Synthesis*, Harvard University Press, (1975).
40. E.O. Wilson, *The Superorganism: The Beauty, Elegance, and Strangeness of Insect Societies*, W.W. Norton, (2009).
41. F. Soddy, *Wealth, Virtual Wealth and Debt. The solution of the economic paradox*, George Allen and Unwin, (1926).
42. F. Soddy, *The Role of Money*, George Routledge and Sons, London, (1934)
43. N. Georgescu-Roegen, *Energy and Economic Myths : Institutional and Analytical Economic Essays*, Pergamon Press, (1976).
44. N. Georgescu-Roegen, *The Entropy Law and the Economic Process*, Harvard University Press, (1971).
45. J. Rifkin and T. Howard, *Entropy: A New World View* The Viking Press, New York (1980).
46. P. Bartelmus, *Environment, Growth and Development: The Concepts and Strategies of Sustainability*, Routledge, New York, (1994).
47. H.E. Daly and K.N. Townsend, (editors), *Valuing the Earth. Economics, Ecology, Ethics*, MIT Press, Cambridge, Massachusetts, (1993)
48. C. Flavin, *Slowing Global Warming: A Worldwide Strategy*, Worldwatch Paper 91, Worldwatch Institute, Washington D.C., (1989).
49. S.H. Schneider, *The Genesis Strategy: Climate and Global Survival*, Plenum Press, (1976).
50. WHO/UNFPA/UNICEF, *The Reproductive Health of Adolescents: A Strategy for Action*, World Health Organization, Geneva, (1989).
51. World Commission on Environment and Development, *Our Common Future*, Oxford University Press, (1987).
52. W. Jackson, *Man and the Environment*, W.C. Brown, Dubuque, Iowa, (1971).

53. T. Berry, *The Dream of the Earth*, Sierra Club Books, San Francisco, (1988).
54. T.M. Swanson, ed., *The Economics and Ecology of Biodiversity Decline: The Forces Driving Global Change*, Cambridge University Press, (1995).
55. F.H. Bormann, *Unlimited Growth: Growing, Growing, and Gone?*, *BioScience* 22: 706-9, (1972).
56. L.G. Brookes, *A Low-Energy Strategy for the United Kingdom*, *Atom* 269: 73-8, (1979).
57. J. Cherfas, *Skeptics and Visionaries Examine Energy Saving*, *Science* 251: 154-6, (1991).
58. C.J. Cleveland, *Energy Quality and Energy Surplus in the Extraction of Fossil Fuels in the US*, *Ecological Economics* 6: 139-62, (1992).
59. 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).
60. P. Cloud, *Entropy, Materials, and Prosperity*, *Geologische Rundschau* 66: 678-96, (1978).
61. 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).
62. H.E. Daly, *On Nicholas Georgescu-Roegen's Contributions to Economics: An Obituary Essay*, *Ecological Economics* 13: 149-54, (1995).
63. H.E. Daly, *Georgescu-Roegen versus Solow/Stiglitz*, *Ecological Economics* 22: 267-8, (1997).
64. M. Eigen, *Selforganization of Matter and the Evolution of Biological Macro- molecules*, *Naturwissenschaften* 58(10): 465-523, (1971).
65. S.O. Funtowicz and Jerry R. Ravetz, *Post Normal Science: A New Science for New Times*, *Scientific European* 266: 20-2, (1990).
66. N. Georgescu-Roegen, *Fixed Coefficients of Production and the Marginal Productivity Theory*, *Review of Economic Studies* 3: 40-9, (1935a).
67. N. Georgescu-Roegen, (1935b) *Note on a Proposition of Pareto*, *Quarterly Journal of Economics* 49: 706-14.
68. N. Georgescu-Roegen, *Marginal Utility of Money and Elasticities of Demand*, *Quarterly Journal of Economics* 50: 533-9, (1936a).
69. N. Georgescu-Roegen, *The Pure Theory of Consumer's Behavior*, *Quarterly Journal of Economics* 50: 545-93, (1936b).
70. 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).
71. N. Georgescu-Roegen, *The Entropy Law and the Economic Process*, Cambridge, MA: Harvard University Press, (1971).
72. N. Georgescu-Roegen, *Energy and Economic Myths*, *Southern Economic Journal* 41: 347-81, (1975).

73. N. Georgescu-Roegen, *Energy and Economic Myths*. New York: Pergamon Press, (1976).
74. N. Georgescu-Roegen, *Inequality, Limits and Growth from a Bioeconomic Viewpoint*, Review of Social Economy 35: 361-75, (1977a).
75. N. Georgescu-Roegen, *The Steady State and Ecological Salvation: A Thermodynamic Analysis*, BioScience 27: 266-70, (1977b).
76. N. Georgescu-Roegen, *Energy Analysis and Economic Valuation*, Southern Economic Journal 45: 1023-58, (1979a).
77. N. Georgescu-Roegen, *Methods in Economic Science*, Journal of Economic Issues 13 (2): 317-28, (1979b).
78. N. Georgescu-Roegen, *Methods in Economic Science: A Rejoinder*, Economic Issues 15: 188-93, (1981).
79. N. Georgescu-Roegen, *The Promethean Condition of Viable Technologies*, Materials and Society 7: 425-35, (1983).
80. 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).
81. N. Georgescu-Roegen, *An Emigrant from a Developing Country: Autobiographical Notes-I*, Banca Nazionale del Lavoro Quarterly Review 164: 3-31, (1988a).
82. 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).
83. 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).
84. 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).
85. 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).
86. M. Giampietro, *Sustainability and Technological Development in Agriculture: A Critical Appraisal of Genetic Engineering*, BioScience 44(10): 677-89, (1994).
87. M. Giampietro and Kozo Mayumi, *Another View of Development, Ecological Degradation and North-South Trade*, Review of Social Economy 56: 21-37, (1998).
88. M. Giampietro and Kozo Mayumi, *The Biofuel Delusion: The Fallacy of Large Scale Agro-biofuel Production*, London: Earthscan, (2009).
89. R. Goldschmidt, *Some Aspects of Evolution*, Science 78: 539-47, (1933).
90. S.J. Gould, *The Return to Hopeful Monsters*, Natural History 86: 22-30, (1977).
91. S.J. Gould and Niles Eldredge, *Punctuated Equilibria: The Tempo and Mode of Evolution Reconsidered*, Paleobiology 3: 115-51, (1977).
92. J. Gowdy, *The Value of Biodiversity: Markets, Society and Ecosystems*, Land Economics 73(1): 25-41, (1997).

93. J. Gribbin, *The Death of the Sun* New York: Delacorte Press, (1980).
94. C.A.S. Hall, Cutler J. Cleveland and Robert Kaufman, *Energy and Resource Quality* New York: John Wiley and Sons, (1986).
95. S.R. Ichtiaque and Stephen H. Schneider, *Atmospheric Carbon Dioxide and Aerosols: Effects of Large Increases on Global Climate*, Science 173: 138-41, (1971).
96. 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).
97. F. Jevons, *Greenhouse: A Paradox*, Search 21: 171-2, (1990).
98. W.S. Jevons, *The Coal Question* (reprint of 3rd edn, 1906). New York: Augustus M. Kelley, (1965).
99. N. Kawamiya, *Entropii to Kougyoushakai no Sentaku (Entropy and Future Choices for the Industrial Society)*, Tokyo: Kaimei, (1983).
100. J.D. Khazzoom, *Economic Implications of Mandated Efficiency Standards for Household Appliances*, Energy Journal 1: 21-39, (1980).
101. J.D. Khazzoom, *Energy Saving Resulting from the Adoption of More Efficient Appliances*, Energy Journal 8: 85-9, (1987).
102. T.C. Koopmans, *Three Essays on the State of Economic Science*, New York: McGraw-Hill Book Company, (1957).
103. T.S. Kuhn, *The Structure of Scientific Revolutions*, Chicago, IL: The University of Chicago Press, (1962).
104. J. von Liebig, *Letters on Modern Agriculture* (J. Blyth ed.). New York: John Wiley, (1959).
105. A.J. Lotka, *Elements of Mathematical Biology*, New York: Dover Publications, (1956).
106. G. Luft, *Fueling the Dragon: China's Race Into the Oil Market*. <http://www.iags.org/china.htm>, (2007).
107. K. Mayumi, *The Origins of Ecological Economics: The Bioeconomics of Georgescu-Roegen*, London: Routledge, (2001).
108. 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).
109. 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).
110. 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).
111. Newman, Peter, *Greenhouse, Oil and Cities*, Futures May: 335-48, (1991).
112. D. Pearce, *Substitution and Sustainability: Some Reflections on Georgescu-Roegen*, Ecological Economics 22: 295-7, (1997).
113. D. Pearce, Edward Barbier and Anil Markandya, *Sustainable Development*, Hampshire: Edward Elgar, (1990).

114. J. Polimeni, Kozo Mayumi, Mario Giampietro and Blake Alcott, *The Jevons Paradox and the Myth of Resource Efficiency Improvements*, London: Earthscan, (2008).
115. J.F. Randolph, *Basic Real and Abstract Analysis*, New York: Academic Press, (1968).
116. 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).
117. E. Schrödinger, *What is Life? With Mind and Matter and Autobiographical Sketches*, Cambridge: Cambridge University Press, (1967).
118. J.A. Schumpeter, *The Theory of Economic Development*, Cambridge, MA: Harvard Economic Press, (1951).
119. 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).
120. M.R. Simmons, *Twilight in the Desert: The Coming Saudi Oil Shock and the World Economy* New Jersey: John Wiley and Sons, Inc., (2005).
121. B.J. Skinner, *Earth Resource (3rd edn)*, New Jersey: Prentice Hall, (1986).
122. V. Smil, *Global Catastrophes and Trends: The Next Fifty Years* Cambridge, MA: MIT Press, (2008).
123. R. Solow, *Technical Change and the Aggregate Production Function*, *Review of Economics and Statistics* 39: 312-20, (1957).
124. R. Solow, *The Economics of Resources or the Resources of Economics*, *American Economic Review* 64: 1-14, (1974).
125. R.E. Ulanowicz, *Growth and Development: Ecosystem Phenomenology* New York: Springer-Verlag, (1986).
126. US Geological Survey, *Commodity Statistics and Information*, (2005).
127. G.K. Zipf, *National Unity and Disunity: The Nation as a Bio-social Organism*. Bloomington, IN: Principia Press, (1941).

Chapter 6

OVERCOMING INSTITUTIONAL INERTIA

6.1 Why don't we act immediately?

The acute crisis of civilization that we are facing today requires immediate action. As Swedish climate activist Greta Thunberg says, **“...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, will hope come today.”**

But we do not act. The weight of tradition, the weight of habits, the weight of our institutions and culture - all these seem too heavy for us. How can we break these enormously heavy bonds that prevent us from saving the human future and the future of the biosphere?

Does history repeat itself? Is it cyclic, or is it unidirectional? Certainly many aspects of history are repetitive - the rise and fall of empires, the lies of politicians, cycles of war and peace, cycles of construction and destruction. But on the other hand, if we look at the long-term history of human progress, we can see that it is clearly unidirectional. An explosion of knowledge has created the modern world. This is something that never happened before. Never before has the world had a population of more than 7 billion people, to which a billion are added every decade. Never before have we had the power to destroy human civilization and the biosphere with thermonuclear weapons or catastrophic anthropogenic climate change. Our situation today is unique. We cannot rely on old habits, old traditions or old institutions. To save the long-term future for our children and grandchildren, and for all the other creatures with which we share the gift of life, we must overcome the inertia of our institutions and our culture.

6.2 Fossil fuel infrastructure

Here are a few excerpts from a November 30 2018 article by Mathew Carr in Bloomberg Technology¹

“The surge in coal prices in the past three years and muted power prices are cutting into the profitability of power stations that burn the fuel, a prominent forecaster said.

“About 42 percent of the world’s coal generation capacity is losing money, according to Carbon Tracker, an energy researcher that advocates for climate protection. That proportion will rise to 56 percent by 2030, said Matthew Gray, a senior utilities and power analyst at the consultant.

“While coal prices are forecast to fall 13 percent by the end of the next decade, the cost of emitting carbon dioxide is set to double in Europe and is forecast to jump in China, which is introducing an emissions trading market. Those factors mean the cost of running coal plants will exceed what they can earn, the researcher said.

“Depressed wholesale electricity prices are a problem for the entire conventional power industry – nuclear, hydro, coal, gas, but not subsidized renewables, which are of course the reason for the low wholesale prices their income coming from outside the market,’ said Brian Ricketts, secretary general of industry body Euracoal. That, he said, is why support measures for fossil-fuel plants are spreading to help ensure those generators don’t shut too quickly.

“Other big causes of the losses at coal plants are rules designed to limit air pollution as well as competition from wind and solar generation. Carbon Tracker’s analysis assumes existing rules stay constant. It doesn’t assume a big increase in other climate measures.”

¹<https://www.bloomberg.com/news/articles/2018-11-30/almost-half-of-coal-power-plants-seen-unprofitable-to-operate>



Figure 6.1: A bulldozer moves coal that will be burned to generate electricity at the American Electric Power Co. Inc. coal-fired John E. Amos Power Plant in Winfield, West Virginia, U.S. Photographer: Luke Sharrett.

6.3 The remarkable properties of exponential growth

Exponential growth of any quantity with time has some remarkable characteristics, which we ought to try to understand better, since this understanding will help us to predict the future. The knowledge will also show us the tasks which history has given to our generation. We must perform them with urgency in order to create a future in which our descendants will be able to survive.

If any quantity, for example population, industrial production or indebtedness, is growing at the rate of 3% per year, it will double in 23.1 years; if it is growing at the rate of 4% per year, the doubling time is 17.3 years.

For a 5% growth rate, the doubling time is 13.9 years, if the growth rate is 7% (the rate of economic growth that China's leaders hope to maintain), the doubling time is only 9.9 years. If you want to find out the doubling time for any exponentially growing quantity, just divide 69.3 years by the growth rate in percent.

Looking at the long-term future, we can calculate that any quantity increasing at the modest rate of 3% per year will grow by a factor of 20.1 in a century.

This implies that in four centuries, whatever is growing at 3% will have increased by a factor of 163,000. These facts make it completely clear that long-continued economic growth on a finite planet is a logical absurdity.

Yet economists and governments have an almost religious belief in perpetual economic growth. They can only maintain this belief by refusing to look more than a short distance into the future.

Exponential decay of any quantity follows similar but inverse rules. For example, if the chance of a thermonuclear war will be initiated by accident or miscalculation or malice is 3% in any given year, the chance that the human race will survive for more than four centuries under these conditions is only 1 in 163,000, i.e. 0.000625 percent.

Clearly, in the long run, if we do not completely rid ourselves of nuclear weapons, our species will have little hope of survival.

Besides nuclear war, the other great threat to the survival of the human species and the biosphere is catastrophic climate change. The transition to 100% renewable energy must take place within about a century because fossil fuels will become too rare and expensive to burn.

But scientists warn that if the transition does not happen much faster than that, there is a danger that we may reach a tipping point beyond which feedback loops, such as the albedo effect and the methane hydrate feedback loop, could take over and produce an out-of-control and fatal increase in global temperature.

In 2012, the World Bank issued a report ² warning that without quick action to curb CO₂ emissions, global warming is likely to reach 4 degrees C during the 21st century. This is dangerously close to the temperature which initiated the Permian-Triassic extinction event: 6 degrees C above normal.

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

During the Permian-Triassic extinction event, which occurred 252 million years ago. In this event, 96 percent of all marine species were wiped out, as well as 70 percent of all terrestrial vertebrates.

6.4 Renewable energy is now cheaper than fossil fuels!

Here are some excerpts from a 3-part series of articles by Angus Harvey entitled “Homo Electric”, and subtitled “The story of the greatest technological challenge in human history”. The articles were published in 2018:

I set out to understand what it truly means to make the transition to a low carbon energy system and came away with a new appreciation for how high the stakes are, a head full of numbers and a heart full of hope and fear. I don’t have any easy takeaways for you. But if you make it to the end, you’ll have a much deeper understanding of where the human race stands in our attempt to make the leap across the great energy divide.

There’s a lot of good news if you know where to look, plenty of sobering evidence, and some downright scary scenarios. It’s complicated. You have to be able to consider competing ideas, to combine the encouraging news with a recognition of just how much inertia is in the system, and increasingly alarming narratives about the catastrophic impacts climate change will wreak, or more accurately, is already wreaking. Throughout, I’ve tried as much as possible to channel Michael Liebrich, the head of Bloomberg New Energy Finance, who says, “The world doesn’t need fairy stories, it needs clear thought, robust analysis and data, data, data.”...

Our energy system today is a world-spanning, mind-blowingly complicated tangle of turbines, tankers, transformers, pipelines, pylons, gas wells, wires and waterways, cars, coal mines, heaters and ovens. It’s what philosopher Timothy Morton calls a hyperobject, an “event or system or process that is too complex, too massively distributed across space and time, for humans to get a grip on.”...

When most of us think of clean energy, we associate it with electricity. You’ll often see this mistake in newspapers, who report that because a country or a city or a business is planning on getting all their electricity from renewables, they’re “moving to 100% clean energy.”

However, while electricity is a very important part of our energy system, it’s far from the only part. Burning fossil fuels for electricity only accounts for around a third of global carbon emissions. Other major sources of carbon emissions in the energy system include transport (that burns oil), the heating of homes and buildings (a lot of natural gas) and industry (that use oil, coal and gas). Concrete alone is responsible for around 8% of global CO2 emissions. If the cement sector were a country, only the US and China would emit more

each year.

Combined with electricity, these account for around 70% of global carbon emissions, and they're what I'm going to be concentrating on in this article. Then of course, you've got the emissions that come from agriculture, land clearing and deforestation. Those are crucial. Obviously they're a major part of the energy system too, but if we included them in this story then we'd be here forever. And if you want to get really technical, then carbon emissions only account for about three quarters of total greenhouse gas emissions. Another 17% is methane from landfills, oil and gas wells, coal mines, and cow belches. And 7% is nitrous oxide from agriculture and wastewater management.

The point I'm trying to make here is that while carbon dioxide is the most important greenhouse gas, it's not the only greenhouse gas. Likewise, electricity is an important component of energy, but it's not the only aspect. If we want to reduce the world's carbon emissions then yes, cleaner electricity is a good place to start. But it's only the beginning. All the planes, trains and automobiles? We have to figure out a way of getting them to run cleanly too. We've got to figure out new ways to heat our homes and cook our food. All the steel, concrete and plastic whose production depends on fossil fuels? We need to come up with new ways of making them. We have to keep creating all the basic things that modern societies need...

Developed nations are going to have to start racing toward net-zero emissions by mid-century and developing nations will need to find a very different path to prosperity than the one travelled by the countries before them. By 2020, global spending on zero emissions technologies needs to be doubled, and the cost of renewable energy must beat out coal in every single energy market. The majority of the world's countries must have fully committed to electrifying their transportation systems, and new transmission infrastructure needs to start being built on a mass scale. All of the Fortune 500 companies that represent heavy industries must have committed to the Paris targets, and their emissions-reduction plans must be in effect...

We've just had a crazy summer in the northern hemisphere of the planet. Los Angeles, Marrakesh, Montreal, Denver, Lisbon, Amsterdam, Glasgow, Belfast and Tbilisi have all recorded their highest ever temperatures. In Siberia, for the first time in memory, the ground that insulates some of the deepest layers of permafrost did not freeze, and in the Arctic, some of the oldest and thickest sea ice has started to break up, a phenomenon that has never been recorded before. In the past two months new temperature records have been set in Algeria (51.3 degrees C), South Korea (40.7 degrees C), Norway (33.5 degrees C) and Japan (41.1 degrees C). Oman has recorded the hottest ever global overnight minimum (42.6), and California's Death Valley set the record for the hottest month ever recorded on Earth, with an average temperature of (42.2 degrees C).

A heatwave has gripped Japan, North Korea and South Korea, leaving

hundreds of people dead, and in California and Greece, deadly fires have ripped across the land, leaving tens of thousands homeless. Sweden experienced its hottest July in 260 years and its worst drought in 74 years. Northern Ireland and Wales recorded their hottest June temperatures ever. The first half of summer in the United Kingdom was the driest on record...+

The planet has warmed by 1 degree C since the Industrial Revolution, and the bill is starting to come due. Average carbon dioxide concentration is now at its highest level ever recorded, and higher than at any point in the past 800,000 years. The last three years are the three hottest in recorded history, and 2018 is on track to make it four out of four. It's not just polar bears or storm surges on tiny islands any more; changing weather patterns are now on the doorsteps of everyday Americans, Europeans and Asians. That's the thing about climate change. As Alex Steffen says, "The science always wins. You can fool yourself, you can fool other people for a while, but you can't fool Mother Nature."...

None of this is inevitable. It's the result of choices made by people who are still alive. Between 1990 and now, half of all greenhouse gases humanity has ever emitted were poured into the sky. Go back to the end of World War Two and the percentage rises past 85%. The energy, transportation, manufacturing and agricultural systems we've built are unsustainable by design. If we don't change them, if we don't make the fourth energy transition happen orders of magnitude faster than the previous three, we won't just heat the world up another few degrees. We'll push the climate system past a critical threshold, at which point the entire thing spins out of control.

According to Johan Rockström, the executive director of the Stockholm Resilience Centre, these climate thresholds, these tipping points, act like a row of dominoes, "Once one is pushed over, it pushes Earth towards another." Temperature rises past a certain level, say 2 degrees C or 3 degrees C, could set off a cascade of catastrophe, with melting permafrost releasing methane to ratchet temperatures up even further, enough to kill off the Amazon and the boreal forests, melt the polar ice sheets and so on, in a chain reaction that pushes Earth into a terrifying hothouse state from which there is no return...

Part 2

A few months ago, the world's total capacity of wind and solar passed the historic milestone of 1,000 GW. Which sounds pretty exciting. But what does it mean, exactly?

You might remember from school that a watt is a measure of energy, and we know 1,000 watts are 1 kilowatt, 1,000 kilowatts are 1 megawatt, and 1,000 megawatts are 1 gigawatt (years of dealing with flash disks and hard drives means we're familiar with that kind of math)...

In 2017, global investment in renewable energy easily outstripped investment in coal, gas and nuclear power combined. We spent \$280 billion on clean energy, and used that money to build 178 GW of renewables in a single year; solar installations alone reached 98.9GW. To put that into perspective, ten years ago the world had 8GW of solar capacity, most of it on the roofs of grizzled survivalists and lentil-eating environmentalists. Since then, installations have grown 57-fold, with utility scale solar overtaking small scale in 2014. The price of energy from utility-scale solar plants has dropped by 86% since 2009. The lowest price for solar power last year is the highest price now, and the price is set to halve again by 2020.

We're improving the technology all the time too. Clever engineering breakthroughs, like the use of diamond wire to slice silicon wafers into ever-skinier slabs, produce higher yields with less raw material. Cells are also getting smaller and more flexible, using new fabrication techniques that are less and less resource-intensive. How small? Try less than the width of a human hair. In June 2017, South Korean scientists created solar PV cells that were 1 micrometer thick. The cells produce roughly as much power as thicker PV cells, though in testing, they could wrap around a radius as small as 1.4 millimeters.

We're also using new materials, like perovskite, an abundant and naturally occurring mineral that could make solar cells even cheaper in the future. Today, most commercial solar cells are made from crystalline silicon, which has a relatively high efficiency of around 22%. However, while silicon is abundant, processing it tends to be complex and shoots up the manufacturing costs, making the finished product expensive. Perovskite offers a more affordable solution. According to Professor Yabing Qi, from the Shaanxi Normal University in China, "Research on perovskite cells is very promising. In only nine years, the efficiency of these cells has gone from 3.8% to 23.3%. Other technologies have taken over 30 years of research to reach the same level." Until recently, perovskite's biggest Achilles heel was that it degraded when exposed to air, but in early 2018, the US Department of Energy's National Renewable Energy Laboratory reported that by tinkering with the innards of the cell, they were able to expose it to air without protection for 1,000 hours, and it retained 94% of its conversion efficiency.

These kinds of technologies are all still extremely expensive, and will be for a while. Most have been in development for less than a decade. Given the explosion of investment into this space though, eventually, they will find their way into markets and start getting scaled up. And with scale, costs come down. This is a crucial point - the price drops in the solar industry are happening not just because of innovation in the panel technology, but because of innovation that reduces the cost of manufacturing the panels, through reducing the costs of installations, and through sheer learning by doing.

This learning curve actually has a name. It's called Swanston's Law, and it's one of the most famous phenomena in the energy world. It says that the price

of solar is a function of scale. Every time you double the amount of solar you're manufacturing the price drops by 28%. And every time you double the size of a large scale solar project, it brings down prices by 15%. This has held true all the way back to the first ever solar panels used for the US space program in the 1970s. It's an exponential function.

Wind also has a learning curve, with a 10.5% reduction in cost for every doubling in capacity. While this is less impressive than solar, it's only part of the story. Wind energy is also getting more efficient. The average capacity factor of onshore wind has risen from around 20% in 2000 to 42.5% for projects built in 2016. If this trend continues, the best sites will be reaching 60% capacity factors by 2025, approaching baseload levels of reliability.

New turbines have bigger, wider blades, and their towers are taller, lifting them into less turbulent air. The algorithms that calibrate them are more sophisticated, computer modelling positions them more effectively across the landscape, and they're equipped with more sensors, generating data that improves operational performance and feeds into the development of the next generation of machines. According to a 2017 report from Goldman Sachs, wind turbines today generate the same power in 18 km/h winds that turbines a decade ago required 36 km/h winds for.

Where wind turbines get really exciting though, is when you move them off the land and into the sea. Offshore wind has three key advantages over onshore wind. First, most people in the world live near the coast, so you don't have to transmit the energy as far. Secondly, because ocean winds are steadier, they deliver power that is less variable than their onshore counterparts. Onshore wind farms might have average capacity factors of around 40%, but the best new offshore turbines are already at a 50%, and could eventually get to 70% or higher. Most importantly, out in the ocean, with land barely in sight, the only limitation on size is engineering. Consequently, offshore turbines are getting bigger even faster than onshore turbines have over the past decade.

Vestas for example, has just released a 9.5 MW offshore turbine that is "two to three times bigger than the standard turbines from only a few years ago." And in March 2018, GE Renewable Energy announced it would be investing \$400 million to develop a new 12 MW monster: the Haliade-X, the biggest, tallest, and most powerful wind turbine in the world. It will be as tall as the Eiffel Tower, and each of its blades longer than the Statue of Liberty. Its average capacity factor will be 63%, and the first units are expected to ship in 2021.

Take all of this together, and you get one of the fastest and most astonishing turnarounds in the history of energy. We are now well past the point at which building new wind and solar is cheaper than building new coal or gas. According to the most recent edition of a highly influential benchmarking study done by a financial firm called Lazard, the cost of producing 1 GWh of energy from solar is now \$50,000, while the cost of the same amount from coal is \$102,000...

Part 3

...If you make electricity clean, without worrying about vehicles, you've neglected one of the largest parts of your energy system. Vice versa, as energy storage expert Dánes Csala points out, if you only clean up transportation, but forget about your electricity, then cars charged with electricity from a coal-fired power plant actually create more emissions than a car that burns petrol. For a switch to reduce net emissions, the electricity that powers those cars must be renewable too. A successful transition to clean energy means you have to solve power AND transportation, simultaneously. The good news is that slowly but surely, that's happening

In 2006, *Who Killed The Electric Car* premiered at the Sundance International Film Festival. It was a popular documentary that explored the creation, and subsequent destruction of the electric vehicle in the United States. A decade later, the number of electric vehicles in the country are on track to surpass the 1 million mark this year. As of June 2018, there were 4 million electric vehicles on roads around the world, and the next million will hit the streets in just five months. China, the largest car market in the world, was the first to pass 1 million, followed by Europe, after sales soared there by more than 40% in the first half of 2018.

Of course, it's still only a drop in the ocean. There are 2 billion cars on the planet, and with an annual production capacity of roughly 100 million cars, it takes about 20 years to update the global fleet. So 4 million electric vehicles hasn't yet had any effect on transportation emissions or oil production. They're still a fraction of the world's total. However, electric vehicles are on an exponential trajectory that looks every bit as extraordinary as the ones for wind and solar.

There are two reasons for this. The first is the rising cost of complying with emissions regulations. In Europe for example, a tougher testing regime, introduced in the wake of VW's diesel-cheating scandal, is making emissions targets too hard to reach with combustion engines, regardless of efficiency gains or weight reductions. Likewise, California's new zero carbon goals are going to mean stricter vehicle standards, and pure electric vehicles will become the only way to meet them. In China, the government is using sticks and carrots. Automakers will be given tougher vehicle emission rules and quotas for producing zero or low emission cars from 2019.

We're also starting to see the announcement of bans on the sales of new petrol and diesel powered engines around the world. England, Wales, Northern Ireland, Austria, Denmark, France, Germany, Netherlands, Norway, Scotland and Spain have all committed to bans before 2040. India has done the same, as have Costa Rica, Israel, South Korea, Taiwan, and most importantly of

all China, which has committed to no new sales of petrol and diesel powered vehicles from 2040. Indeed, China is already buying more electric cars than any other nation and its middle class's buying power will only keep growing.

This process is going to accelerate as the price of electric vehicles comes down. Battery prices, which account for almost one half the cost of electric cars today, are falling by as much as 20% a year. In 2010, their average price was \$1,000/kWh. Today it's \$190/kWh for the Tesla Model 3. They still need to fall another 50% before electric vehicles become cost competitive, but that's happening quickly. General Motors for example, says that by reducing the amount of expensive cobalt and adding nickel, its battery costs will drop by 45% over the next three years. In China a company called CATL is planning a \$1.3 billion lithium-ion battery factory with enough capacity to surpass Tesla. Assuming the prices continue on the same curve, batteries will fall another 54% to \$96/kWh in 2025, and 67% to \$70/kWh by 2030.

Electric vehicles are also just better. Costs and range get most of the attention in the media, but the truly revolutionary bit is actually the drivetrain. That's because the drivetrain for an internal combustion engine contains about 2,000 moving parts while an electric one contains about 20. A system with two orders of magnitude fewer parts is way more reliable and saves money by eliminating around half the cost of traditional car maintenance. There are fewer metal things rubbing against other metal things.

That gives electric vehicles much longer lifespans. The average combustion vehicle lasts about 250,000 km, while current estimates for the lifespans of today's electric vehicles are around 800,000 km. You know how the value of a car drops by a quarter when you drive it out the dealer? Well, not if it's electric.

The electric drive-train is also more efficient and powerful than the ones in petrol or diesel cars, which lose most of their energy through heat. This allows electric vehicles to achieve the kinds of power and acceleration that internal combustion engines can only dream of...

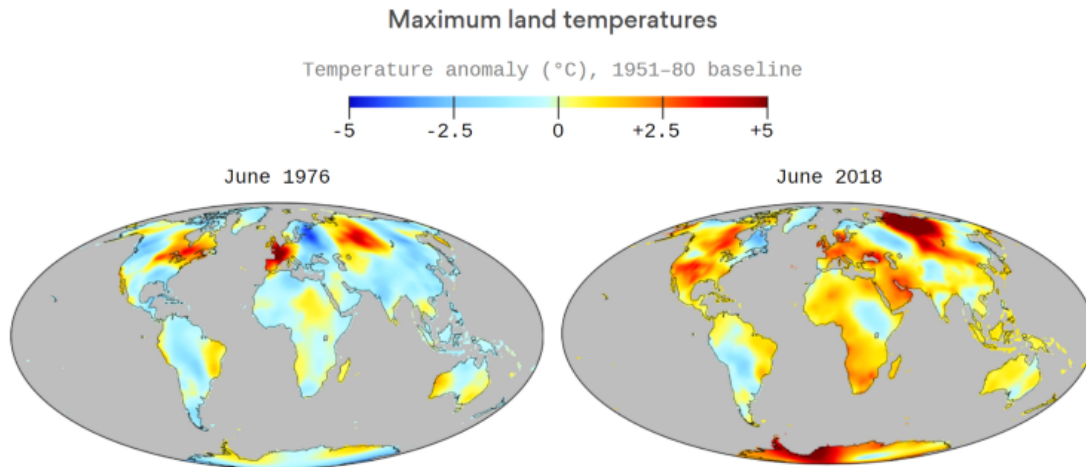


Figure 6.2: Maximum land temperature anomalies.



Figure 6.3: A fireman fighting a wildfire in California.

Global fossil fuel & industry emissions 2014

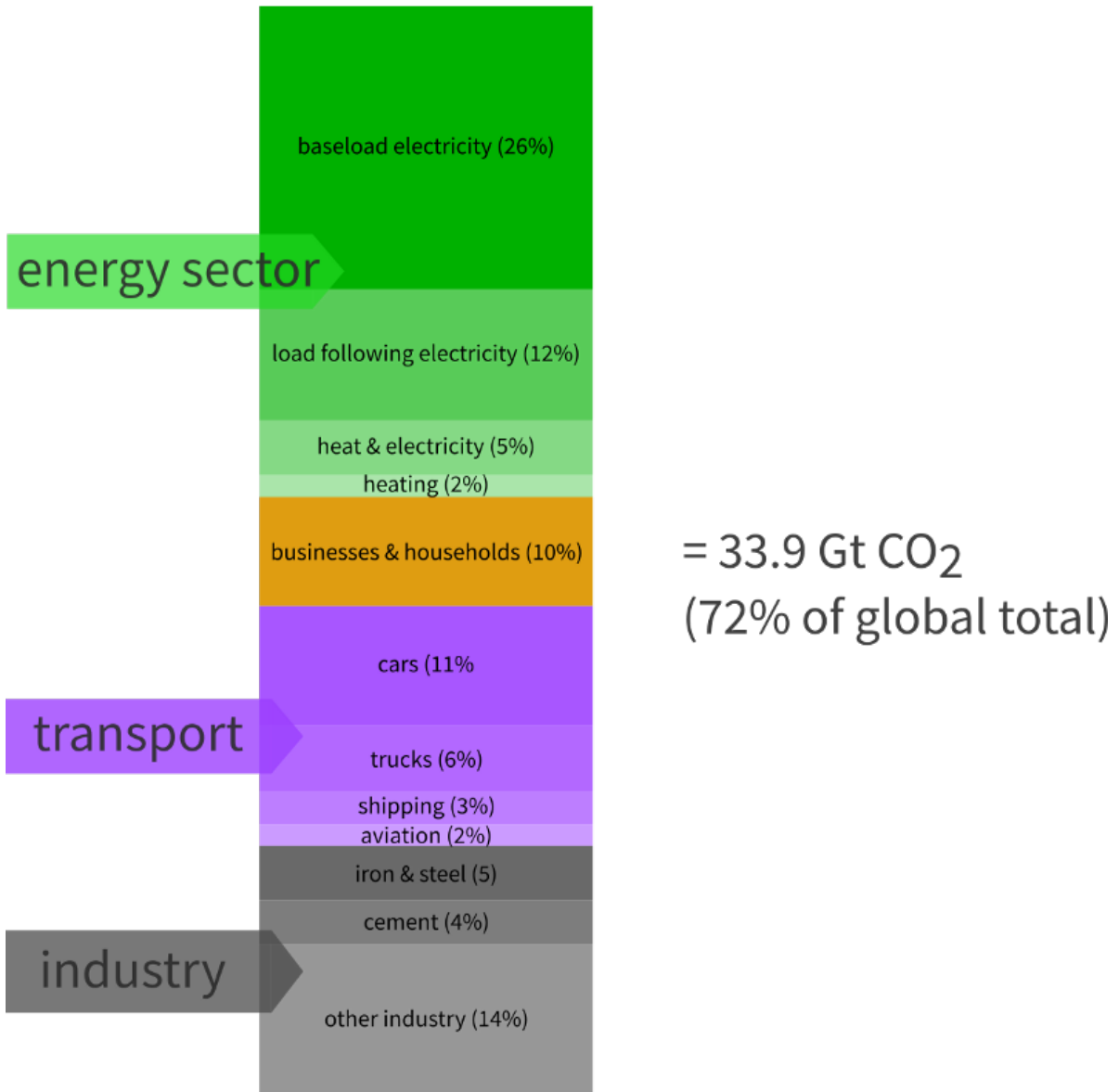


Figure 6.4: Sectors contributing to CO₂ emissions.



Figure 6.5: Wind turbines and solar panels can use the same ground.

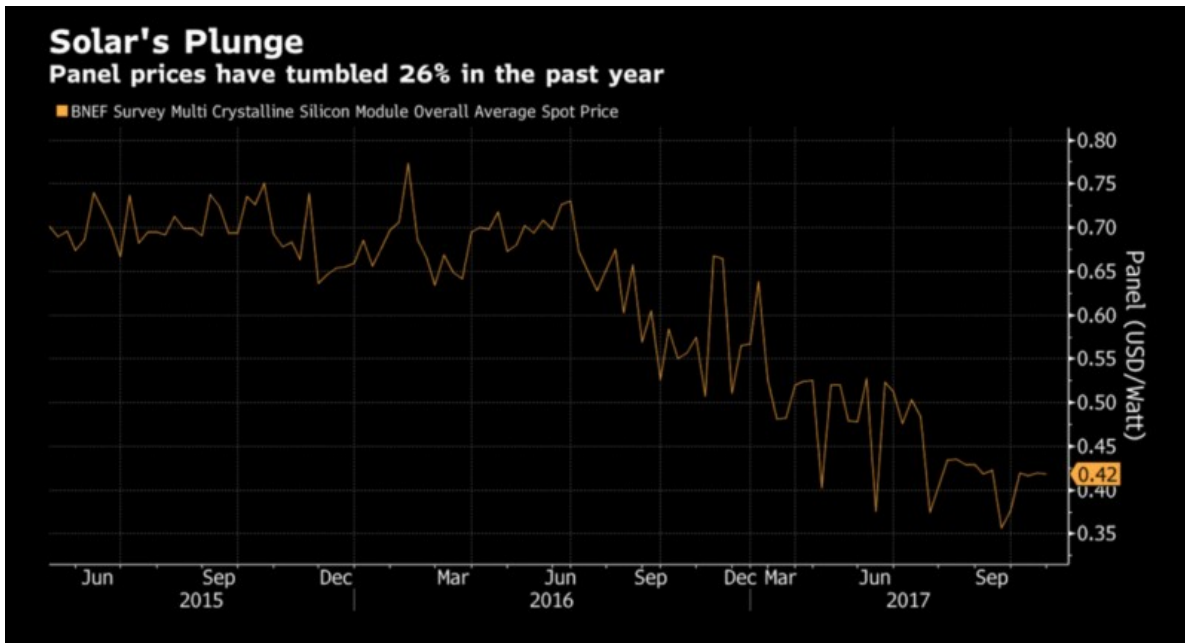


Figure 6.6: Solar panel price fell 26% in a single year.

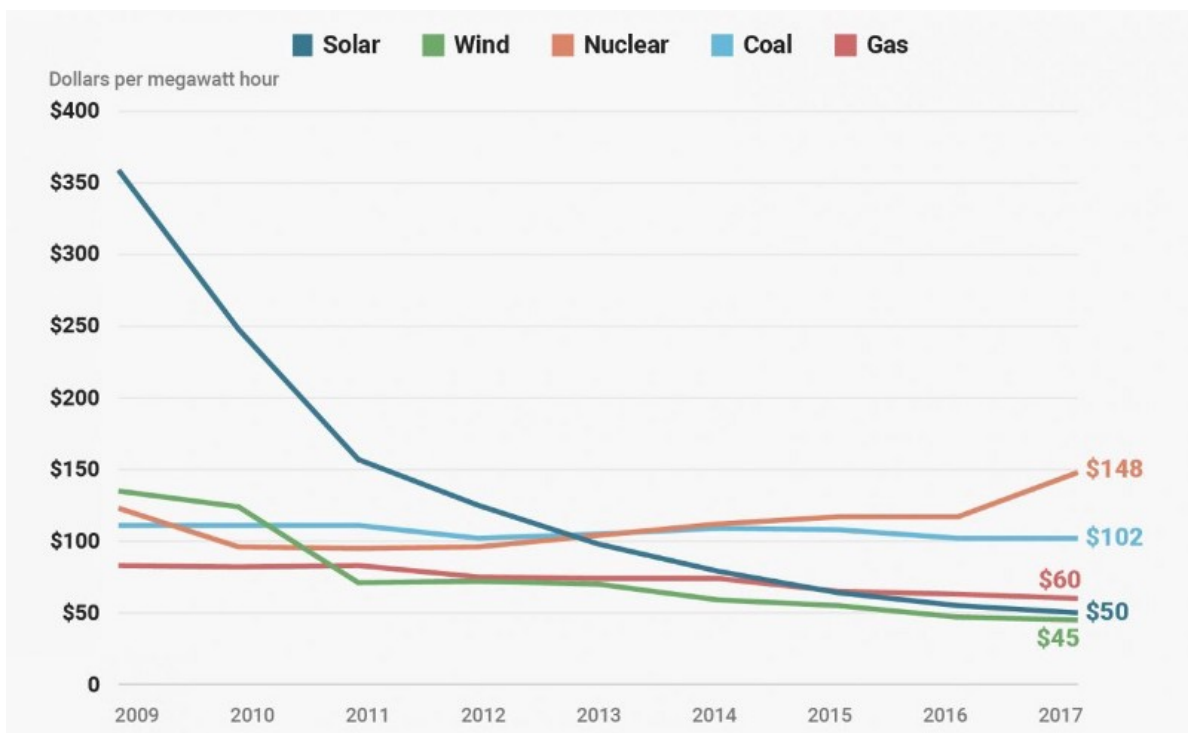
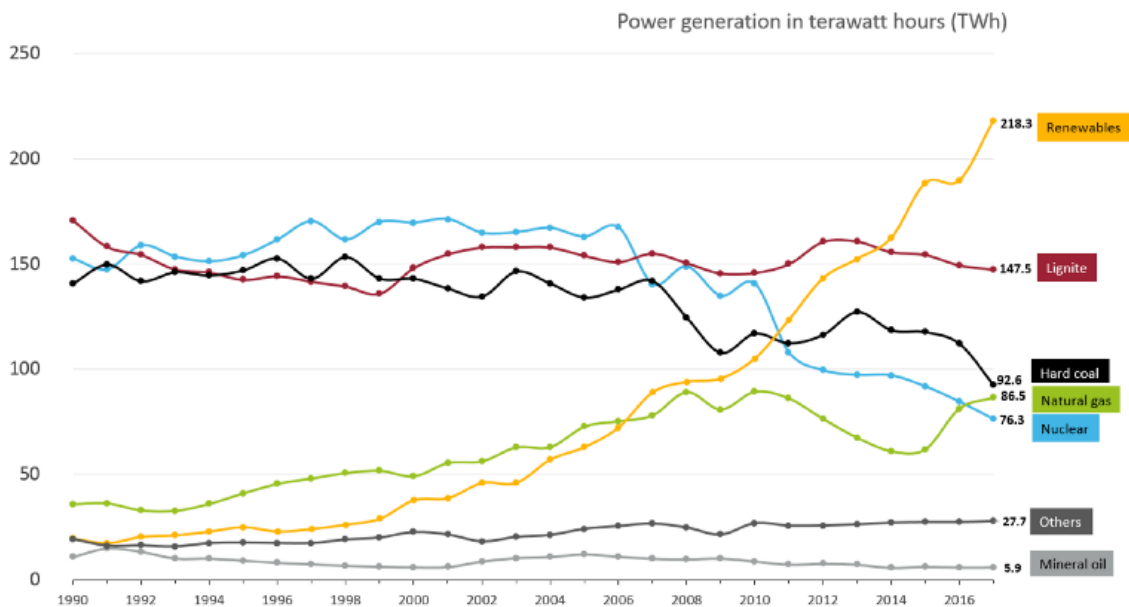


Figure 6.7: Renewables are now cheaper than fossil fuel energy.

Gross power production in Germany 1990 - 2017, by source.

Data: AG Energiebilanzen 2017, 2017 data preliminary.



CC BY SA 4.0

Figure 6.8: Renewables are rising rapidly in Germany’s power mix.



Figure 6.9: A Minister in India speaks out against coal.



Figure 6.10: China seeks harmony with nature.

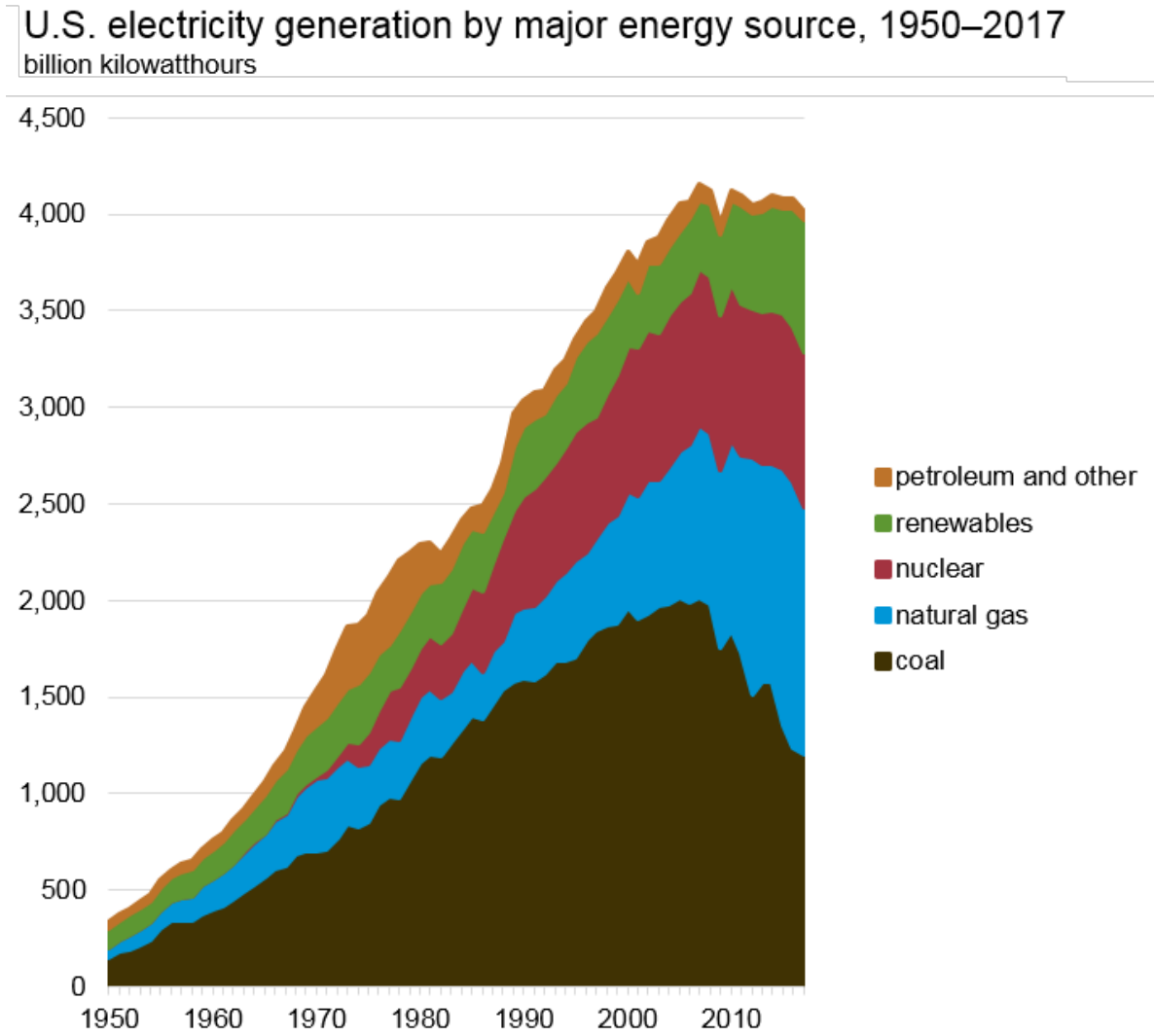


Figure 6.11: In the US, the use of coal for electricity generation is falling.

Figure 3: Cumulative global passenger EV sales, current and forecast

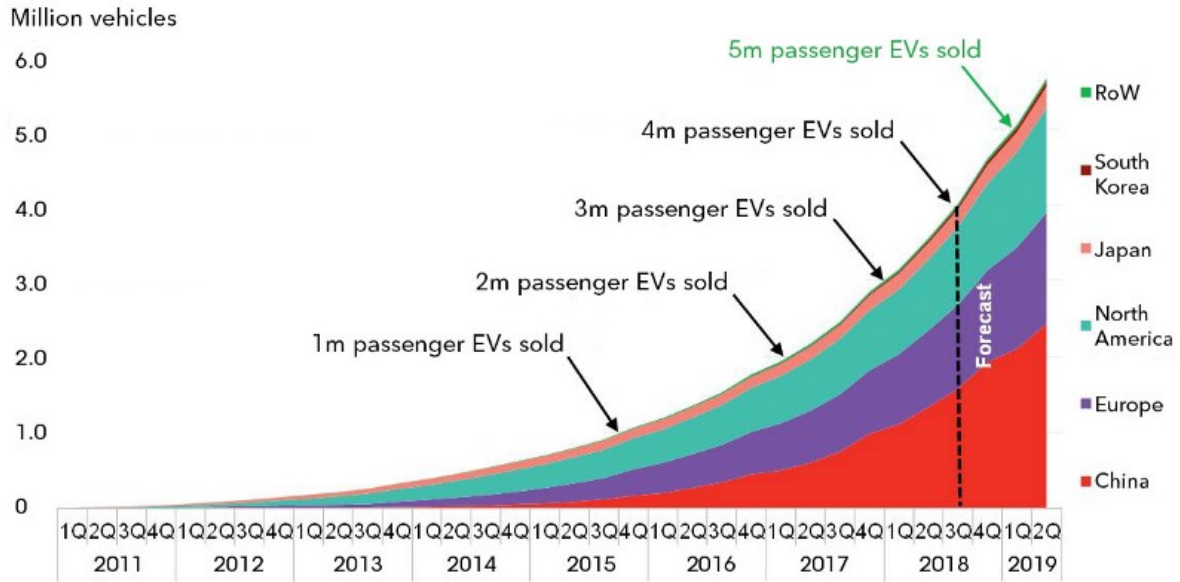


Figure 6.12: Sales of electric vehicles are rising exponentially.

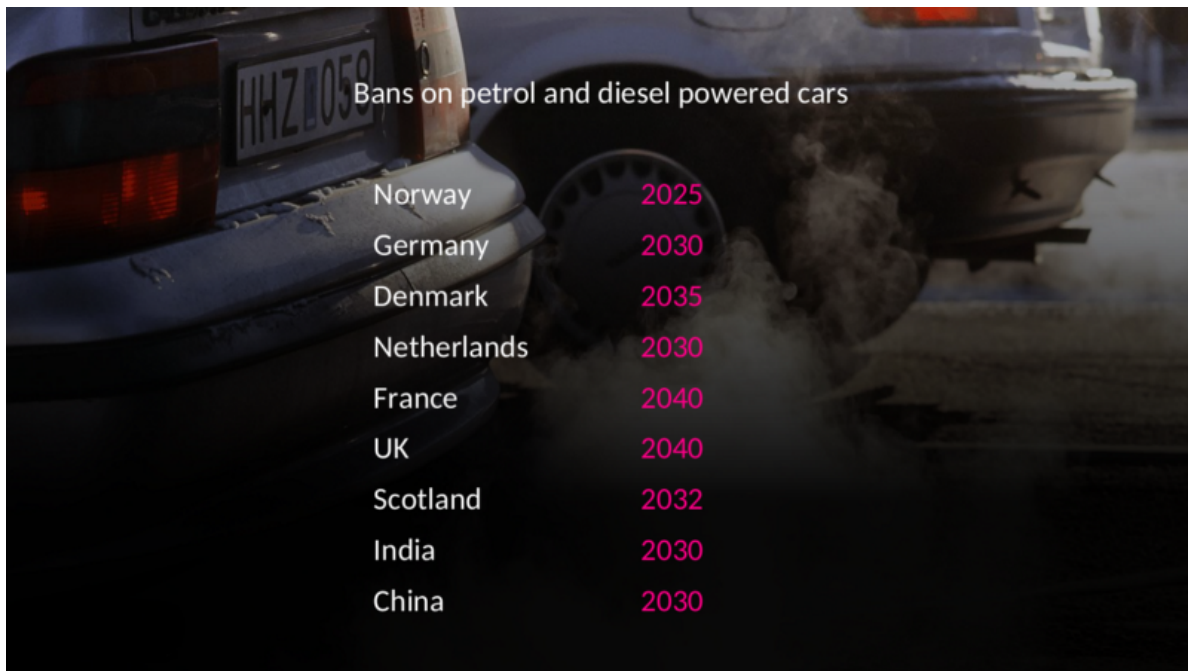


Figure 6.13: Many countries plan to ban vehicles powered with fossil fuels.

6.5 Overcoming the inertia of our political institutions

The constantly-accelerating accumulation of human knowledge has brought with it unprecedented human power over nature, and unprecedented growth of population and industry. Thus, the crisis of civilization that we face today is unique. It is unprecedented. It requires actions for which genetic evolution and human history have not prepared us.

The Nobel-Laureate biochemist Albert Szent-Györgyi once wrote: “The story of man consists of two parts, divided by the appearance of modern science at the turn of the century. In the first period, man lived in the world in which his species was born and to which his senses were adapted. In the second, man stepped into a new, cosmic world to which he was a complete stranger.... The forces at man’s disposal were no longer terrestrial forces, of human dimension, but were cosmic forces, the forces which shaped the universe. The few hundred Fahrenheit degrees of our flimsy terrestrial fires were exchanged for the ten million degrees of the atomic reactions which heat the sun.”

“This is but a beginning, with endless possibilities in both directions - a building of a human life of undreamt of wealth and dignity, or a sudden end in utmost misery. Man lives in a new cosmic world for which he was not made. His survival depends on how well and how fast he can adapt himself to it, rebuilding all his ideas, all his social and political institutions.”

“...Modern science has abolished time and distance as factors separating nations. On our shrunken globe today, there is room for one group only - the family of man.”

The absolutely sovereign nation-state is a dangerous anachronism. Blind nationalism is a dangerous anachronism. Our present lack of effective global governance is a dangerous anachronism. Our enormous military budgets are a dangerous anachronism. Our greed-driven corporate oligarchies are a dangerous anachronism. We cannot rely on tradition. We need to change these things, and to change them rapidly. As Szent-Györgyi says, human survival depends on how fast we can adapt ourselves to the new world that we have created, rebuilding all our ideas, all our social and political institutions.

In a similar way, Albert Einstein said, “Nuclear weapons have changed everything except our way of thinking, and thus we drift towards unprecedented catastrophes.” He also said, “We cannot solve our problems with the same thinking that created them.”



Figure 6.14: Albert Szent-Györgyi: “We must rebuild all our ideas, all our social and political institutions.”



Figure 6.15: Judges in the United Kingdom, wearing their traditional robes and wigs. Throughout the world, legal systems rely heavily on tradition, thus contributing to the inertia of our political institutions.

6.6 Fascism then and now

The two world wars

In 1870, the fiercely nationalistic Prussian Chancellor, Otto von Bismark, won revenge for the humiliations which his country had suffered under Napoleon Bonaparte. In a lightning campaign, Prussia's modern army overran France and took Emperor Napoleon III prisoner. The victorious Prussians demanded from France not only the payment of a huge sum of money - five billion francs - but also the annexation of the French provinces of Alsace and Lorraine. In 1871, Kaiser Wilhelm I was proclaimed Emperor of all Germany in the Hall of Mirrors at Versailles. The dreams of the German nationalists had been realized! The small German-speaking states of central Europe were now united into a powerful nation dominated by Prussia.

Bismark had provoked a number of wars in order to achieve his aim - the unification of Germany under Prussia; but after 1871 he strove for peace, fearing that war would harm his new creation. "I am bored", Bismark remarked to his friends, "The great things are done. The German Reich is made."

In order to preserve the status quo in Europe, Bismark now made alliances not only with Austria-Hungary and Italy, but also with Russia. To make alliances with both Austria-Hungary and Russia required considerable diplomatic skill, since the two empires were enemies - rivals for influence in the Balkan Peninsula. Several small Balkan states had broken away from the decaying Turkish Empire. Both the Hapsburg Emperors and the Romanoff Czars were anxious to dominate these small states. However, nationalist emotions were even more frenzied in the Balkans than they were elsewhere in Europe. Nationalism was a cause for which 19th century Europeans were willing to kill each other, just as three centuries earlier they had been willing to kill each other over their religious differences.

Serbia was an independent state, but the fanatical Serbian nationalists were far from satisfied. Their real aim was to create an independent Pan-Serbia (or Yugoslavia) which would include all the Slavic parts of Austria-Hungary. Thus, at the turn of the century, the Balkans were a trouble spot, much as the Middle East is a trouble spot today.

Kaiser Wilhelm I was a stable monarch, but in 1888 he died and the German throne passed to his son, Frederick III, who was incurably ill with cancer of the throat. After reigning only 90 days, Frederick also died, and his 29 year old son became the new German Emperor - Kaiser Wilhelm II. Wilhelm II had been born with a withered arm, and as a boy he had been constantly told that he must become a great warrior. His adult behavior sometimes showed tendencies towards both paranoia and megalomania.

In 1890, Wilhelm dismissed Otto von Bismark ("dropping the pilot"). Bismark was now on the side of peace, and he might have guided Germany safely through the troubled waters of European politics if he had been allowed to continue; but Wilhelm wanted to play Bismark himself.

Wilhelm's first act was to break off Germany's alliance with Russia. Czar Alexander III, against his principles, then formed an alliance with republican France. Realizing that he had blundered, Wilhelm tried to patch up relations with the Czar, but it was too late.



Figure 6.16: **Otto von Bismarck**

Europe was now divided into two armed camps - Germany, Austria-Hungary and Italy, opposed by Russia and France.

Wilhelm's government then began to build a huge modern navy, much to the consternation of the English. The government of England felt that it was necessary for their country to have control of the sea, since England was a densely-populated island, dependent on imports of food. It was not only with respect to naval power that England felt threatened: After being united in 1871, Germany had undergone an industrial revolution; and German industries were pouring out steel and high-quality manufactured goods that threatened England's dominance of world trade. Commercial and naval competition with the rising German Empire drove England into an informal alliance with Russia and France - the Triple Entente.

Meanwhile the situation in the Balkans became increasingly troubled, and at the end of July, 1914, the Austrian Foreign Minister, Count Brechtold, used the assassination of Archduke Francis Ferdinand and his wife as a pretext for crushing the Serbian Pan-Slavic movement. Russia mobilized against Austria in defense of the Serbs, and the Austrian government interpreted the mobilization as a declaration of war. Germany was linked to Austria by an alliance, while France was linked to Russia. In this way, both France and Russia were drawn into the conflict.

On August 2, Wilhelm demanded free passage of German troops through Belgium. The Belgians refused. They gave warning that an invasion would be resisted, and they appealed to England for support of their country's neutrality. On August 4, Britain sent



an ultimatum to the Kaiser: Unless he halted the invasion of Belgium, Britain would enter the war. The invasion of Belgium rolled on. It was now too late to stop the great death-machine, and as it gained momentum, Sir Edward Grey spoke the sad and prophetic words. “The lamps are going out all over Europe; we shall not see them lit again in our lifetime.”

None of the people who started the First World War had the slightest idea what it would be like. The armies of Europe were dominated by the old feudal landowning class, whose warlike traditions were rooted in the Middle Ages. The counts and barons who still ruled Europe’s diplomatic and military establishments knew how to drink champaign, dance elegantly, ride horses, and seduce women. They pranced off to war in high spirits, the gold on their colorful uniforms glittering in the sunshine, full of expectations of romantic cavalry charges, kisses stolen from pretty girls in captured villages, decorations, glory and promotion, like characters in “The Chocolate Soldier” or “Die Fledermaus”. The romantic dreams of glory of every small boy who ever played with toy soldiers were about to become a thrilling reality!

But the war, when it came, was not like that. Technology had taken over. The railroads, the telegraph, high explosives and the machine gun had changed everything. The opposing armies, called up by means of the telegraph and massed by means of the railroads, were the largest ever assembled up to that time in the history of the world. In France alone, between August 2 and August 18, 1914, the railway system transported 3,781,000 people under military orders. Across Europe, the railways hurled more than six million highly armed men into collision with each other. Nothing on that scale had ever happened before, and no one had any idea of what it would be like.

At first the Schlieffen Plan seemed to be working perfectly. When Kaiser Wilhelm had sent his troops into battle, he had told them: “You will be home before the leaves are off the trees”, and at first it seemed that his prediction would be fulfilled. However, the

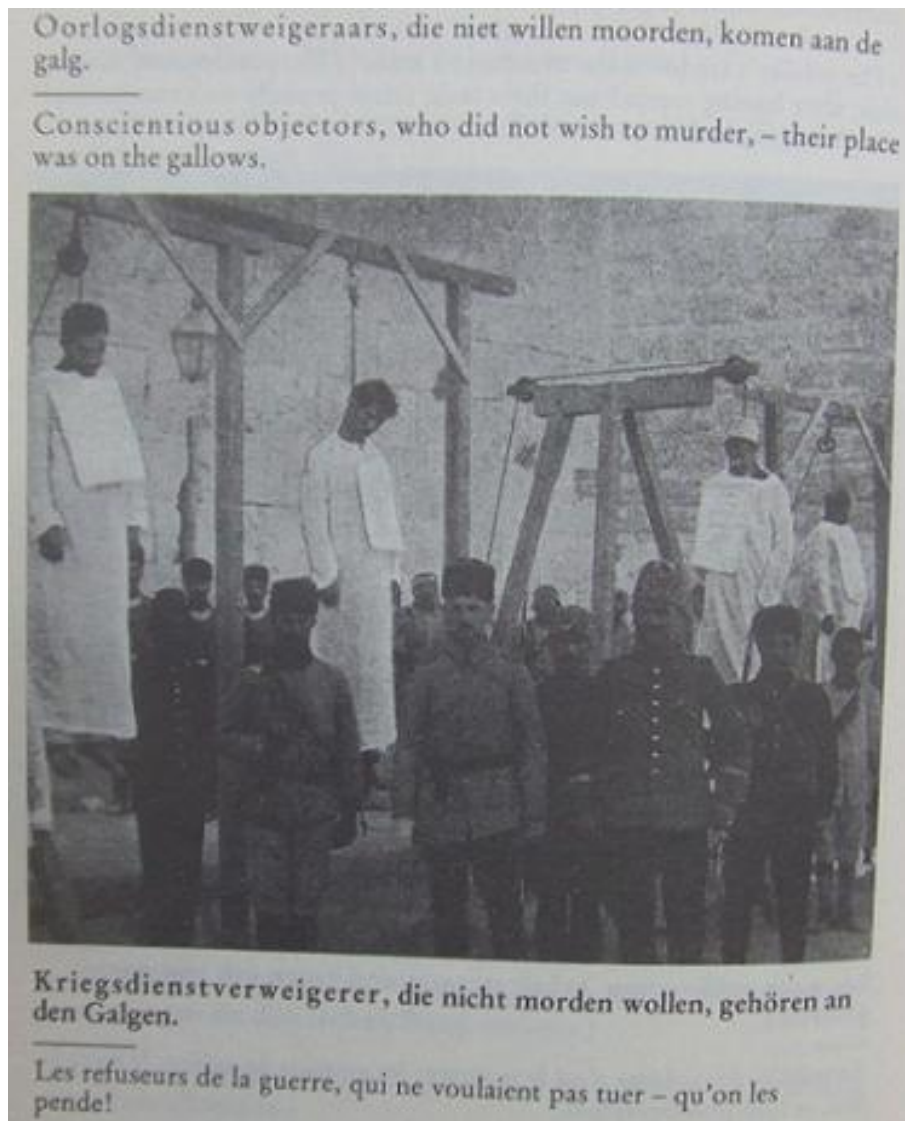


Figure 6.17: The fate of conscientious objectors.



machine gun had changed the character of war. Attacking infantry could be cut down in heaps by defending machine gunners. The war came to a stalemate, since defense had an advantage over attack.

On the western front, the opposing armies dug lines of trenches stretching from the Atlantic to the Swiss border. The two lines of trenches were separated by a tangled mass of barbed wire. Periodically the generals on one side or the other would order their armies to break through the opposing line. They would bring forward several thousand artillery pieces, fire a million or so high explosive shells to cut the barbed wire and to kill as many as possible of the defenders, and then order their men to attack. The soldiers had to climb out of the trenches and struggle forward into the smoke. There was nothing else for them to do. If they disobeyed orders, they would be court-martialed and shot as deserters. They were driven forward and slaughtered in futile attacks, none of which gained anything. Their leaders had failed them. Civilization had failed them. There was nothing for them to do but to die, to be driven forward into the poison gas and barbed wire and to be scythed down by machine gun fire, for nothing, for the ambition, vanity and stupidity of their rulers.

At the battle of Verdun, 700,000 young men were butchered in this way, and at the battle of Somme, 1,100,000 young lives were wasted. On the German side, the soldiers sang “Lili Marlein” - “She waits for a boy who’s far away...” and on the other side, British and American soldiers sang:

“There’s a long long trail a-winding
into the land of my dreams
where the nightingale is singing
and the pale moon beams.
There’s a long long night of waiting
until my dreams all come true,
'til the day that I’ll be going
down that long long trail with you.”

For millions of Europe’s young men, the long, long trail lead only to death in the mud and smoke; and for millions of mothers and sweethearts waiting at home, dreams of the future were shattered by a telegram announcing the death of the boy for whom they were waiting.

When the war ended four years later, ten million young men had been killed and twenty million wounded, of whom six million were crippled for life. The war had cost 350,000,000,000 1919 dollars. This was a calculable cost; but the cost in human suffering and brutalization of values was incalculable. It hardly mattered whose fault the catastrophe had been. Perhaps the Austrian government had been more to blame than any other. But blame for the war certainly did not rest with the Austrian people nor with the young Austrians who had been forced to fight. However, the tragedy of the First World War was that it created long-lasting hatred between the nations involved; and in this way it lead, only twenty years later, to an even more catastrophic global war.

The First World War brought about the downfall of four emperors: the Russian Czar, the Turkish Sultan, the Austro-Hungarian Emperor and the German Kaiser. The decaying and unjust Czarist government had for several years been threatened by revolution; and the horrors of the war into which the Czar had led his people were enough to turn them decisively against his government. During 1915 alone, Russia lost more than two million men, either killed or captured. Finally the Russian soldiers refused to be driven into battle and began to shoot their officers. In February, 1917, the Czar abdicated; and on December 5, 1917, the new communist government of Russia signed an armistice with Germany.

The German Chief of Staff, General Ludendorff, then shifted all his troops to the west in an all-out offensive. In March, 1918, he threw his entire army into a gigantic offensive which he called “the Emperor’s Battle”. The German army drove forward, and by June they were again on the Marne, only 50 miles from Paris. However, the Allies counterattacked, strengthened by the first American troops, and using, for the first time, large numbers of tanks. The Germans fell back, and by September they had lost more than a million men in six months. Morale in the retreating German army was falling rapidly, and fresh American troops were landing in France at the rate of 250,000 per month. Ludendorff realized that the German cause was hopeless and that if peace were not made quickly, a communist revolution would take place in Germany just as it had in Russia.

The old feudal Prussian military caste, having led Germany into disaster, now unloaded responsibility onto the liberals. Ludendorff advised the Kaiser to abdicate, and a liberal leader, Prince Max of Baden, was found to head the new government. On November 9,

1918, Germany was proclaimed a republic. Two days later, an armistice was signed and the fighting stopped.

During the last years of the war the world, weary of the politics of power and nationalist greed, had looked with hope towards the idealism of the American President, Woodrow Wilson. He had proposed a “peace without victory” based on his famous Fourteen Points”. Wilson himself considered that the most important of his Fourteen Points was the last one, which specified that “A general association of nations must be formed... for the purpose of affording mutual guaranties of political independence and territorial integrity of great and small states alike.”

When Wilson arrived in Europe to attend the peace conference in Paris, he was wildly cheered by crowds of ordinary people, who saw in his idealism new hope for the world. Unfortunately, the hatred produced by four years of horrible warfare was now too great to be overcome. At the peace conference, the aged nationalist Georges Clemenceau was unswerving in his deep hatred of Germany. France had suffered greatly during the war. Half of all French males who had been between the ages of 20 and 32 in 1914 had been killed; much of the French countryside had been devastated; and the retreating German armies had destroyed the French coal mines. Clemenceau was determined to extract both revenge and financial compensation from the Germans.

In the end, the peace treaty was a compromise. Wilson was given his dream, the League of Nations; and Clemenceau was given the extremely harsh terms which he insisted should be imposed on Germany. By signing the treaty, Germany would be forced to acknowledge sole responsibility for having caused the war; it would be forced to hand over the Kaiser and other leaders to be tried as war criminals; to pay for all civilian damage during the war; to agree to internationalization of all German rivers and the Kiel Canal; to give France, Belgium and Italy 25 million tons of coal annually as part of the reparations payments; to surrender the coal mines in Alsace-Lorraine to France; to give up all foreign colonies; to lose all property owned by Germans abroad; and to agree to Allied occupation of the Rhineland for fifteen years.

The loss of coal, in particular, was a death-blow aimed at German industry. Reading the terms of the treaty, the German Chancellor cried: “May the hand wither that signs such a peace!” The German Foreign Minister, Count Ulrich von Brockendorff-Rantzau, refused to sign, and the German government made public the terms of the treaty which it had been offered.

French newspapers picked up the information, and at 4 a.m. one morning, a messenger knocked at the door of the Paris hotel room where Herbert Hoover (the American war relief administrator) was staying, and handed him a copy of the terms. Hoover was so upset that he could sleep no more that night. He dressed and went out into the almost deserted Paris streets, pacing up and down, trying to calm himself. “It seemed to me”, Hoover wrote later, “that the economic consequences alone would pull down all Europe and thus injure the United States.” By chance, Hoover met the British economist, John Maynard Keynes, who was walking with General Jan Smuts in the pre-dawn Paris streets. Both of them had received transcripts of the terms offered to Germany, and both were similarly upset. “We agreed that it was terrible”, Hoover wrote later, “and we agreed that we would do what

we could... to make the dangers clear.”

In the end, continuation of the blockade forced the Germans to sign the treaty; but they did so with deeply-felt bitterness. Describing the signing of the Versailles treaty on June 28, 1919, a member of the American delegation wrote: “It was not unlike when in olden times the conqueror dragged the conquered at his chariot wheel.”

While he participated in the peace negotiations, Wilson had been absent from the United States for six months. During that time, Wilson’s Democratic Party had been without its leader, and his Republican opponents made the most of the opportunity. Republican majorities had been returned in both the House of Representatives and the Senate. When Wilson placed the peace treaty before the Senate, the Senate refused to ratify it. Wilson desperately wanted America to join the League of Nations, and he took his case to the American people. He traveled 8,000 miles and delivered 36 major speeches, together with scores of informal talks urging support for the League. Suddenly, in the middle of this campaign, he was struck with a cerebral thrombosis from which he never recovered.

Without Wilson’s leadership, the campaign collapsed. The American Senate for a second time rejected the peace treaty, and with it the League of Nations. Without American participation, the League was greatly handicapped. It had many successes, especially in cultural and humanitarian projects and in settling disputes between small nations; but it soon became clear that the League of Nations was not able to settle disputes between major powers.

Postwar Germany was in a state of chaos - its economy in ruins. The nation was now a republic, with its capital in Weimar, but this first experiment in German democracy was not running smoothly. Many parts of the country, especially Bavaria, were swarming with secret societies led by former officers of the German army. They blamed the republican government for the economic chaos and for signing a disgraceful peace treaty. The “war guilt” clause of the treaty especially offended the German sense of honor.

In 1920 a group of nationalist and monarchist army officers led by General Ludendorff staged an army revolt or “Putsch”. They forcibly replaced the elected officials of the Weimar Republic by a puppet head of state named Dr. Kapp. However, the republic was saved by the workers of Berlin, who turned off the public utilities.

After the failure of the “Kapp Putsch”, Ludendorff went to Bavaria, where he met Adolf Hitler, a member of a small secret society called the National Socialist German Workers Party. (The name was abbreviated as “Nazi” after the German pronunciation of the first two syllables of “National”). Together, Ludendorff and Hitler began to plot another “Putsch”.

In 1921, the Reparations Commission fixed the amount that Germany would have to pay at 135,000,000,000 gold marks. Various western economists realized that this amount was far more than Germany would be able to pay; and in fact, French efforts to collect it proved futile. Therefore France sent army units to occupy industrial areas of the Ruhr in order to extract payment in kind. The German workers responded by sitting down at their jobs. Their salaries were paid by the Weimar government, which printed more and more paper money. The printing presses ran day and night, flooding Germany with worthless currency. By 1923, inflation had reached such ruinous proportions that baskets



Figure 6.18: **Hitler addresses a rally at Dortmund in 1932**

full of money were required to buy a loaf of bread. At one point, four trillion paper marks were equal to one dollar. This catastrophic inflation reduced the German middle class to poverty and destroyed its faith in the orderly working of society.

The Nazi Party had only seven members when Adolf Hitler joined it in 1919. By 1923, because of the desperation caused by economic chaos, it had grown to 70,000 members. On November 8, 1923, there was a meeting of nationalists and monarchists at the Bürgerbräu beer hall in Munich. The Bavarian State Commissioner, Dr. Gustav von Kahr, gave a speech denouncing the Weimar Republic. He added, however, that the time was not yet ripe for armed revolt.

In the middle of Kahr's speech, Adolf Hitler leaped to the podium. Firing two revolver bullets into the ceiling Hitler screamed that the revolution was on - it would begin immediately! He ordered his armed troopers to bar the exits, and he went from one Bavarian leader to the other, weeping with excitement, a beer stein in one hand and a revolver in the other, pleading with them to support the revolution. At this point, the figure of General Ludendorff suddenly appeared. In full uniform, and wearing all his medals, he added his pleading to that of Hitler. The Bavarian leaders appeared to yield to Hitler and Ludendorff; and that night the Nazis went into action. Wild disorder reigned in Munich. Republican newspapers and trade union offices were smashed, Jewish homes were raided, and an attempt was made to seize the railway station and the post office. However, units of policemen and soldiers were forming to resist the Nazis. Hitler realized that the Bavarian government officials under Kahr had only pretended to go along with the revolution in order to escape from the armed troopers in the beer hall.

At dawn, Hitler grouped his followers together for a parade to show their strength and to intimidate opposition. With swastika flags flying, the Nazis marched to the main square of Munich. There they met troops of Bavarian government soldiers and policemen massed in force. A volley of shots rang out, and 18 Nazis fell dead. Many other Nazis were



Figure 6.19: A portrait of Adolf Hitler

wounded, and the remainder scattered. Hitler broke his shoulder diving for the pavement. Only General Ludendorff remained standing where he was. The half-demented old soldier, who had exercised almost dictatorial power over Germany during the last years of the war, marched straight for the Bavarian government troops. They stepped aside and let him pass.

Adolf Hitler was arrested and sentenced to five years in prison. After serving less than a year of his sentence, he was released. He had used the time in prison to write a book, *Mein Kampf*.

Nationalism and fascism today

The United States is drifting towards fascism. The 2016 Republican presidential debates were held in the gaudy and luxurious Venetian Casino in Los Vegas, a building whose billionaire Republican-backing owner Sheldon Adelson held a private meeting with fellow-billionaire Donald Trump before the debate.³

In the two-hour hate-show that followed, the Republican candidates for the 2016 presidential nomination competed with each other over who could be the most avid in advocating war and racism. To worried observers, the scene was disturbingly reminiscent of the slide into fascism seen in Germany and Italy in the 1930's. At that time too, there were serious economic problems, and there was a desperate need for reassurance among populations.

Hitler and Mussolini appealed to the lower instincts of their electorates, especially to the primitive instinct of tribalism; and this is why these two hate-mongering politicians of the 1930's were genuinely popular, just as Donald Trump is today.

There are other parallels with the 1930's: The Nazis used the Reichstag fire as an excuse for attacks on civil rights, just as terrorism today is used as an excuse for suspending civil liberties.

The dominant role of corporations today also parallels their role in the rise of fascism in the 1930's. According to Benito Mussolini, "Fascism should more properly be called corporatism because it is the merger of state and corporate power".

For those of us who feel affection for the United States, it is sad to see the country slide towards political irresponsibility and fascism. Even more importantly, just as in the 1930's, political irresponsibility led to an all-destroying world war, so today there is a great

³<http://www.informationclearinghouse.info/article43743.htm>
<http://www.informationclearinghouse.info/article43748.htm>
<http://www.truth-out.org/opinion/item/34059-how-many-children-could-you-kill-the-gop-debates-in-brief>
<http://www.truth-out.org/opinion/item/34057-the-media-is-ignoring-economic-justice-in-the-2016-election>
<http://www.truth-out.org/news/item/34066-democracy-is-being-dismantled-before-our-eyes-bob-herbert-on-sheldon-adelson-backed-gop-debate>
<http://www.commondreams.org/news/2015/12/16/observers-slam-cnn-aiding-and-abetting-hate-speech-gop-debate>
<http://www.commondreams.org/views/2015/12/16/republicans-principle-free-presidential-debate>

danger of a world war; and the threat today is far greater because of the terrible power of thermonuclear weapons.

But there are many very good people in the United States. We know this because of the great popularity of Bernie Sanders. It is time for them to speak out and act. We cannot have a situation where, as Yeats put it, “the best lack all conviction, while the worst are filled with passionate intensity.” We must prevent the rough beast of fascism from slouching towards Bethlehem to be born.

Trump threatens an unconstitutional state of emergency

We can remember that while Hitler gained power by a legal election, he retained it by illegal and violent methods. Today Donald Trump threatens to repeat this tactic by declaring a state of emergency in order to build his controversial border wall.

In a January 9, 2019, article in the New York Times, Charlie Savage wrote: “ If the president does invoke emergency powers to circumvent Congress, it would be an extraordinary violation of constitutional norms - and establish a precedent for presidents who fail to win approval for funding a policy goal.”

In fact, emergency powers would allow a president to use the army to keep himself in power, just as Hitler did.

Neofacism worldwide

In 2018, the psychoanalyst and futurist Dieter Duhm wrote: “November 9 this year marks the 80th anniversary of what went down in history as ‘Kristallnacht’ or the ‘Night of Broken Glass.’ On the night of November 9, 1938, the Nazis burned down 1000 synagogues and 7000 Jewish businesses all over Germany. This orchestrated attack marked the beginning of the Holocaust, resulting in six million Jews killed in less than seven years.

“From surging white-identity terrorism and Trump’s brutal response to the migrant caravan in the United States to the atrocious ‘war on drugs’ in the Philippines; from Israel’s ‘nation state law’ to racist policies in Italy and Christian fascism in Brazil, we currently see history reverberating in the far-right movements rising to power at breakneck speed around the world. Is there still something we can do to stop the fascist takeover?”

The refugee crisis and the extreme right

Brexit

Across the developed world, the reaction to threatened migration of refugees from climate change has been less than generous, to say the least. The recent decision of Britain to leave the European Union was motivated largely by the fear of British workers that EU laws would force their country to accept large numbers of refugees.



Figure 6.20: Neofascist leaders can be found in many countries today. They are worryingly similar to the fascists of the 1930's,

Swings to the right in Europe

In Germany, Angela Merkel's generous policies towards refugees have cost her votes, while an openly racist party, the Alternative for Germany (AfD) party, has gained in strength. Frauke Petry, 40, the party's leader, has said border guards might need to turn guns on anyone crossing a frontier illegally. The party's policy platform says "Islam does not belong in Germany" and calls for a ban on the construction of mosques.

In September, 2017, eight people from the neo-Nazi Freital Group were put on trial in Dresden for bomb attacks on homes for asylum applicants. Hundreds of similar assaults occur in Germany every year, but they had never before been tried as terrorism in a federal court.

In the German election, which took place on Sunday, October 1, 2017, Angela Merkel won a fourth term as Chancellor, but her party won only 33% of the votes, a percentage much reduced from the 41% won in the election of 2013. Angela Merkel was paying a high price for her refugee-friendly policies.

Meanwhile the far right anti-immigration AfD party made a historic breakthrough, winning 13.5% of the vote, thus becoming the first overtly nationalist party to sit in the Bundestag in 60 years. The Greens have already complained that "Nazis have returned to parliament". In fact, members of the AfD party have begun to say that Germans should stop being ashamed of their country's Nazi past.

In France, the National Front is a nationalist party that uses populist rhetoric to promote its anti-immigration and anti-European Union positions. The party favors protectionist economic policies and would clamp down on government benefits for immigrants.

Similarly, in the Netherlands, the anti-European Union, anti-Islam Party for Freedom has called for closing all Islamic schools and recording the ethnicity of all Dutch citizens. In early November, the party was leading in polls ahead of next year's parliamentary elections.

Other far-right anti-immigrant parties in Europe include Golden Dawn (Greece), Jobbic (Hungary), Sweden Democrats (Sweden), Freedom Party (Austria), and People's Party - Our Slovakia (Slovakia). All of these parties have gained in strength because of the widespread fear of immigration.

Populism in the United States

The election of Donald Trump, who ran for President in 2016 on an openly racist and anti-immigrant platform, can also be seen as the result of fear of immigration, especially on the part of industrial workers.

A more humane response to the refugee crisis

In the long-term future, climate change will make the refugee crisis much more severe. Heat and drought will make large regions of the world uninhabitable, and will threaten many

populations with famine. The severity of the refugee crisis will depend on how quickly we reduce greenhouse gas emissions.

While making many parts of the world uninhabitable, long-term climate change will make other regions more suitable for human habitation and agriculture. For example, farming will become more possible in Siberia, Greenland, the Canadian Arctic, Alaska and Patagonia. A humane response to the refugee crisis could include the generous opening of these regions to refugees.

The global population of humans is currently increasing by almost a billion people every decade. Global population must be stabilized, and in the long run, gradually reduced. Money currently wasted (or worse than wasted) on armaments could be used instead to promote universal primary health care, and with it, universal access to the knowledge and materials needed for family planning.

Finally, reduced consumption of meat, particularly beef, would shorten the food chain thus make more food available for famine relief.

The refugee crisis will become progressively more severe, as populations are displaced for the following reasons:

Populations displaced by sea level rise

In a recent article⁴ discussed the long-term effects of sea level rise and the massive refugee crisis that it might create. By 2060, about 1.4 billion people could be climate change refugees, according to the paper, and that number could reach 2 billion by 2100.

The lead author, Prof. Emeritus Charles Geisler of Cornell University says: “The colliding forces of human fertility, submerging coastal zones, residential retreat, and impediments to inland resettlement is a huge problem. We offer preliminary estimates of the lands unlikely to support new waves of climate refugees due to the residues of war, exhausted natural resources, declining net primary productivity, desertification, urban sprawl, land concentration, ‘paving the planet’ with roads and greenhouse gas storage zones offsetting permafrost melt.”

We should notice that Prof. Geisler’s estimate of 2 billion climate refugees by 2100 includes all causes, not merely sea level rise. However, the number of refugees from sea level rise alone will be very large, since all the world’s coastal cities, and many river deltas will be at risk.

Populations displaced by drought and famine

Climate change could produce a refugee crisis that is “unprecedented in human history”, Barack Obama has warned as he stressed global warming was the most pressing issue of the age.

⁴Geisler C. et al., *Impediments to inland resettlement under conditions of accelerated sea level rise*, Land Use Policy, Vol 55, July 2017, Pages 322-330

Speaking at an international food conference in Milan, the former US President said rising temperatures were already making it more difficult to grow crops and rising food prices were “leading to political instability”.

If world leaders put aside “parochial interests” and took action to reduce greenhouse gas emissions by enough to restrict the rise to one or two degrees Celsius, then humanity would probably be able to cope.

Failing to do this, Mr Obama warned, increased the risk of “catastrophic” effects in the future, “not only real threats to food security, but also increases in conflict as a consequence of scarcity and greater refugee and migration patterns”.

“If you think about monsoon patterns in the Indian subcontinent, maybe half a billion people rely on traditional rain patterns in those areas,”

Populations displaced by rising temperatures

A new study published in *Nature: Climate Change* has warned that up to 75% of the world’s population could face deadly heat waves by 2100 unless greenhouse gas emissions are rapidly controlled.⁵ The following is an excerpt from the article:

“Here we conducted a global analysis of documented lethal heat events to identify the climatic conditions associated with human death and then quantified the current and projected occurrence of such deadly climatic conditions worldwide. We reviewed papers published between 1980 and 2014, and found 783 cases of excess human mortality associated with heat from 164 cities in 36 countries.

“Based on the climatic conditions of those lethal heat events, we identified a global threshold beyond which daily mean surface air temperature and relative humidity become deadly. Around 30% of the world’s population is currently exposed to climatic conditions exceeding this deadly threshold for at least 20 days a year.

“By 2100, this percentage is projected to increase to 48% under a scenario with drastic reductions of greenhouse gas emissions and 74% under a scenario of growing emissions. An increasing threat to human life from excess heat now seems almost inevitable, but will be greatly aggravated if greenhouse gases are not considerably reduced.”⁶

Populations displaced by war

A recent article in *The Guardian*⁷ discusses the relationship between climate change and war, Here are some excerpts from the article:

“Climate change is set to cause a refugee crisis of ‘unimaginable scale’, according to senior military figures, who warn that global warming is the greatest security threat of the 21st century and that mass migration will become the ‘new normal’.

⁵Mora, C. et al., *Global risk of deadly heat*, *Nature: Climate Change*, 19 June 2017

⁶See also <https://phys.org/news/2017-08-deadly-south-asia-century.html> and <https://cleantechnica.com/2017/09/28/extreme-heatwaves-like-recent-lucifer-heatwave-become-normal-europe-2050s/>

⁷Thursday, 1 December, 2016

“The generals said the impacts of climate change were already factors in the conflicts driving a current crisis of migration into Europe, having been linked to the Arab Spring, the war in Syria and the Boko Haram terrorist insurgency.

“Military leaders have long warned that global warming could multiply and accelerate security threats around the world by provoking conflicts and migration. They are now warning that immediate action is required.

“‘Climate change is the greatest security threat of the 21st century,’ said Maj Gen Muniruzzaman.

“Muniruzzaman, chairman of the Global Military Advisory Council on climate change and a former military adviser to the president of Bangladesh. He said one meter of sea level rise will flood 20% of his nation. ‘We’re going to see refugee problems on an unimaginable scale, potentially above 30 million people.’

“Previously, Bangladesh’s finance minister, Abul Maal Abdul Muhith, called on Britain and other wealthy countries to accept millions of displaced people.

“Brig Gen Stephen Cheney, a member of the US Department of State’s foreign affairs policy board and CEO of the American Security Project, said: ‘Climate change could lead to a humanitarian crisis of epic proportions. We’re already seeing migration of large numbers of people around the world because of food scarcity, water insecurity and extreme weather, and this is set to become the new normal’.

6.7 Overcoming the inertia of our educational institutions

School systems aim at indoctrination in nationalism

School systems have traditionally aimed at producing nationalism in their students. Within the Roman Empire, students were taught the motto “Dulce et decorum est pro patria mori” (It is sweet and noble to die for one’s country). In the era when the sun never set on the British Empire, schoolboys in England were taught the same motto, and the Roman Empire was held up as an ideal. One said the “The battle of Waterloo was won on the playing fields of Eton”.

If the reader will excuse a personal note, I can remember attending elementary schools in the United States where every morning we pledged allegiance to the US flag. With hands on our hearts, we students repeated “I pledge allegiance to the flag of the United States of America, and to the Republic for which it stands - one nation, indivisible, with liberty and justice for all.” I believe that with small changes in wording, this ceremony is repeated every day today in all American schools.

I can also remember, later on, my great surprise in learning that many of the wars conducted by the United States have been aggressive and unjust. There had been no hint of that in the history lessons of US schools. I believe that the situation is the same in every country. History lessons are an indoctrination in nationalism. In history, as it is taught, one’s own country is always heroic and in the right.

Today, in an era of instantaneous communication, global economic and cultural interdependence, and all-destroying modern weapons, the absolutely sovereign nation-state has become a dangerous anachronism. Blind nationalism too, has become a dangerous anachronism. Therefore we need to reform our school systems, but the process of making the needed changes is slowed the habits of teachers and administrators, and by shelves full of nationalistic history books.

The urgent need for peace education

Since modern war has become prohibitively dangerous, there is an urgent need for peace education. Why do we pay colossal sums for war, which we know is the source of so much human suffering, and which threatens to destroy human civilization? Why not instead support peace and peace education?

In this section, we will see that many groups and individuals are already working for this goal. With even a little more support, they would be much more effective.

The growth of global consciousness

Besides a humane, democratic and just framework of international law and governance, we urgently need a new global ethic, - an ethic where loyalty to family, community and nation will be supplemented by a strong sense of the brotherhood of all humans, regardless of race, religion or nationality. Schiller expressed this feeling in his “Ode to Joy”, a part of which is the text of Beethoven’s Ninth Symphony. Hearing Beethoven’s music and Schiller’s words, most of us experience an emotion of resonance and unity with the message: All humans are brothers and sisters - not just some - all! It is almost a national anthem of humanity. The feelings that the music and words provoke are similar to patriotism, but broader. It is this sense of a universal human family that we need to cultivate in education, in the mass media, and in religion. We already appreciate music, art and literature from the entire world, and scientific achievements are shared by all, regardless of their country of origin. We need to develop this principle of universal humanism so that it will become the cornerstone of a new ethic.

Reformed teaching of history

Educational reforms are urgently needed, particularly in the teaching of history. As it is taught today, history is a chronicle of power struggles and war, told from a biased national standpoint. Our own race or religion is superior; our own country is always heroic and in the right.

We urgently need to replace this indoctrination in chauvinism by a reformed view of history, where the slow development of human culture is described, giving adequate credit to all who have contributed. Our modern civilization is built on the achievements of many ancient cultures. China, Japan, India, Mesopotamia, Egypt, Greece, the Islamic world, Christian Europe, and the Jewish intellectual traditions all have contributed. Potatoes,

corn, squash, vanilla, chocolate, chili peppers, pineapples, quinine, etc. are gifts from the American Indians. Human culture, gradually built up over thousands of years by the patient work of millions of hands and minds, should be presented as a precious heritage - far too precious to be risked in a thermonuclear war.

The teaching of history should also focus on the times and places where good government and internal peace have been achieved, and the methods by which this has been accomplished. Students should be encouraged to think about what is needed if we are to apply the same methods to the world as a whole. In particular, the histories of successful federations should be studied, for example the Hanseatic League, the Universal Postal Union, the federal governments of Australia, Brazil, Germany, Switzerland, the United States, Canada, and so on. The recent history of the European Union provides another extremely important example. Not only the successes, but also the problems of federations should be studied in the light of the principle of subsidiarity⁸. The essential features of federations should be clarified⁹, as well as the reasons why weaker forms of union have proved to be unsuccessful.

Reformed education of economists and businessmen

The education of economists and businessmen needs to face the problems of global poverty - the painful contrast between the affluence and wastefulness of the industrial North and the malnutrition, disease and illiteracy endemic in the South. Students of economics and business must look for the roots of poverty not only in population growth and war, but also in the history of colonialism and neocolonialism, and in defects in global financial institutions and trade agreements. They must be encouraged to formulate proposals for the correction of North-South economic inequality.

The economic impact of war and preparation for war should be included in the training of economists. Both direct and indirect costs should be studied. An example of an indirect cost of war is the effect of unimaginably enormous military budgets in reducing the amount of money available for solving the serious problems facing the world today.

Law for a united world

Law students should be made aware of the importance of international law. They should be familiar with its history, starting with Grotius and the Law of the Sea. They should know the histories of the International Court of Justice and the Nuremberg Principles. They should study the United Nations Charter (especially the articles making war illegal) and the Universal Declaration of Human Rights, as well as the Rome Treaty and the foundation

⁸The principle of subsidiarity states that within a federation, decisions should be taken at the lowest level at which there are no important externalities. Thus, for example, decisions affecting air quality within Europe should be taken in Bruxelles because winds blow freely across national boundaries, but decisions affecting only the local environment should be taken locally.

⁹One of the most important of these features is that federations have the power to make and enforce laws that are binding on individuals, rather than trying to coerce their member states.

of the International Criminal Court. They should be made aware of a deficiency in the present United Nations - the lack of a legislature with the power to make laws that are binding on individuals.

Students of law should be familiar with all of the details of the World Court's historic Advisory Opinion on Nuclear Weapons, a decision that make the use or threat of use of nuclear weapons illegal. They should also study the Hague and Geneva Conventions, and the various international treaties related to nuclear, chemical and biological weapons. The relationship between the laws of the European Union and those of its member states should be given high importance. The decision by the British Parliament that the laws of the EU take precedence over British law should be a part of the curriculum.

Teaching global ethics

Professors of theology should emphasize three absolutely central components of religious ethics: the duty to love and forgive one's enemies, the prohibition against killing, and the concept of universal human brotherhood. They should make their students conscious of a responsibility to give sermons that are relevant to the major political problems of the modern world, and especially to relate the three ethical principles just mentioned to the problem of war. Students of theology should be made conscious of their responsibility to soften the boundaries between ethnic groups, to contribute to interreligious understanding, and to make marriage across racial and religious boundaries more easy and frequent.

The social responsibility of scientists

In teaching science too, reforms are needed. Graduates in science and engineering should be conscious of their responsibilities. They must resolve never to use their education in the service of war, nor for the production of weapons, nor in any way that might be harmful to society or to the environment.

Science and engineering students ought to have some knowledge of the history and social impact of science. They could be given a course on the history of scientific ideas; but in connection with modern historical developments such as the industrial revolution, the global population explosion, the development of nuclear weapons, genetic engineering, and information technology, some discussion of social impact of science could be introduced. One might hope to build up in science and engineering students an understanding of the way in which their own work is related to the general welfare of humankind, and a sense of individual social and ethical responsibility. These elements are needed in science education if rapid technological progress is to be beneficial to society rather than harmful.

The changes just mentioned in the specialized lawyers, theologians, scientists and engineers should have a counterpart in elementary education. The basic facts about peace and war should be communicated to children in simple language, and related to the everyday experiences of children. Teachers' training colleges ought to discuss with their student-teachers the methods that can be used to make peace education a part of the curriculum at various levels, and how it can be related to familiar concepts. They should also discuss

the degree to which the painful realities of war can be explained to children of various ages without creating an undesirable amount of anxiety.

Peace education can be made a part of the curriculum of elementary schools through (for example) theme days or theme weeks in which the whole school participates. This method has been used successfully in many European schools. During the theme days the children have been encouraged to produce essays, poems and drawings illustrating the difference between peace and war, and between negative peace and positive peace¹⁰. Another activity has been to list words inspired by the concept “peace”, rapidly and by free association, and to do the same for the concept “war”. Drama has also been used successfully in elementary school peace education, and films have proved to be another useful teaching aid.

The problems of reducing global inequalities, of protecting human rights, and of achieving a war-free world can be introduced into grade school courses in history, geography, religion and civics. The curriculum of these courses is frequently revised, and advocates of peace education can take curriculum revisions as opportunities to introduce much-needed reforms that will make the students more international in their outlook. The argument (a true one) should be that changes in the direction of peace education will make students better prepared for a future in which peace will be a central issue and in which they will interact with people of other nations to a much greater extent than was the case in previous generations. The same can be said for curriculum revisions at the university level.

Large nations compared with global government

The problem of achieving internal peace over a large geographical area is not insoluble. It has already been solved. There exist today many nations or regions within each of which there is internal peace, and some of these are so large that they are almost worlds in themselves. One thinks of China, India, Brazil, Australia, the Russian Federation, the United States, and the European Union. Many of these enormous societies contain a variety of ethnic groups, a variety of religions and a variety of languages, as well as striking contrasts between wealth and poverty. If these great land areas have been forged into peaceful and cooperative societies, cannot the same methods of government be applied globally?

But what are the methods that nations use to achieve internal peace? Firstly, every true government needs to have the power to make and enforce laws that are binding on individual citizens. Secondly the power of taxation is a necessity. These two requirements of every true government have already been mentioned; but there is a third point that still remains to be discussed:

Within their own territories, almost all nations have more military power than any of their subunits. For example, the US Army is more powerful than the State Militia of

¹⁰Negative peace is merely the absence of war. In positive peace, neighboring nations are actively engaged in common projects of mutual benefit, in cultural exchanges, in trade, in exchanges of students and so on.

Illinois. This unbalance of power contributes to the stability of the Federal Government of the United States. When the FBI wanted to arrest Al Capone, it did not have to bomb Chicago. Agents just went into the city and arrested the gangster. Even if Capone had been enormously popular in Illinois, the government of the state would have realized in advance that it had no chance of resisting the US Federal Government, and it still would have allowed the “Feds” to make their arrest. Similar considerations hold for almost all nations within which there is internal peace. It is true that there are some nations within which subnational groups have more power than the national government, but these are frequently characterized by civil wars.

Of the large land areas within which internal peace has been achieved, the European Union differs from the others because its member states still maintain powerful armies. The EU forms a realistic model for what can be achieved globally in the near future by reforming and strengthening the United Nations. In the distant future, however, we can imagine a time when a world federal authority will have much more power than any of its member states, and when national armies will have only the size needed to maintain local order.

Today there is a pressing need to enlarge the size of the political unit from the nation-state to the entire world. The need to do so results from the terrible dangers of modern weapons and from global economic interdependence. The progress of science has created this need, but science has also given us the means to enlarge the political unit: Our almost miraculous modern communications media, if properly used, have the power to weld all of humankind into a single supportive and cooperative society.

Culture, education and human solidarity

Cultural and educational activities have a small ecological footprint, and therefore are more sustainable than pollution-producing, fossil-fuel-using jobs in industry. Furthermore, since culture and knowledge are shared among all nations, work in culture and education leads societies naturally towards internationalism and peace.

Economies based on a high level of consumption of material goods are unsustainable and will have to be abandoned by a future world that renounces the use of fossil fuels in order to avoid catastrophic climate change, a world where non-renewable resources such as metals will become increasingly rare and expensive. How then can full employment be maintained?

The creation of renewable energy infrastructure will provide work for a large number of people; but in addition, sustainable economies of the future will need to shift many workers from jobs in industry to jobs in the service sector. Within the service sector, jobs in culture and education are particularly valuable because they will help to avoid the disastrous wars that are currently producing enormous human suffering and millions of refugees, wars that threaten to escalate into an all-destroying global thermonuclear war.¹¹

¹¹<http://www.fredsakademiet.dk/library/need.pdf>
<http://eruditio.worldacademy.org/issue-5/article/urgent-need-renewable-energy>



Figure 6.21: Cultural exchanges lead to human solidarity (Public domain)

Human nature has two sides: It has a dark side, to which nationalism and militarism appeal; but our species also has a genius for cooperation, which we can see in the growth of culture. Our modern civilization has been built up by means of a worldwide exchange of ideas and inventions. It is built on the achievements of many ancient cultures. China, Japan, India, Mesopotamia, Egypt, Greece, the Islamic world, Christian Europe, and the Jewish intellectual traditions all have contributed. Potatoes, corn, squash, vanilla, chocolate, chilli peppers, and quinine are gifts from the American Indians.¹²

We need to reform our educational systems, particularly the teaching of history. As it is taught today, history is a chronicle of power struggles and war, told from a biased national standpoint. We are taught that our own country is always heroic and in the right. We urgently need to replace this indoctrination in chauvinism by a reformed view of history, where the slow development of human culture is described, giving credit to all who have contributed. When we teach history, it should not be about power struggles. It should be about how human culture was gradually built up over thousands of years by the patient work of millions of hands and minds. Our common global culture, the music, science, literature and art that all of us share, should be presented as a precious heritage - far too precious to be risked in a thermonuclear war.

We have to extend our loyalty to the whole of the human race, and to work for a world not only free from nuclear weapons, but free from war. A war-free world is not utopian but very practical, and not only practical but necessary. It is something that we can achieve and must achieve. Today there are large regions, such as the European Union, where war would be inconceivable. What is needed is to extend these.

Nor is a truly sustainable economic system utopian or impossible. To achieve it, we

¹²<http://eruditio.worldacademy.org/article/evolution-cooperation>

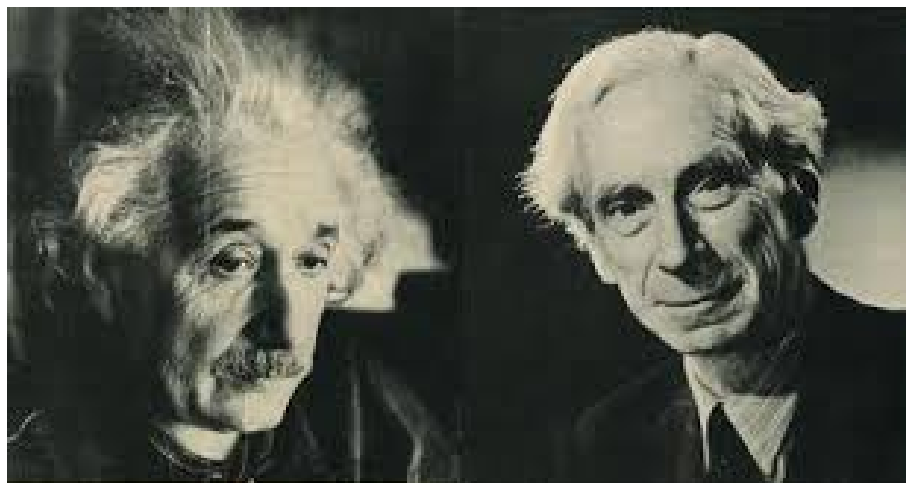


Figure 6.22: **The Russell-Einstein Manifesto: “Shall we put an end to the human race, or shall mankind renounce war?”** (Pugwash Conferences)

should begin by shifting jobs to the creation of renewable energy infrastructure, and to the fields of culture and education. By so doing we will support human solidarity and avoid the twin disasters of catastrophic war and climate change.

The Danish National Group of Pugwash Conferences on Science and World Affairs

In March, 1954, the US tested a hydrogen bomb at the Bikini Atoll in the Pacific Ocean. It was 1000 times more powerful than the Hiroshima bomb. The Japanese fishing boat, Lucky Dragon, was 130 kilometers from the Bikini explosion, but radioactive fallout from the test killed one crew member and made all the others seriously ill.

Concerned about the effects of a large-scale war fought with such bombs, or even larger ones, Albert Einstein and Bertrand Russell published a manifesto containing the words: “Here then is the problem that we present to you, stark and dreadful and inescapable: Shall we put an end to the human race, or shall mankind renounce war?... There lies before us, if we choose, continual progress in happiness, knowledge and wisdom. Shall we, instead, choose death because we cannot forget our quarrels? We appeal as human beings to human beings: Remember your humanity, and forget the rest. If you can do so, the way lies open to a new Paradise; if you cannot, there lies before you the risk of universal death.”

The Russell-Einstein Manifesto called for a meeting of scientists from both sides of the Cold War to try to minimize the danger of a thermonuclear conflict. The first meeting took place in 1957 at the summer home of the Canadian philanthropist Cyrus Eaton at the small village of Pugwash, Nova Scotia.

From this small beginning, a series of conferences developed, in which scientists, especially physicists, attempted to work for peace, and tried to address urgent problems

related to science. These conferences were called Pugwash Conferences on Science and World Affairs, taking their name from the small village in Nova Scotia where the first meeting was held. From the start, the main aim of the meetings was to reduce the danger that civilization would be destroyed in a thermonuclear war.

Many countries have local Pugwash groups, and the Danish National Pugwash Group is one of these. Our activities include conferences at the Danish Parliament, aimed at influencing decision-makers, but other activities are aimed influencing public opinion. Peace education activities include the award of student peace prizes on United Nations Day.

United Nations Day Student Peace Prizes

In collaboration with the Danish Peace Academy, and with the help of the Hermod Lannung Foundation the Danish National Group of Pugwash Conferences on Science and World Affairs has offered prizes each year to students at 10 Danish gymnasiums for projects related to global problems and their solutions and to the United Nations.

These projects are essays, dramatic sketches, videos, websites, posters, etc., and they were judged on UN Day, before large audiences of students. The background for this project is as follows: In 2007, in collaboration with several other NGO's, we arranged a visit to Copenhagen by Dr. Tadatoshi Akiba, the Mayor of Hiroshima. In connection with his visit, we arranged a Peace Education Conference at the University of Copenhagen.

In connection with Dr. Akiba's visit, we also arranged a day of peace education at Copenhagen's Open Gymnasium. About 15 people from various branches of Denmark's peace movement arrived at the gymnasium at 7.00 a.m., and between 8.00 and 10.00 they talked to 15 groups of about 25-50 students about topics related to peace. At 10.30, all 500 students assembled in a large hall, where Dr. Akiba gave an address on abolition of nuclear weapons. A chorus from the gymnasium sang, and finally there was a panel discussion.

The students were extremely enthusiastic about the whole program. The success of our 2007 effort made us want to do something similar in 2008, and perhaps to broaden the scope. Therefore we wrote to the Minister of Education, and proposed that October 24, United Nations Day, should be a theme day in all Danish schools and gymnasiums, a day devoted to the discussion of global problems and their solutions. We received the very kind reply. The Minister said that he thought our idea was a good one, but that he did not have the power to dictate the curricula to schools. We needed to contact the individual schools, gymnasiums and municipalities.

In the autumn of 2008 we arranged a United Nations Day program on October 24 at Sankt Annæ Gymnasium with the cooperation of Nørre Gymnasium. We offered prizes to drama students at the two gymnasiums for the best peace-related dramatic sketch, a condition being that the sketches should be performed and judged before a large audience. Our judges were the famous actress Mia Luhne, Johan Olsen, the lead singer of a popular rock group, and the dramatist Steen Haakon Hansen. The students' sketches and the judges speeches about the meaning of peace were very strong and moving. Everyone was very enthusiastic about the day. The judges have said that they would be willing to work with us again on peace-related cultural events.



Figure 6.23: **A painting representing the work of the United Nations. It won first prize at a UN Day Student Peace Prize competition.** (Danish National Pugwash Group)

Our successes in 2007 and 2008 have made us wish to continue and possibly expand the idea of making United Nations Day a theme day in Danish schools and gymnasiums, a day for discussion of global problems and their solutions, with special emphasis on the role of the United Nations. The Hermod Lannung Foundation supported our project for extending this idea to 10 Danish gymnasiums from 2010 until the present.

The Grundtvigian Peoples' Colleges

A unique feature of the Danish educational system is the adult education that is available at about a hundred Folkehøjskole (Peoples' Colleges). This tradition of adult education dates back to the Danish poet-bishop N.F.S. Grundtvig (1783-1872). Besides writing more than half of the hymns presently used in Danish churches, Grundtvig also introduced farmers' cooperatives into Denmark and founded a system of adult education.

At the time when Grundtvig lived, the Industrial Revolution had already transformed England into a country that exported manufactured goods but was unable to feed itself because of its large population. In this situation, Denmark began a prosperous trade, exporting high quality agricultural produce to England (for example dairy products, bacon, and so on). Grundtvig realized that it would be to the advantage of small-scale Danish farmers to process and export these products themselves, thus avoiding losing a part of their profits to large land-owners or other middlemen who might do the processing and exporting for them. He organized the small farmers into cooperatives, and in order to give

the farmers enough knowledge and confidence to run the cooperatives, Grundtvig created a system of adult education: the Peoples' Colleges. The cooperatives and the adult education system contributed strongly to making Denmark a prosperous and democratic country.

Of the hundred or so Grundtvigian Peoples' Colleges existing today, about forty offer peace education as a subject. An example of such a peace education course was the two-week summer school "Towards a Non-violent Society", held at the International College in Elsinore during the summer of 1985. Since it was supported not only by the students' fees but also by a government subsidy, the summer school was able to pay the travel and living expenses for lecturers who came from many parts of the world.

Among the stars of the summer school were former US Governor Harold Stassen, the only living person who had signed the UN Charter; the famous Cambridge University ethologist, Professor Robert Hinde; Professor Suman Khana from India, an expert on non-violence and Gandhi; Sister George, a Catholic nun from Jerusalem, who spoke 12 languages during the course of her daily work and who was an expert on the conflicts of the Middle East; and Meta Ditzel, a member of the Danish Parliament who advocated legislation to make excessively violent videos less easily available to children. Other lectures were given by representatives of Amnesty International and the Center for Rehabilitation of Torture Victims.

In discussing Danish peace education initiatives, we must not fail to mention Holger Terp's enormous and popular Danish Peace Academy website¹³. Despite serious health problems, which include almost complete loss of vision and multiple heart bypass operations, Holger Terp singlehandedly established a unique website devoted to peace education. The Danish Peace Academy website contains more than 99,000 files in Danish, English and German. The website is visited by many thousands of students from around the world.

The World Conference of Religions for Peace

Other powerful voices for peace have been raised by the World Conference of Religions for Peace, which met for the first time in October 1970 in Kyoto, Japan.¹⁴ At this meeting, more than 1000 religious leaders gathered to discuss the grave dangers posed by modern war. Among them were representatives of the Baha'i, Mahayana and Trevida Buddhists, Protestants, Roman Catholics, Orthodox Christians, Confucians, representatives of several streams of Hinduism, a number of communities of indigenous faith, Shiite and Sunni Muslims, Jains, Reform Jews, Shintos, Sikhs, Zoroastrians, and representatives of a number of new religions.

The WCRP sponsors many projects related to conflict resolution, the world's children, development, disarmament and security, human rights, and peace education. For example, in the field of peace education, WCRP sponsors a project in Israel called "Common Values/Different Sources" which brings together Jews, Muslims and Christians to study sacred

¹³www.fredsakademiet.dk

¹⁴Subsequent World Assemblies of the WCRP have been held in Louvain, Belgium, (1974); Princeton New Jersey, (1979); Nairobi, Kenya, (1984); Melbourne, Australia, (1989); Riva del Garde, Italy, (1994); and Amman, Jordan, (1999).

texts together in search of shared values, eventually resulting in a book for classroom use. In England and Germany, another WCRP project analyzes school textbooks' treatment of religious traditions that are foreign to the books' intended audiences.

Dr. Edy Korthals Altes, a former Ambassador of the Netherlands to Poland and Spain and an Honorary President of the World Conference of Religions for Peace, has expressed his vision of our current global situation in the following words: "We need a new concept of security. The old concept dates back to the Romans who said 'If you want peace, prepare for war.' The new concept I would propose is exactly the opposite, 'If you want peace, prepare for peace.' While this may sound simplistic, it is difficult to put into practice since the application of justice and solidarity in international political and economic relations requires sacrifices from 'those who have.' I would give three reasons why the old concept of 'security' is no longer valid: a) The extreme vulnerability of modern society; b) The tremendous destructive power of modern arms and terrorism; c) The interdependence between nations. These three elements are closely interconnected. It is therefore imperative to apply justice and solidarity in our international relations. If not, disaster looms!"

Dr. Altes feels that economic reforms are needed if global peace is to be achieved. "Not only economic justice is involved", he writes, "but also political justice. A clear example of which is the current situation in the Middle East. There must also be justice in the economic world situation in which 1/5 of the world population enjoys a high standard of living while 1/5 lives in terrible poverty, millions dying every year from hunger. This 'North South gap' is increasing!"

Discussing "myths that underlie our present economic system", he points to

1. "The notion that each person has unlimited material needs. We are told to 'consume more' which is totally contrary to any religion. What is more, it is a self-defeating program that is contrary to humanity in general. The New Testament is clear 'you shall not live on bread alone.' Our deeper needs are not for material goods but for inner growth."
2. "Unlimited growth. The economy, my firm, my salary should all grow. In a finite planet, this is total nonsense. This maxim of growth has brought about great ecological damage."
3. Idolatry of the Free Market. I am in favor of a free market, but one that is set in the context of social and human conditions. We need to apply means to avoid the 'law of the jungle' in the market place."

No enumeration of religious voices raised in the cause of peace would be complete without mention of the Religious Society of Friends (Quakers), all of whom refuse to give any support whatever to the institution of war. Although they are fundamentally opposed to war as being completely contrary to Christian ethics, the Quakers are active in caring for the victims of war, and in 1947 the American Friends Service Committee and the Friends Service Council were jointly awarded the Nobel Peace Prize.

The non-violence of Mahatma Gandhi, Martin Luther King and Nelson Mandela, the writings of the Dalai Lama, the messages of Pope John Paul II and other popes, the

anti-war convictions of the Quakers, and the many projects of the World Conference of Religions for Peace all illustrate the potentialities of the world's religions as powerful forces for mobilizing public opinion in the cause of peace. One hopes that the voice of religion in this cause will become still more powerful in the future. Each week, all over the world, congregations assemble and are addressed by their leaders on ethical issues. But all too often there is no mention of the astonishing and shameful contradiction between the institution of war (especially the doctrine of "massive retaliation"), and the principle of universal human brotherhood, loving and forgiving one's enemies, and returning good for evil. At a moment of history when the continued survival of civilization is in doubt because of the incompatibility of war with the existence of thermonuclear weapons, our religious leaders ought to use their enormous influence to help to solve the problem of war, which is after all an ethical problem. In this way, religion can become part of the cure of a mortal social illness rather than part of the disease - part of the answer rather than of part of the problem.

The Hiroshima Peace Committee and the last remaining hibakushas

In Japanese the survivors of injuries from the nuclear bombing of Hiroshima and Nagasaki are called "hibakushas". Over the years, the Soka Gakkai Hiroshima Peace Committee has published many books containing their testimonies. The most recent of these books, "A Silence Broken", contains the testimonies of 14 men, now all in their late 70's or in their 80's, who are among the last few remaining hibakushas. All 14 of these men have kept silent until now because of the prejudices against hibakushas in Japan, where they and their children are thought to be unsuitable as marriage partners because of the effects of radiation. But now, for various reasons, they have chosen to break their silence. Many have chosen to speak now because of the Fukushima disaster.

The testimonies of the hibakushas give a vivid picture of the hell-like horrors of the nuclear attack on the civilian population of Hiroshima, both in the short term and in the long term. For example, Shigeru Nonoyama, who was 15 at the time of the attack, says: "People crawling out from crumbled houses started to flee. We decided to escape to a safe place on the hill. We saw people with melted ears stuck to their cheeks, chins glued to their shoulders, heads facing in awkward positions, arms stuck to bodies, five fingers joined together and grab nothing. Those were the people fleeing. Not merely a hundred or two, The whole town was in chaos."

"I saw the noodle shop's wife leg was caught under a fallen pole, and a fire was approaching. She was screaming, 'Help me! Help me!' There were no soldiers, no firefighters. I later heard that her husband had cut off his wife's leg with a hatchet to save her."

"Each and every scene was hell itself. I couldn't tell the difference between the men and the women. Everybody had scorched hair, burned hair, and terrible burns. I thought I saw a doll floating in a fire cistern, but it was a baby. A wife trapped under her fallen house was crying, 'Dear, please help me, help me!' Her husband had no choice but to leave her in tears."

The Catholic Church

An outstanding example of religious leadership in addressing global problems was given by H.H. Pope John Paul II. In his Christmas address on 25 December, 2002, the Pope said that efforts for peace were urgently needed “in the Middle East, to extinguish the ominous smouldering of a conflict which, with the joint efforts of all, can be avoided.”

Pope John Paul II was not an exception among the Roman Catholic Popes of the 20th century. All of them have spoken strongly against the institution of war. Especially notable are H.H. Pope Paul IV who made a one-day visit to the United Nations where his speech included the words “no more war, war never again”, and H.H. Pope John XXIII, author of the eloquent encyclical, *Pacem in Terris*. One can think also of the Ecumenical Council Vatican II, which denounced the arms race as an “utterly treacherous trap for humanity”, questioned the method of deterrence as a safe way to preserve a steady peace, and condemned war as a “crime against God and man himself”.

In his Apostolic Exhortation, “*Evangelii Gaudium*”, Pope Francis said: “In our time humanity is experiencing a turning-point in its history, as we can see from the advances being made in so many fields. We can only praise the steps being taken to improve people’s welfare in areas such as health care, education and communications. At the same time we have to remember that the majority of our contemporaries are barely living from day to day, with dire consequences. A number of diseases are spreading. The hearts of many people are gripped by fear and desperation, even in the so-called rich countries. The joy of living frequently fades, lack of respect for others and violence are on the rise, and inequality is increasingly evident. It is a struggle to live and, often, to live with precious little dignity.”

“This epochal change has been set in motion by the enormous qualitative, quantitative, rapid and cumulative advances occurring in the sciences and in technology, and by their instant application in different areas of nature and of life. We are in an age of knowledge and information, which has led to new and often anonymous kinds of power.”

“Just as the commandment ‘Thou shalt not kill’ sets a clear limit in order to safeguard the value of human life, today we also have to say ‘thou shalt not’ to an economy of exclusion and inequality. Such an economy kills. How can it be that it is not a news item when an elderly homeless person dies of exposure, but it is news when the stock market loses two points? This is a case of exclusion. Can we continue to stand by when food is thrown away while people are starving? This is a case of inequality. Today everything comes under the laws of competition and the survival of the fittest, where the powerful feed upon the powerless. As a consequence, masses of people find themselves excluded and marginalized: without work, without possibilities, without any means of escape.”

“In this context, some people continue to defend trickle-down theories which assume that economic growth, encouraged by a free market, will inevitably succeed in bringing about greater justice and inclusiveness in the world. This opinion, which has never been confirmed by the facts, expresses a crude and naive trust in the goodness of those wielding economic power and in the sacralized workings of the prevailing economic system. Meanwhile, the excluded are still waiting.”

The Dalai Lama

In his excellent and highly readable book, *Ancient Wisdom, Modern World: Ethics for the New Millennium*, the Dalai Lama writes: “..At present and for the conceivable future, the UN is the only global institution capable of influencing and formulating policy on behalf of the international community. Of course, many people criticize it on the grounds that it is ineffective, and it is true that time and again we have seen its resolutions ignored, abandoned and forgotten. Nevertheless, in spite of its shortcomings, I for one continue to have the highest regard not only for the principles on which it was founded but also for the great deal that it has achieved since its inception in 1945. We need only ask ourselves whether or not it has helped to save lives by defusing potentially dangerous situations to see that it is more than the toothless bureaucracy some people say it is. We should also consider the great work of its subsidiary organizations, such as UNICEF, United Nations High Commission for Refugees, UNESCO and the World Health Organization...”

“I see the UN, developed to its full potential, as being the proper vehicle for carrying out the wishes of humanity as a whole. As yet it is not able to do this very effectively, but we are only just beginning to see the emergence of a global consciousness (which is made possible by the communications revolution). And in spite of tremendous difficulties, we have seen it in action in numerous parts of the world, even though at the moment there may be only one or two nations spearheading these initiatives. The fact that they are seeking the legitimacy conferred by a United Nations mandate suggests a felt need for justification through collective approbation. This, in turn, I believe to be indicative of a growing sense of a single, mutually dependent, human community.”

Unfulfilled responsibilities of the mainstream media

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 in general their role is not only unhelpful - it is often negative. War and conflict are blatantly advertised by television and newspapers. Meanwhile the peace movement has almost no access to the mainstream media.

Today we are faced with the task of creating a new global ethic in which loyalty to family, religion and nation will be supplemented by a higher loyalty to humanity as a whole. In case of conflicts, loyalty to humanity as a whole must take precedence. In addition, our present culture of violence must be replaced by a culture of peace. To achieve these essential goals, we urgently need the cooperation of the mass media.

The predicament of humanity today has been called “a race between education and catastrophe”: Human emotions have not changed much during the last 40,000 years, and human nature still contains an element of tribalism to which nationalistic politicians successfully appeal. The completely sovereign nation-state is still the basis of our global political system. The danger in this situation is due to the fact that modern science has given us incredibly destructive weapons. Because of these weapons, the tribal tendencies in human nature and the politically fragmented structure of our world have both become dangerous anachronisms.

After the tragedies of Hiroshima and Nagasaki, Albert Einstein said, “The unleashed power of the atom has changed everything except our way of thinking, and thus we drift towards unparalleled catastrophes.” We have to learn to think in a new way. Will we learn this in time to prevent disaster? When we consider the almost miraculous power of our modern electronic media, we can be optimistic. Cannot our marvelous global communication network be used to change anachronistic ways of thought and anachronistic social and political institutions in time, so that the system will not self-destruct as science and technology revolutionize our world? If they were properly used, our instantaneous global communications could give us hope.

The success of our species is built on cultural evolution, the central element of which is cooperation. Thus human nature has two sides, tribal emotions are present, but they are balanced by the human genius for cooperation. The case of Scandinavia - once war-torn, now cooperative - shows that education is able to bring out either the kind and cooperative side of human nature, or the xenophobic and violent side. Which of these shall it be? It is up to our educational systems to decide, and the mass media are an extremely important part of education. Hence the great responsibility that is now in the hands of the media.

How do the media fulfill 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 need for strengthening the United Nations, and the ways that it could be strengthened? 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 the military-industrial complex and other powerful lobbys. Do they present us with the need for a just system of international law that acts on individuals? On the whole, the subject is neglected. Do they tell of of the essentially genocidal nature of nuclear weapons, and the need for their complete abolition? 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 35 or 45 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 and environmental catastrophes. The television viewer sits slumped in a chair, passive, isolated, disempowered and stupefied. The future of the world hangs in the bal-

ance, the fate of children and grandchildren hang 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.

The alternative media

Luckily, there are alternatives to the mainstream media, available primarily on the Internet, but also to a certain extent on radio and television and in films. One can think of such alternative media figures as Thom Hartmann, Leonardo DiCaprio, Amy Goodman and Oliver Stone, or Internet sites such as Common Dreams, EcoWatch, Truthout, Countercurrents, the Danish Peace Academy website and TMS Weekly Digest. Interestingly, Bob Dylan, a longtime counterculture hero, has recently been awarded the Nobel Prize in Literature.

Johan Galtung

One of the founders of Peace Studies and Conflict Resolution as academic disciplines, is Professor Johan Galtung (1930 -). He is the author of more than a thousand articles and over a hundred books in these fields. He was also the main founder of the Peace Research Institute Oslo in 1959, and he served as its first director until 1970. Prof. Galtung established the *Journal of Peace Research* in 1964. A few years later, in 1969, he was appointed to the world's first chair in peace and conflict studies at the University of Oslo. Dr. Jan Øberg, a student of Prof. Galtung, went on to found the influential Transnational Foundation for Peace and Future Research in Lund, Sweden.

Universities Offering Peace Studies Degrees

Among the American universities and colleges offering degrees in Peace Studies and Conflict Resolution¹⁵, one can mention the University of Notre Dame, the University of California, Berkeley, Georgetown University, Swarthmore College, Tufts University, Wellesley College, the University of North Carolina at Chapel Hill, Colgate University, Brandeis University, the University of Texas at Austin, George Washington University, DePauw University, Smith College, Syracuse University, Southern Methodist University, Saint Johns University, American University, Marquette University, College of Saint Benedict, University of San Diego, Creighton University, Willamette University, University of Denver, Duquesne University, John Carroll University, Earlham College, George Mason University, Juniata College, University of Utah and Manhattan College. A degree program in Peace Studies is also offered by Clark University¹⁶.

¹⁵<http://colleges.startclass.com/d/o/Peace-Studies-and-Conflict-Resolution>

¹⁶<https://www2.clarku.edu/departments/peacestudies/gradprograms.cfm>

In Costa Rica, the University for Peace (UPEACE)¹⁷ offers a wide variety of courses. The departments of UPEACE include Environment and Development, International Law and Human Rights, and Peace and Conflict Studies. UPEACE also offers online education¹⁸.

The many educational institutions founded by Soka Gakkai International offer courses in peace studies. Among these are Soka University Japan, the Toda Institute for Global Peace, and Soka University of America.

Masters courses in peace studies and conflict resolution¹⁹ are also offered at Universitat Oberta de Catalunya, University of Malta, Durham University, Trinity College Dublin, Alice Salomon University of Applied Sciences Berlin, University of Nicosia, Australian National University, Middlebury Institute of International Studies at Monterey, Swansea University, Aarhus University, Utrecht University, University of Kent, CIFE, University of Technology Sydney, University of Bridgeport, Duquesne University, SOAS University of London, Chapman University, SIT Graduate Institute, Kings College London, Goethe University Frankfurt, Joan B. Kroc School of Peace Studies, Johns Hopkins University School of Advanced International Studies, University of Bradford Faculty of Social and International Studies, and University of East Anglia Faculty of Social Sciences.

Jakob von Uexküll and The World Future Council

Jakob von Uexküll belongs to a brilliant family. His grandfather was a famous Baltic-German physiologist who founded the discipline of Biosemiotics. Besides being a former Member of the European Parliament and a leader of the German Green Party, von Uexküll himself founded both the Right Livelihood Award (sometimes called the Alternative Nobel Prize) and also the World Future Council.²⁰ Here are a few excerpts from one of his speeches to the WFC:

“Today we are heading for unprecedented dangers and conflicts, up to and including the end of a habitable planet in the foreseeable future, depriving all future generations of their right to life and the lives of preceding generations of meaning and purpose.”

“This apocalyptic reality is the elephant in the room. Current policies threaten temperature increases triggering permafrost melting and the release of ocean methane hydrates which would make our earth unliveable, according to research presented by the British Government Met office at the Paris Climate Conference.”

“The myth that climate change is conspiracy to reduce freedom is spread by a powerful and greedy elite which has largely captured governments to preserve their privileges in an increasingly unequal world.”

¹⁷<https://www.upeace.org/academic/academic-departments/peace-and-conflict-studies/peace-education>

¹⁸<http://www.elearning.upeace.org/>

¹⁹<http://www.masterstudies.com/Masters-Degree/Political-Science/Peace-and-Conflict-Studies/>

²⁰<http://www.rightlivelihood.org/>

<http://www.worldfuturecouncil.org/>

<http://www.worldfuturecouncil.org/gpact/>

“Long before that point, our prosperity, security, culture and identity will disintegrate. A Europe unable to cope with a few million war refugees will collapse under the weight of tens or even hundreds of millions of climate refugees.”

Some of the major organizations in the peace movement

Among the many organizations working actively for peace education, one can think of the following:²¹

- **The Nuclear Age Peace Foundation**
- **The International Peace Bureau**
- **International Physicians for the Prevention of Nuclear War**
- **Greenpeace**
- **Pugwash Conferences on Science and World Affairs**
- **Global Zero**
- **Abolition 2000**
- **Mayors for Peace**
- **International Campaign to Abolish Nuclear Weapons (ICAN)**
- **World Association of World Federalists**
- **Campaign for Nuclear Disarmament**
- **Pax Christi**
- **American Friends Service Committee**
- **The Society of Prayer for World Peace**
- **The Danish Peace Academy**
- **International Network of Engineers and Scientists for Global Responsibility (INES)**
- **War Resisters International**
- **Stockholm International Peace Research Institute (SIPRI)**
- **Peace Research Institute, Oslo**
- **Soka Gakkai International (SGI)**
- **Hiroshima Peace Memorial Museum**
- **Transcend International**
- **Transnational Foundation for Peace and Future Research (TFF)**
- **Gandhi International Institute of Peace**
- **Bertrand Russell Peace Foundation**
- **Lawyers’ Committee on Nuclear Policy**
- **Parliamentarians for Nuclear Nonproliferation and Disarmament**
- **Nuclear Abolition Forum**
- **Code Pink**
- **Jewish Voice for Peace**
- **Women’s International League for Peace and Freedom**
- **World Beyond War**

²¹The list is in no particular order, and is by no means complete

- Global Security Institute
- The Council of Canadians
- International Fellowship of Reconciliation
- Physicians for Social Responsibility
- Anglican Pacifist Fellowship
- Institute for Economics and Peace
- Veterans Against War
- The Elders
- Nobel Women's Initiative
- Peace Pledge Union
- United Nations Integrated Peacebuilding Office
- The Committee for a Sane Nuclear Policy
- Seeds of Peace
- Middle Powers Initiative

Suggestions for further reading

1. EA (2017a) *World Energy Balances 2016*.
2. BP (2018) *Statistical Review of World Energy*.
3. Wilson, I.A.G. and Staffell, I. (2018). *Rapid fuel switching from coal to natural gas through effective carbon pricing*. *Nature Energy*, 3, 365-372.
4. Powering Past Coal Alliance (2018). *About*. <https://poweringpastcoal.org>
5. OECD (2018a) *OECD analysis of budgetary support and tax expenditures*. <http://www.oecd.org/site/>
6. OECD (2018b) *OECD Companion to the Inventory of Support Measures for Fossil Fuels 2018*.
7. IEA (2017a) *World Energy Balances 2016*.
8. BP (2018) *Statistical Review of World Energy*.
9. IRENA (2018) *Renewable Capacity Statistics*
10. Francesco Stipo, *World Federalist Manifesto. Guide to Political Globalization*, (April 10, 2007), pages 1, 3, 21 and 136.
11. Francesco Stipo, *United Nations Reorganization. The Unification of the UN System*, (April 21, 2007).
12. International Commission on Peace and Food, *Uncommon Opportunities: An Agenda for Peace and Equitable Development, 2nd Edition*, pages 43-46, (2004).
13. Alexander Hamilton, James Madison and John Jay, *The Federalist Papers*, (1787-1788), Project Gutenberg.
14. Edith Wynner, *World Federal Government in Maximum Terms: Proposals for United Nations Charter Revision*, Fedonat Press, Afton N.Y., (1954).
15. Grenville Clark and Louis B. Sohn, *World Peace Through World Law*, Harvard University Press, (1958).
16. Bertrand Russell, *Has Man A Future?*, Penguin, Hammondsworth, (1961).
17. Michael Klare, *Resource Wars: The New Landscape of Global Conflict* Owl Books, New York, (reprint edition 2002).
18. Michael Klare, *Rising Powers, Shrinking Planet: The New Geopolitics of Energy*, Henry Holt & Company, (2008).
19. Michael Klare, *The Race for What's Left: The Global Scramble for the World's Last Resources*, Metropolitan Books, (2012).
20. United Nations General Assembly, *Principles of International Law Recognized in the Charter of the Nürnberg Tribunal and in the Judgment of the Tribunal*, (1950).
21. Bengt Broms, *United Nations*, Suomalainen Tiedeakatemia, Helsinki, (1990).
22. S. Rosenne, *The Law and Practice at the International Court*, Dordrecht, (1985).
23. S. Rosenne, *The World Court - What It Is and How It Works*, Dordrecht, (1995).
24. J. D'Arcy and D. Harris, *The Procedural Aspects of International Law (Book Series), Volume 25*, Transnational Publishers, Ardsley, New York, (2001).
25. H. Cullen, *The Collective Complaints Mechanism Under the European Social Charter*, *European Law Review*, Human Rights Survey, p. 18-30, (2000).
26. S.D. Bailey, *The Procedure of the Security Council*, Oxford, (1988).
27. R.A. Akindale, *The Organization and Promotion of World Peace: A Study of Universal-Regional Relationships*, Univ. Toronto Press, Toronto, Ont., (1976).

28. J.S. Applegate, *The UN Peace Imperative*, Vantage Press, New York, (1992).
29. S.E. Atkins, *Arms Control, Disarmament, International Security and Peace: An Annotated Guide to Sources, 1980-1987*, Clio Press, Santa Barbara, CA, (1988).
30. N. Ball and T. Halevy, *Making Peace Work: The Role of the International Development Community*, Overseas Development Council, Washington DC, (1996).
31. F. Barnaby, Ed., *The Gaia Peace Atlas: Survival into the Third Millennium*, Doubleday, New York, (1988)
32. J.H. Barton, *The Politics of Peace: An Evaluation of Arms Control*, Stanford Univ. Press, Stanford, CA, (1981).
33. W. Bello, *Visions of a Warless World*, Friends Committee on National Education Fund, Washington DC, (1986).
34. A. Boserup and A. Mack, *Abolishing War: Cultures and Institutions; Dialogue with Peace Scholars Elise Boulding and Randall Forsberg*, Boston Research Center for the Twenty-first Century, Cambridge, MA, (1998).
35. E. Boulding et al., *Bibliography on World Conflict and Peace*, Westview Press, Boulder, CO, (1979).
36. E. Boulding et al., Eds., *Peace, Culture and Society: Transnational Research Dialogue*, Westview Press, Boulder, CO, (1991).
37. A. Gore, *An Inconvenient Truth: The Planetary Emergency of Global Warming and What We Can Do About It*, Rodale Books, New York, (2006).
38. A. Gore, *Earth in the Balance: Forging a New Common Purpose*, Earthscan, (1992).
39. A.H. Ehrlich and P.R. Ehrlich, *Earth*, Thames and Methuen, (1987).
40. P.R. Ehrlich and A.H. Ehrlich, *The Population Explosion*, Simon and Schuster, (1990).
41. P.R. Ehrlich and A.H. Ehrlich, *Healing the Planet: Strategies for Resolving the Environmental Crisis*, Addison-Wesley, (1991).
42. P.R. Ehrlich and A.H. Ehrlich, *Betrayal of Science and Reason: How Anti-Environmental Rhetoric Threatens our Future*, Island Press, (1998).
43. P.R. Ehrlich and A.H. Ehrlich, *One With Nineveh: Politics, Consumption and the Human Future*, Island Press, (2004).
44. 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).
45. D.H. Meadows et al., *Beyond the Limits. Confronting Global Collapse and Envisioning a Sustainable Future*, Chelsea Green Publishing, Post Mills, Vermont, (1992).
46. 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).
47. A. Peccei and D. Ikeda, *Before it is Too Late*, Kodansha International, Tokyo, (1984).
48. V.K. Smith, ed., *Scarcity and Growth Reconsidered*, Johns Hopkins University Press, Baltimore, (1979).
49. British Petroleum, *BP Statistical Review of World Energy*, (published yearly).
50. R. Costanza, ed., *Ecological Economics: The Science and Management of Sustainability*, Columbia University Press, New York, (1991).

51. J. Darmstadter, *A Global Energy Perspective*, Sustainable Development Issue Backgrounder, Resources for the Future, (2002).
52. D.C. Hall and J.V. Hall, *Concepts and Measures of Natural Resource Scarcity*, *Journal of Environmental Economics and Management*, **11**, 363-379, (1984).
53. 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).
54. IPCC, Intergovernmental Panel on Climate Change, *Climate Change 2001: The Scientific Basis*, (2001).
55. J.A. Krautkraemer, *Nonrenewable Resource Scarcity*, *Journal of Economic Literature*, bf 36, 2065-2107, (1998).
56. N. Stern et al., *The Stern Review*, www.sternreview.org.uk, (2006).
57. T.M. Swanson, ed., *The Economics and Ecology of Biodiversity Decline: The Forces Driving Global Change*, Cambridge University Press, (1995).
58. P.M. Vitousek, H.A. Mooney, J. Lubchenco and J.M. Melillo, *Human Domination of Earth's Ecosystems*, *Science*, **277**, 494-499, (1997).
59. World Resources Institute, *World Resources 200-2001: People and Ecosystems: The Fraying Web of Life*, WRI, Washington D.C., (2000).
60. A. Sampson, *The Seven Sisters: The Great Oil Companies of the World and How They Were Made*, Hodder and Staughton, London, (1988).
61. D. Yergin, *The Prize*, Simon and Schuster, New York, (1991).
62. M.B. Stoff, *Oil, War and American Security: The Search for a National Policy on Oil, 1941-1947*, Yale University Press, New Haven, (1980).
63. J. Stork, *Middle East Oil and the Energy Crisis*, Monthly Review, New York, (1976).
64. F. Benn, *Oil Diplomacy in the Twentieth Century*, St. Martin's Press, New York, (1986).
65. K. Roosevelt, *Countercoup: The Struggle for the Control of Iran*, McGraw-Hill, New York, (1979).
66. E. Abrahamian, *Iran Between Two Revolutions*, Princeton University Press, Princeton, (1982).
67. J.M. Blair, *The Control of Oil*, Random House, New York, (1976).
68. M.T. Klare, *Resource Wars: The New Landscape of Global Conflict*, Owl Books reprint edition, New York, (2002).
69. H. Mejcher, *Imperial Quest for Oil: Iraq, 1910-1928*, Ithaca Books, London, (1976).
70. P. Sluglett, *Britain in Iraq, 1914-1932*, Ithaca Press, London, (1976).
71. D.E. Omissi, *British Air Power and Colonial Control in Iraq, 1920-1925*, Manchester University Press, Manchester, (1990).
72. V.G. Kiernan, *Colonial Empires and Armies, 1815-1960*, Sutton, Stroud, (1998).
73. R. Solh, *Britain's 2 Wars With Iraq*, Ithaca Press, Reading, (1996).
74. 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).

75. 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).
76. 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).
77. 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).
78. L.F. Ivanhoe, *Oil Discovery Indices and Projected Discoveries*, Oil and Gas Journal, **11**, 19, (1984).
79. L.F. Ivanhoe, *Future Crude Oil Supplies and Prices*, Oil and Gas Journal, July 25, 111-112, (1988).
80. L.F. Ivanhoe, *Updated Hubbert Curves Analyze World Oil Supply*, World Oil, November, 91-94, (1996).
81. L.F. Ivanhoe, *Get Ready for Another Oil Shock!*, The Futurist, January-February, 20-23, (1997).
82. Energy Information Administration, *International Energy Outlook, 2001*, US Department of Energy, (2001).
83. Energy Information Administration, *Caspian Sea Region*, US Department of Energy, (2001).
84. National Energy Policy Development Group, *National Energy Policy*, The White House, (2004). (<http://www.whitehouse.gov/energy/>)
85. 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).
86. IEA, *CO2 from Fuel Combustion Fact-Sheet*, International Energy Agency, (2005).
87. H. Youguo, *China's Coal Demand Outlook for 2020 and Analysis of Coal Supply Capacity*, International Energy Agency, (2003).
88. R.H. Williams, *Advanced Energy Supply Technologies*, in *World Energy Assessment: Energy and the Challenge of Sustainability*, UNDP, (2000).
89. H. Lehmann, *Energy Rich Japan*, Institute for Sustainable Solutions and Innovations, Achen, (2003).
90. D. King, *Climate Change Science: Adapt, Mitigate or Ignore*, Science, **303** (5655), pp. 176-177, (2004).
91. S. Connor, *Global Warming Past Point of No Return*, The Independent, (116 September, 2005).
92. D. Rind, *Drying Out the Tropics*, New Scientist (6 May, 1995).
93. J. Patz et al., *Impact of Regional Climate Change on Human Health*, Nature, (17 November, 2005).
94. M. McCarthy, *China Crisis: Threat to the Global Environment*, The Independent, (19 October, 2005).
95. L.R. Brown, *The Twenty-Ninth Day*, W.W. Norton, New York, (1978).

96. W.V. Chandler, *Materials Recycling: The Virtue of Necessity*, Worldwatch Paper 56, Worldwatch Institute, Washington D.C, (1983).
97. W.C. Clark and others, *Managing Planet Earth*, Special Issue, *Scientific American*, September, (1989).
98. B. Commoner, *The Closing Circle: Nature, Man and Technology*, Bantam Books, New York, (1972).
99. C. Flavin, *Slowing Global Warming: A Worldwide Strategy*, Worldwatch Paper 91, Worldwatch Institute, Washington D.C., (1989).
100. J.R. Frisch, *Energy 2000-2020: World Prospects and Regional Stresses*, World Energy Conference, Graham and Trotman, (1983).
101. 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).
102. J. Holdren and P. Herrera, *Energy*, Sierra Club Books, New York, (1971).
103. N. Myers, *The Sinking Ark*, Pergamon, New York, (1972).
104. National Academy of Sciences, *Energy and Climate*, NAS, Washington D.C., (1977).
105. W. Ophuls, *Ecology and the Politics of Scarcity*, W.H. Freeman, San Francisco, (1977).
106. A. Peccei, *The Human Quality*, Pergamon Press, Oxford, (1977).
107. A. Peccei, *One Hundred Pages for the Future*, Pergamon Press, New York, (1977).
108. E. Pestel, *Beyond the Limits to Growth*, Universe Books, New York, (1989).
109. C. Pollock, *Mining Urban Wastes: The Potential for Recycling*, Worldwatch Paper 76, Worldwatch Institute, Washington D.C., (1987).
110. S.H. Schneider, *The Genesis Strategy: Climate and Global Survival*, Plenum Press, (1976).
111. 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).
112. World Resources Institute, *World Resources*, Oxford University Press, New York, (published annually).
113. J.E. Young, John E., *Mining the Earth*, Worldwatch Paper 109, Worldwatch Institute, Washington D.C., (1992).
114. J.R. Craig, D.J. Vaughan and B.J. Skinner, *Resources of the Earth: Origin, Use and Environmental Impact, Third Edition*, Prentice Hall, (2001).
115. W. Youngquist, *Geodesinies: The Inevitable Control of Earth Resources Over Nations and Individuals*, National Book Company, Portland Oregon, (1997).
116. M. Tanzer, *The Race for Resources. Continuing Struggles Over Minerals and Fuels*, Monthly Review Press, New York, (1980).
117. C.B. Reed, *Fuels, Minerals and Human Survival*, Ann Arbor Science Publishers Inc., Ann Arbor Michigan, (1975).
118. A.A. Bartlett, *Forgotten Fundamentals of the Energy Crisis*, American Journal of Physics, **46**, 876-888, (1978).
119. N. Gall, *We are Living Off Our Capital*, Forbes, September, (1986).
120. J.H. Bodley, *Cultural Anthropology: Tribes, States, and the Global System, 3rd ed.*, Mayfield, Mountain View, CA, (2000).

121. K. Raaflaub and N. Rosenstein, eds., *War and Society in the Ancient and Medieval Worlds*, Harvard University Press and Center for Hellenic Studies, (1999).
122. Elie Kedourie, *Nationalism*, Hutchison University Library, Third Edition, (1966).
123. Eugene Kamenka, editor, *Nationalism*, Edward Arnold Ltd., London, (1976).
124. Elie Kedourie, editor, *Nationalism in Asia and Africa*, New American Library, (1970).
125. G. Allport, *The Nature of Prejudice*, Doubleday Anchor Books, New York, (1958).
126. I.A. Berg and B.M. Bass, eds., *Conformity and Deviation*, Harper and Row, New York, (1961).
127. W. Buchanan and H. Cantril, *How Nations See Each Other*, University of Illinois Press, Urbana, IL, (1953).
128. H.C.J. Duijker and N.H. Frijda, *National Character and National Stereotypes*, North-Holland Publishing Co., Amsterdam, (1960).
129. S. Freud, *Warum Krieg? Das Bild vom Feind*, Arbeitsgem. Friedenspädagogik, (1983).
130. S. Freud, *Why War?*, in *The Basic Writings of Sigmund Freud*, A.A. Brill, ed., Modern Library, (1995).
131. S. Freud, *Civilization, War and Death. Psycho-analytical Epitomes No. 4*, Hogarth Press, London, (1953).
132. S. Keen, *Faces of the Enemy: Reflections of the Hostile Imagination*, Harper and Row, San Francisco, (1986).
133. W.E. Lampert, *Children's Views of Foreign Peoples*, Appleton-Century-Crofts, New York, (1967).
134. R.A. Levine and D.T. Campbell, *Ethnocentrism: Theories of Theories of Conflict, Ethnic Attitudes and Group Behavior*, Wiley, New York, (1972).
135. V.D. Volken, *Cyprus: War and Adaption: A Psychoanalytical History of Two Ethnic Groups in Conflict*, University Press of Virginia, Charlottesville, VA, (1979).
136. L. Durrell, *Bitter Lemons* (nationalism in the Cyprus conflicts), Faber and Faber, London, (1957).
137. N. Choucri and R. North, *Nations in Conflict: National Growth and International Violence*, W.H. Freeman, San Francisco, (1975).
138. R. Cohen, *Warfare and State Formation*, in *Warfare, Culture and the Environment*, B. Ferguson, ed., Academic Press, Orlando, (1984).
139. A. Giddens, *The Nation-State and Violence: Volume Two of a Contemporary Critique of Historical Materialism*, University of California, Berkeley, CA, (1985).
140. M. Haas, *Social Change and National Aggressiveness, 1900-1960*, in *Quantitative International Politics*, J.D. Singer, ed., Free Press, New York, (1968).
141. W. Schwartzwaller, *The Unknown Hitler*, Berkeley Books, (1990).
142. Francis King, *Satan and the Swastika*, Mayflower, St. Albans, (1976).
143. J.M. Angebert, *The Occult and the Third Reich*, New York, (1974).
144. J.H. Brennan, *Occult Reich*, New York, (1974).
145. N. Goodrick-Clarke, *The Occult Roots of Nazism*, Aquarium Press, Wellingborough, (1985).
146. T. Ravenscroft, *The Spear of Destiny*, Putnam's, New York, (1974).

147. D. Sklar, *The Nazis and the Occult*, Dorset Press, New York, (1977).
148. W. Schirer, *The Rise and Fall of the Third Reich*, Crest Books, New York, (1962).
149. B. Broms, *United Nations*, Suomalainen Tiedeakatemia, Helsinki, (1990).
150. S. Rosenne, *The Law and Practice at the International Court*, Dordrecht, (1985).
151. S. Rosenne, *The World Court - What It Is and How It Works*, Dordrecht, (1995).
152. J. D'Arcy and D. Harris, *The Procedural Aspects of International Law (Book Series), Volume 25*, Transnational Publishers, Ardsley, New York, (2001).
153. H. Cullen, *The Collective Complaints Mechanism Under the European Social Charter*, European Law Review, Human Rights Survey, p. 18-30, (2000).
154. S.D. Bailey, *The Procedure of the Security Council*, Oxford, (1988).
155. R.A. Akindale, *The Organization and Promotion of World Peace: A Study of Universal-Regional Relationships*, Univ. Toronto Press, Toronto, Ont., (1976).
156. J.S. Applegate, *The UN Peace Imperative*, Vantage Press, New York, (1992).
157. S.E. Atkins, *Arms Control, Disarmament, International Security and Peace: An Annotated Guide to Sources, 1980-1987*, Clio Press, Santa Barbara, CA, (1988).
158. N. Ball and T. Halevy, *Making Peace Work: The Role of the International Development Community*, Overseas Development Council, Washington DC, (1996).
159. F. Barnaby, Ed., *The Gaia Peace Atlas: Survival into the Third Millennium*, Doubleday, New York, (1988)
160. J.H. Barton, *The Politics of Peace: An Evaluation of Arms Control*, Stanford Univ. Press, Stanford, CA, (1981).
161. W. Bello, *Visions of a Warless World*, Friends Committee on National Education Fund, Washington DC, (1986).
162. A. Boserup and A. Mack, *Abolishing War: Cultures and Institutions; Dialogue with Peace Scholars Elise Boulding and Randall Forsberg*, Boston Research Center for the Twenty-first Century, Cambridge, MA, (1998).
163. E. Boulding et al., *Bibliography on World Conflict and Peace*, Westview Press, Boulder, CO, (1979).
164. E. Boulding et al., Eds., *Peace, Culture and Society: Transnational Research Dialogue*, Westview Press, Boulder, CO, (1991).
165. A.T. Bryan et al., Eds., *Peace, Development and Security in the Caribbean*, St. Martins Press, New York, (1988).
166. A.L. Burns and N. Heathcote, *Peace-Keeping by UN Forces from Suez to Congo*, Praeger, New York, (1963).
167. F. Capra and C. Spretnak, *Green Politics: The Global Promise*, E.P. Dutton, New York, (1986).
168. N. Carstarphen, *Annotated Bibliography of Conflict Analysis and Resolution*, Inst. for Conflict Analysis and Resolution, George Mason Univ., Fairfax, VA, (1997).
169. N. Chomsky, *Peace in the Middle East? Reflections on Justice and Nationhood*, Vintage Books, New York, (1974).
170. G. Clark and L. Sohn, *World Peace Through World Law*, World Without War Pubs., Chicago, IL, (1984).

171. K. Coates, *Think Globally, Act Locally: The United Nations and the Peace Movements*, Spokesman Books, Philadelphia, PA, (1988).
172. G. De Marco and M. Bartolo, *A Second Generation United Nations: For Peace and Freedom in the 20th Century*, Columbia Univ. Press, New York, (1997).
173. F.M. Deng and I.W. Zartman, Eds., *Conflict Resolution in Africa*, Brookings Institution, Washington, DC, (1991).
174. W. Desan, *Let the Future Come: Perspectives for a Planetary Peace*, Georgetown Univ. Press, Washington, DC, (1987).
175. D. Deudney, *Whole Earth Security. A Geopolitics of Peace*, Worldwatch paper 55. Worldwatch Institute, Washington, DC, (1983).
176. A.J. Donovan, *World Peace? A Work Based on Interviews with Foreign Diplomats*, A.J. Donovan, New York, (1986).
177. R. Duffey, *International Law of Peace*, Oceania Pubs., Dobbs Ferry, NY, (1990).
178. L.J. Dumas, *The Socio-Economics of Conversion From War to Peace*, M.E. Sharpe, Armonk, NY, (1995).
179. W. Durland, *The Illegality of War*, National Center on Law and Pacifism, Colorado Springs, CO, (1982).
180. F. Esack, *Qur'an, Liberation and Pluralism: An Islamic Perspective on Interreligious Solidarity Against Oppression*, Oxford Univ. Press, London, (1997).
181. I. Hauchler and P.M. Kennedy, Eds., *Global Trends: The World Almanac of Development and Peace*, Continuum Pubs., New York, (1995).
182. H.B. Hollins et al., *The Conquest of War: Alternative Strategies for Global Security*, Westview Press, Boulder, CO, (1989).
183. H.J. Morgenthau, *Peace, Security and the United Nations*, Ayer Pubs., Salem, NH, (1973).
184. C.C. Moskos, *Peace Soldiers: The Sociology of a United Nations Military Force*, Univ. of Chicago Press, Chicago, IL, (1976).
185. L. Pauling, *Science and World Peace*, India Council for Cultural Relations, New Delhi, India, (1967).
186. C. Peck, *The United Nations as a Dispute Resolution System: Improving Mechanisms for the Prevention and Resolution of Conflict*, Kluwer, Law and Tax, Cambridge, MA, (1996).
187. D. Pepper and A. Jenkins, *The Geography of Peace and War*, Basil Blackwell, New York, (1985).
188. J. Perez de Cuellar, *Pilgrimage for Peace: A Secretary General's Memoir*, St. Martin's Press, New York, (1997).
189. R. Pickus and R. Woito, *To End War: An Introduction to the Ideas, Books, Organizations and Work That Can Help*, World Without War Council, Berkeley, CA, (1970).
190. S.R. Ratner, *The New UN Peacekeeping: Building Peace in Lands of Conflict after the Cold War*, St. Martins Press, New York, (1995).

191. I.J. Rikhye and K. Skjelsbaek, Eds., *The United Nations and Peacekeeping: Results, Limitations and Prospects: The Lessons of 40 Years of Experience*, St. Martins Press, New York, (1991).
192. J. Rotblat, Ed., *Scientists in Quest for Peace: A History of the Pugwash Conferences*, MIT Press, Cambridge, MA, (1972).
193. J. Rotblat, Ed., *Scientists, The Arms Race, and Disarmament*, Taylor and Francis, Bristol, PA, (1982).
194. J. Rotblat, Ed., *Striving for Peace, Security and Development in the World*, World Scientific, River Edge, NJ, (1991).
195. J. Rotblat, Ed., *Towards a War-Free World*, World Scientific, River Edge, NJ, (1995).
196. J. Rotblat, Ed., *Nuclear Weapons: The Road to Zero*, Westview, Boulder, CO, (1998).
197. J. Rotblat and L. Valki, Eds., *Coexistence, Cooperation and Common Security*, St. Martins Press, New York, (1988).
198. United Nations, *Peaceful Settlement of Disputes between States: A Select Bibliography*, United Nations, New York, (1991).
199. United States Arms Control and Disarmament Agency, *Arms Control and Disarmament Agreements: Texts and Histories of Negotiations*, USACDA, Washington, DC, (updated annually)
200. D. Fahrni, *An Outline History of Switzerland - From the Origins to the Present Day*, Pro Helvetia Arts Council of Switzerland, Zurich, (1994).
201. J.M. Luck, *A History of Switzerland*, Sposs, Palo Alto, CA, (1985).

Chapter 7

OVERCOMING CULTURAL INERTIA

7.1 Automobile worship - a false religion

According to a recent article in AutoNation ¹, the top five reasons why we love our cars are the following:

1. **Meditation** You've heard it from friends and you've most likely done the same - you recall vivid details about setting out in your trusty automobile and arriving at your destination. But the details in between are a bit foggy. This is the cathartic, driving-induced trance that we sometimes slip into under just the right conditions and coordinates. Think about it. This is an outstanding entryway into mediation. Where else can such profound introspection occur? The fact that you weren't even trying to meditate makes it all the more special. The same results apply for those who work on their cars, or who travel long distances in their favorite vehicles.
2. **Sunday Drives** The pointlessness of the Sunday Drive is - the point. You love your car when it gets you swiftly and reliably to work. But what fun - windows down, tunes blasting, twisty roads and big empty spaces - no pressure to be anywhere or answer to anyone. Bliss.
3. **Freedom** From the moment you get that driver's license, you'll never be the same again. You can go places. You break the bonds of being a dependent to actually being able to just bounce, on a whim, whenever you like. You are free to move about the country at your own pace. Getting the keys for the first time is your official rite of passage into adulthood.
4. **Personality/Status** The wheels you choose are a direct extension of how you view yourself as a person. You should have a car that reflects traits of your personality.

¹<http://autonationdrive.com/5-reasons-why-we-love-cars/>

For the bold and adventurous, maybe you define yourself with a Subaru Outback. For those concerned about the environment, perhaps a Toyota Prius shows the world who you are.

5. **Bonding** Cars are one of the greatest environments for bonding with family and friends. If you're forming a new relationship, there are dozens of features and details about your car that can be used as conversation fodder. Long trips in a car with a new friend can also be the perfect tool to get to know someone fast and there are endless opportunities to get glimpses into the genuine personality of your new special friend.

In another article ², Tim Dugan explains why he loves his car:

"This car is bought and paid for by my own hand, it is the first major purchase I ever made as an adult. I worked off the loan and it wholly belongs to me. There is a sense of pride in this. Seeing the fruits of your labor and your saving and scrounging.

"This car is a tribute to my mother, who has passed away a few years ago. I grew up in a 1981 Camaro, she loved her car like I love mine.

"This car goes FAST. I don't care much for racing but I do love driving fast and boy does her 700rwhp provide that!!

"I have personally seen her at her worst and best. I've had my hands covered in Camaro guts, elbow deep. I've felt the pain of seeing your brand new car with a blown motor out of it sitting in your garage with a hole where the engine is supposed to be and knowing your warranty ain't gonna cover that. These experiences made this vehicle mine through blood, sweat, tears, and vulgar language.

"This car is an extension of my personality. I am loud and noisy when I need to be but I prefer to stay subdued. This machine doesn't need to prove anything. She exudes confidence in herself and her ability to perform at 110% at a moments' notice - but she don't need to prove it, you can look at it, you can hear it and you'll know what's up. Just like her owner. I have nothing to prove - I've made my mark, I believe in myself and let the world make its decision.

"Lastly, this car changed my life. It gave me confidence and pride in myself. It helped me to get in touch with the man I would later grow up to become. It pushed me into a direction in life of working with my hands and being proud of doing well for myself without being stuck in a cubicle. It introduced and brought me into a huge group of amazing people I wouldn't have otherwise known. It gave my future wife a sense of my personality before she even met me. She knew I was a confident self sufficient red blooded American Male without me even saying a word - my Camaro did all the talking for me. She turns heads, she makes kids jump up and down screaming, 'THERE'S THE BAT-MOBILE!' She is a fantastic money sink, a pleasure to drive, and a fine automobile. Never will this vehicle leave my possession and never will it find decay in a junk heap while I walk this earth. It is my friend and compatriot, through thick and thin we have been together, even on the worst days I can hop in this thing and go for a spin and find solace, enjoyment, and

²<https://www.quora.com/Why-are-people-so-in-love-with-their-cars>

testosterone producing speed.”

We love our cars so much that we are willing to die (and kill) for them: Wikipedia states that “It is estimated that motor vehicle collisions caused the death of around 60 million people during the 20th century, around the same number of World War II casualties. Just in 2010 alone, 1.23 million people were killed due to traffic collisions.”

Besides being dangerous, automobiles make our cities unpleasant. A pleasant city center is, almost by definition, a car-free one. Today, both tourists and Danish citizens enjoy Copenhagen’s bicycle culture and car-free city center³, and throughout the world, the pleasantness of cities is inversely proportional to the number of automobiles.

Some people visualize the transition from internal combustion engines to electric vehicles as the only change needed to make transportation environmentally friendly; but this ignores the enormous amount of energy, water (148,000 liters), and other resources needed to manufacture private automobiles. A truly sustainable future requires a transition, wherever possible, from private to public transport.

The government of Luxembourg recently announced that it intends to make all public transportation entirely free⁴, thus saving on the collection of fares, and eliminating the massive traffic jams that have plagued the country’s capital. Luxembourg City, the capital of the small Grand Duchy, suffers from some of the worst traffic congestion in the world. It is home to about 110,000 people, but a further 400,000 commute into the city to work. It will be interesting to follow the progress of this enlightened decision, due to take effect in 2020. Hopefully other countries will follow Luxembourg’s example. Luxembourg has increasingly shown a progressive attitude to transport. This summer, the government brought in free transport for every child and young person under the age of 20. Secondary school students can use free shuttles between their institution and their home.

Top Gear is long-running BBC program celebrating the delights of car ownership and motor sport. It is an example of the fact that our mass media actively encourage harmful and unsustainable human behavior. The program appeals to car enthusiasts - people who are passionate about automobiles. How much better it would be if they were passionate about saving human civilization and the biosphere from irreversible feedback loops leading in the long run to catastrophic climate change, mass extinctions, and the collapse of human civilization!

³<https://www.theguardian.com/cities/2016/may/05/story-cities-copenhagen-denmark-modernist-utopia>

⁴<https://www.theguardian.com/world/2018/dec/05/luxembourg-to-become-first-country-to-make-all-public-transport-free>



Figure 7.1: Motor traffic in Manila.



Figure 7.2: We love our cars.

7.2 US Evangelicals believe that Trump was sent by God to be King

Here is an excerpt from a December 31, 2018 article in the New York Times by Katherine Stewart:

The month before the 2018 midterms, a thousand theaters screened “The Trump Prophecy,” a film that tells the story of Mark Taylor, a former firefighter who claims that God told him in 2011 that Donald Trump would be elected president.

At a critical moment in the film, just after the actor representing Mr. Taylor collapses in the flashing light of an epiphany, he picks up a Bible and turns to the 45th chapter of the book of Isaiah, which describes the anointment of King Cyrus by God. In the next scene, we hear Mr. Trump being interviewed on “The 700 Club,” a popular Christian television show.

As Lance Wallnau, an evangelical author and speaker who appears in the film, once said, “I believe the 45th president is meant to be an Isaiah 45 Cyrus,” who will “restore the crumbling walls that separate us from cultural collapse.”

Cyrus, in case you’ve forgotten, was born in the sixth century B.C.E. and became the first emperor of Persia. Isaiah 45 celebrates Cyrus for freeing a population of Jews who were held captive in Babylon. Cyrus is the model for a nonbeliever appointed by God as a vessel for the purposes of the faithful.

The identification of the 45th president with an ancient Middle Eastern potentate isn’t a fringe thing. “The Trump Prophecy” was produced with the help of professors and students

at Liberty University, whose president, Jerry Falwell Jr., has been instrumental in rallying evangelical support for Mr. Trump. Jeanine Pirro of Fox News has picked up on the meme, as has Ron Dermer, the Israeli ambassador to the United States, among many others.

As the Trump presidency falls under siege on multiple fronts, it has become increasingly clear that the so-called values voters will be among the last to leave the citadel. A lot of attention has been paid to the supposed paradox of evangelicals backing such an imperfect man, but the real problem is that our idea of Christian nationalism hasn't caught up with the reality. We still buy the line that the hard core of the Christian right is just an interest group working to protect its values. But what we don't get is that Mr. Trump's supposedly anti-Christian attributes and anti-democratic attributes are a vital part of his attraction.

Today's Christian nationalists talk a good game about respecting the Constitution and America's founders, but at bottom they sound as if they prefer autocrats to democrats. In fact, what they really want is a king. "It is God that raises up a king," according to Paula White, a prosperity gospel preacher who has advised Mr. Trump.

Ralph Drollinger, who has led weekly Bible study groups in the White House attended by Vice President Mike Pence and many other cabinet members, likes the word "king" so much that he frequently turns it into a verb. "Get ready to king in our future lives," he tells his followers. "Christian believers will - soon, I hope - become the consummate, perfect governing authorities!"

The great thing about kings like Cyrus, as far as today's Christian nationalists are concerned, is that they don't have to follow rules. They are the law. This makes them ideal leaders in paranoid times.



Figure 7.3: Apparently insanity rules the United States today. The Evangelical Right believes that Trump was sent by God to be King, despite the fact that, according to Glenn Kessler, author of the Washington Post’s Fact Checker column, Trump told an average of 15 lies per day in 2018, bringing the total number of documented lies since he took office in January 2017 to 7,645. But neither Trump’s lies, nor his racism and mysogeny, nor his cruel authorization of imprisonment of very young children and even babies, are his worst crimes. His most serious offense is a crime against human civilization and the biosphere: his support for coal, his climate change denial, his sabotaging of renewable energy, and his withdrawal from the Paris agreement. These actions, and support for them by Republicans, caused Noam Chomsky to call the Republican Party “the most dangerous organization in history”.



Figure 7.4: An artist's impression of Trump's National Security Advisor John Bolton.



Figure 7.5: Stars and stripes.

7.3 Religion, culture and tradition

War is based on destruction, destruction of living persons, destruction of homes, destruction of infrastructure, and destruction of the biosphere. If we are on the side of life, if we are not traitors to life and allies of death, we must oppose the institution of war. We must oppose the military-industrial complex. We must oppose the mass media when they whip up war-fever. We must oppose politicians who vote for obscenely enormous military budgets at a time of financial crisis. We must oppose these things by working with dedication, as though our lives depended on it. In fact, they do.

But let us turn to religious ethics. Not only do they not conflict with science, but there is also a general agreement on ethical principles between the major religions of the world.

The central ethical principles of Christianity can be found in the Sermon on the Mount and in the Parable of the Good Samaritan. In the Sermon on the Mount, we are told that we must not only love our neighbors as much as we love ourselves; we must also love and forgive our enemies. This seemingly impractical advice is in fact of great practicality, since escalatory cycles of revenge and counter-revenge can only be ended by unilateral acts of kindness.

In the Parable of the Good Samaritan, we are told that our neighbor, whom we must love, is not necessarily a member of our own ethnic group. Our neighbor may live on the other side of the world and belong to an entirely different race or culture; but he or she still deserves our love and care.

It is an interesting fact that the Golden Rule, “Do unto others as you would have them do unto you”, appears in various forms in all of the world’s major religions. The Wikipedia article on the Golden Rule gives an impressive and fascinating list of the forms in which the rule appears in many cultures and religions. For example, in ancient China, both Confucius and Laozi express the Golden Rule, but they do it slightly differently: Zi Gong asked, saying, “Is there one word that may serve as a rule of practice for all one’s life?” The Master said, “Is not reciprocity such a word?” (Confucius) and “The sage has no interest of his own, but takes the interests of the people as his own. He is kind to the kind; he is also kind to the unkind: for Virtue is kind. He is faithful to the faithful; he is also faithful to the unfaithful: for Virtue is faithful.” (Laozi)

In the Jewish tradition, we have “The stranger who resides with you shall be to you as one of your citizens; you shall love him as yourself, for you were strangers in the land of Egypt” (Leviticus) In Islam: A Bedouin came to the prophet, grabbed the stirrup of his camel and said: O the messenger of God! Teach me something to go to heaven with it. The Prophet said: “As you would have people do to you, do to them; and what you dislike to be done to you, don’t do to them. This maxim is enough for you; go and act in accordance with it!” (Kitab al-Kafi, vol. 2, p. 146)

The principle of reciprocity is an ancient one in human history, and it is thus embedded in our emotions. It is an important part of human nature. Reciprocity is the basis of non-market economies, and also the basis of social interactions between family members, friends and colleagues. In hunter-gatherer societies, it is customary to share food among all the members of the group. “Today I receive food from you, and tomorrow you will receive food



Figure 7.6: A painting illustrating the Parable of the Good Samaritan

from me.” Similarly, among friends in modern society, no payment is made for hospitality, but it is expected that sooner or later the hospitality will be returned.

According to Wikipedia “Reciprocity in Social Psychology refers to responding to a positive action with another positive action, rewarding kind actions. As a social construct, reciprocity means that in response to friendly actions, people are frequently much nicer and much more cooperative than predicted by the self-interest model; conversely, in response to hostile actions they are frequently much more nasty and even brutal.” As Wikipedia points out, reciprocity can also be negative, as in the case of escalatory cycles of revenge and counter-revenge.

The Buddhist concept of karma has great value in human relations. The word “karma” means simply “action”. In Buddhism, one believes that actions return to the actor. Good actions will be returned, and bad actions will also be returned. This is obviously true in social relationships. If we behave with kindness and generosity to our neighbors, they will return our kindness. Conversely, a harmful act may lead to vicious circles of revenge and counter revenge, such as those we see today in the Middle East and elsewhere. These vicious circles can only be broken by returning good for evil.

However the concept of karma has a broader and more abstract validity beyond the direct return of actions to the actor. When we perform a good action, we increase the total amount of good karma in the world. If all people similarly behave well, the the world as a whole will become more pleasant and more safe. Human nature seems to have a built-in recognition of this fact, and we are rewarded by inner happiness when we perform good and kind actions. In his wonderful book, “Ancient Wisdom, Modern World”, the Dalai Lama says that good actions lead to happiness and bad actions to unhappiness even if our neighbors do not return these actions. Inner peace, he tells us, is incompatible with bad karma and can be achieved only through good karma, i.e. good actions.

In Buddhist philosophy, the concept of Karma, action and reaction, also extends to our relationship with nature. Both Hindu and Buddhist traditions emphasize the unity of all life on earth. Hindus regard killing an animal as a sin, and many try to avoid accidentally stepping on insects as they walk.

The Hindu and Buddhist picture of the relatedness of all life on earth has been confirmed by modern biological science. We now know that all living organisms have the same fundamental biochemistry, based on DNA, RNA, proteins and polysaccharides, and we know that our own human genomes are more similar to than different from the genomes of our close relations in the animal world.

The peoples of the industrialized nations urgently need to acquire a non-anthropocentric element in their ethics, similar to reverence for all life found in the Hindu and Buddhist traditions, as well as in the teachings of Saint Francis of Assisi and Albert Schweitzer. We need to learn to value other species for their own sakes, and not because we expect to use them for our own economic goals.

Today a few societies still follow a way of life similar to that of our hunter-gatherer ancestors. Anthropologists are able to obtain a vivid picture of the past by studying these societies. Often the religious ethics of the hunter- gatherers emphasizes the importance of harmony with nature. For example, respect for nature appears in the tribal traditions

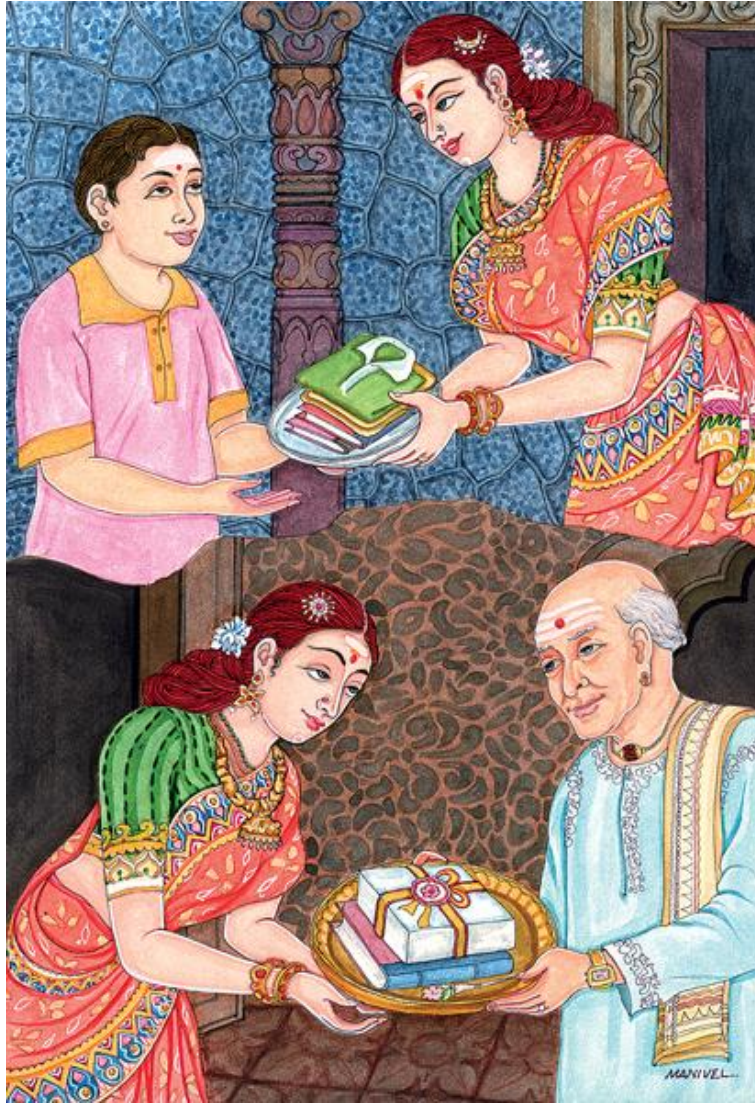


Figure 7.7: This painting illustrates the concept of karma. A lady gives books and clothing to a poor student. Later she receives a gift from a neighbor. There may sometimes be a direct causal connection between such events, but often they are connected only by the fact that each act of kindness makes the world a better place. (Himalayan Academy Publications, Kapaa, Kauai, Hawaii.)

of Native Americans. The attitude towards nature of the Sioux can be seen from the following quotations from “Land of the Spotted Eagle” by the Lakota (Western Sioux) chief, Standing Bear (ca. 1834-1908):

“The Lakota was a true lover of Nature. He loved the earth and all things of the earth... From Waken Tanka (the Great Spirit) there came a great unifying life force that flowered in and through all things, the flowers of the plains, blowing winds, rocks, trees, birds, animals, and was the same force that had been breathed into the first man. Thus all things were kindred and were brought together by the same Great Mystery.”

“Kinship with all creatures of the earth, sky, and water was a real and active principle. For the animal and bird world there existed a brotherly feeling that kept the Lakota safe among them. And so close did some of the Lakota come to their feathered and furred friends that in true brotherhood they spoke a common tongue.”

“The animal had rights, the right of man’s protection, the right to live, the right to multiply, the right to freedom, and the right to man’s indebtedness, and in recognition of these rights the Lakota never enslaved the animal, and spared all life that was not needed for food and clothing.”

“This concept of life was humanizing and gave to the Lakota an abiding love. It filled his being with the joy and mystery of things; it gave him reverence for all life; it made a place for all things in the scheme of existence with equal importance to all. The Lakota could despise no creature, for all were one blood, made by the same hand, and filled with the essence of the Great Mystery.”

A similar attitude towards nature can be found in traditional Inuit cultures, and in some parts of Africa, a man who plans to cut down a tree offers a prayer of apology, telling the tree why necessity has forced him to harm it. This preindustrial attitude is something from which the industrialized North could learn. In industrial societies, land “belongs” to some one has the “right” to ruin the land or to kill the communities of creatures living on it if this happens to give some economic advantage, in much the same way that a Roman slaveowner was thought to have the “right” to kill his slaves. Preindustrial societies have a much less rapacious and much more custodial attitude towards the land and towards its non-human inhabitants.

We have received many gifts from modern technology, but if we are to build a happy, sustainable and war-free world we must combine our new scientific techniques with humanity’s ancient wisdom.

Religion, rituals and resistance to change

Because of the tendency of humans to be religious is so universal, it seems likely that it is programmed into our genes. It is probably an inherited part of human nature. Because evolutionary forces seem to have produced this result, we can infer that religions must have helped humans to survive.

The success of our species is due to cultural evolution, which overwrites inherited behavior patterns and emotions with new ethical rules to fit changed circumstances, for example,



Figure 7.8: Chief Luther Standing Bear, author of “Land of the Spotted Eagle” and many other books.

the invention of agriculture produced life in cities and countries rather than in small tribes, and this required a more inclusive and cosmopolitan set of ethical rules.

Each religion seems to be associated with a particular culture, and religions act to preserve exactly that culture. This includes diet, what men and women wear, marriage customs, and so on.

The rituals that we perform give us a sense of security. This includes not only religions rituals, such as Christmas, Hanaka or Ramadan, but also political rituals such as the changing of the guard at Buckingham Palace, or the Queen's New Year Address in Denmark. We feel emotionally secure when we perform rituals year after year. We feel that all is well.

Sadly, however, all is not well with the world. In fact, we have suddenly reached a moment in human history where extremely quick change is needed to save the future. It is a state of emergency!

Thus, while religions are valuable in preserving ethical principles, the conservatism of religion may be a problem at a unique historical moment when we need to change our ideas quickly and act extremely rapidly.

7.4 Pope Francis addresses the climate emergency

In June, 2015, His Holiness Pope Francis I addressed the climate crisis in an encyclical entitled "Laudato Si' "⁵. 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 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

⁵<https://unfccc.int/news/pope-francis-releases-encyclical-on-climate-and-environment>



Figure 7.9: **His Holiness Pope Francis I** delivered an extremely important encyclical addressing the urgent problem of climate change.

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.

26. Many of those who possess more resources and economic or political power seem mostly to be concerned with masking the problems or concealing their symptoms, simply making efforts to reduce some of the negative impacts of climate change. However, many of these symptoms indicate that such effects will continue to worsen if we continue with current models of production and consumption. There is an urgent need to develop policies so that, in the next few years, the emission of carbon dioxide and other highly polluting gases can be drastically reduced, for example, substituting for fossil fuels and developing sources of renewable energy. Worldwide there is minimal access to clean and renewable energy. There is still a need to develop adequate storage technologies. Some countries have made considerable progress, although it is far from constituting a significant proportion. Investments have also been made in means of production and transportation which consume less energy and require fewer raw materials, as well as in methods of construction and renovating buildings which improve their energy efficiency. But these good practices are still far from widespread.

II: THE ISSUE OF WATER

27. Other indicators of the present situation have to do with the depletion of natural resources. We all know that it is not possible to sustain the present level of consumption in developed countries and wealthier sectors of society, where the habit of wasting and discarding has reached unprecedented levels. The exploitation of the planet has already exceeded acceptable limits and we still have not solved the problem of poverty.

28. Fresh drinking water is an issue of primary importance, since it is indispensable for human life and for supporting terrestrial and aquatic ecosystems. Sources of fresh water are necessary for health care, agriculture and industry. Water supplies used to be relatively constant, but now in many places demand exceeds the sustainable supply, with dramatic consequences in the short and long term. Large cities dependent on significant supplies of water have experienced periods of shortage, and at critical moments these have not always been administered with sufficient oversight and impartiality. Water poverty especially affects Africa where large sectors of the population have no access to safe drinking water or experience droughts which impede agricultural production. Some countries have areas rich in water while others endure drastic scarcity.

29. One particularly serious problem is the quality of water available to the poor. Every day, unsafe water results in many deaths and the spread of water-related diseases, including those caused by microorganisms and chemical substances. Dysentery and cholera, linked to inadequate hygiene and water sup-

plies, are a significant cause of suffering and of infant mortality. Underground water sources in many places are threatened by the pollution produced in certain mining, farming and industrial activities, especially in countries lacking adequate regulation or controls. It is not only a question of industrial waste. Detergents and chemical products, commonly used in many places of the world, continue to pour into our rivers, lakes and seas.

30. Even as the quality of available water is constantly diminishing, in some places there is a growing tendency, despite its scarcity, to privatize this resource, turning it into a commodity subject to the laws of the market. Yet access to safe drinkable water is a basic and universal human right, since it is essential to human survival and, as such, is a condition for the exercise of other human rights. Our world has a grave social debt towards the poor who lack access to drinking water, because they are denied the right to a life consistent with their inalienable dignity. This debt can be paid partly by an increase in funding to provide clean water and sanitary services among the poor. But water continues to be wasted, not only in the developed world but also in developing countries which possess it in abundance. This shows that the problem of water is partly an educational and cultural issue, since there is little awareness of the seriousness of such behaviour within a context of great inequality.

31. Greater scarcity of water will lead to an increase in the cost of food and the various products which depend on its use. Some studies warn that an acute water shortage may occur within a few decades unless urgent action is taken. The environmental repercussions could affect billions of people; it is also conceivable that the control of water by large multinational businesses may become a major source of conflict in this century.

III: LOSS OF BIODIVERSITY

32. The earth's resources are also being plundered because of short-sighted approaches to the economy, commerce and production. The loss of forests and woodlands entails the loss of species which may constitute extremely important resources in the future, not only for food but also for curing disease and other uses. Different species contain genes which could be key resources in years ahead for meeting human needs and regulating environmental problems.

33. It is not enough, however, to think of different species merely as potential "resources" to be exploited, while overlooking the fact that they have value in themselves. Each year sees the disappearance of thousands of plant and animal species which we will never know, which our children will never see, because they have been lost for ever. The great majority become extinct for reasons related to human activity. Because of us, thousands of species will no longer

give glory to God by their very existence, nor convey their message to us. We have no such right.

34. It may well disturb us to learn of the extinction of mammals or birds, since they are more visible. But the good functioning of ecosystems also requires fungi, algae, worms, insects, reptiles and an innumerable variety of microorganisms. Some less numerous species, although generally unseen, nonetheless play a critical role in maintaining the equilibrium of a particular place. Human beings must intervene when a geosystem reaches a critical state. But nowadays, such intervention in nature has become more and more frequent. As a consequence, serious problems arise, leading to further interventions; human activity becomes ubiquitous, with all the risks which this entails. Often a vicious circle results, as human intervention to resolve a problem further aggravates the situation. For example, many birds and insects which disappear due to synthetic agrottoxins are helpful for agriculture: their disappearance will have to be compensated for by yet other techniques which may well prove harmful. We must be grateful for the praiseworthy efforts being made by scientists and engineers dedicated to finding solutions to man-made problems. But a sober look at our world shows that the degree of human intervention, often in the service of business interests and consumerism, is actually making our earth less rich and beautiful, ever more limited and grey, even as technological advances and consumer goods continue to abound limitlessly. We seem to think that we can substitute an irreplaceable and irretrievable beauty with something which we have created ourselves.

35. In assessing the environmental impact of any project, concern is usually shown for its effects on soil, water and air, yet few careful studies are made of its impact on biodiversity, as if the loss of species or animals and plant groups were of little importance. Highways, new plantations, the fencing-off of certain areas, the damming of water sources, and similar developments, crowd out natural habitats and, at times, break them up in such a way that animal populations can no longer migrate or roam freely. As a result, some species face extinction. Alternatives exist which at least lessen the impact of these projects, like the creation of biological corridors, but few countries demonstrate such concern and foresight. Frequently, when certain species are exploited commercially, little attention is paid to studying their reproductive patterns in order to prevent their depletion and the consequent imbalance of the ecosystem.

36. Caring for ecosystems demands far-sightedness, since no one looking for quick and easy profit is truly interested in their preservation. But the cost of the damage caused by such selfish lack of concern is much greater than the economic benefits to be obtained. Where certain species are destroyed or seri-

ously harmed, the values involved are incalculable. We can be silent witnesses to terrible injustices if we think that we can obtain significant benefits by making the rest of humanity, present and future, pay the extremely high costs of environmental deterioration.

37. Some countries have made significant progress in establishing sanctuaries on land and in the oceans where any human intervention is prohibited which might modify their features or alter their original structures. In the protection of biodiversity, specialists insist on the need for particular attention to be shown to areas richer both in the number of species and in endemic, rare or less protected species. Certain places need greater protection because of their immense importance for the global ecosystem, or because they represent important water reserves and thus safeguard other forms of life.

38. Let us mention, for example, those richly biodiverse lungs of our planet which are the Amazon and the Congo basins, or the great aquifers and glaciers. We know how important these are for the entire earth and for the future of humanity. The ecosystems of tropical forests possess an enormously complex biodiversity which is almost impossible to appreciate fully, yet when these forests are burned down or levelled for purposes of cultivation, within the space of a few years countless species are lost and the areas frequently become arid wastelands. A delicate balance has to be maintained when speaking about these places, for we cannot overlook the huge global economic interests which, under the guise of protecting them, can undermine the sovereignty of individual nations. In fact, there are “proposals to internationalize the Amazon, which only serve the economic interests of transnational corporations”. We cannot fail to praise the commitment of international agencies and civil society organizations which draw public attention to these issues and offer critical cooperation, employing legitimate means of pressure, to ensure that each government carries out its proper and inalienable responsibility to preserve its country’s environment and natural resources, without capitulating to spurious local or international interests.

39. The replacement of virgin forest with plantations of trees, usually monocultures, is rarely adequately analyzed. Yet this can seriously compromise a biodiversity which the new species being introduced does not accommodate. Similarly, wetlands converted into cultivated land lose the enormous biodiversity which they formerly hosted. In some coastal areas the disappearance of ecosystems sustained by mangrove swamps is a source of serious concern.

40. Oceans not only contain the bulk of our planet’s water supply, but also most of the immense variety of living creatures, many of them still unknown to us and threatened for various reasons. What is more, marine life in rivers,

lakes, seas and oceans, which feeds a great part of the world's population, is affected by uncontrolled fishing, leading to a drastic depletion of certain species. Selective forms of fishing which discard much of what they collect continue unabated. Particularly threatened are marine organisms which we tend to overlook, like some forms of plankton; they represent a significant element in the ocean food chain, and species used for our food ultimately depend on them.

41. In tropical and subtropical seas, we find coral reefs comparable to the great forests on dry land, for they shelter approximately a million species, including fish, crabs, molluscs, sponges and algae. Many of the world's coral reefs are already barren or in a state of constant decline. "Who turned the wonder-world of the seas into underwater cemeteries bereft of colour and life?" This phenomenon is due largely to pollution which reaches the sea as the result of deforestation, agricultural monocultures, industrial waste and destructive fishing methods, especially those using cyanide and dynamite. It is aggravated by the rise in temperature of the oceans. All of this helps us to see that every intervention in nature can have consequences which are not immediately evident, and that certain ways of exploiting resources prove costly in terms of degradation which ultimately reaches the ocean bed itself.

42. Greater investment needs to be made in research aimed at understanding more fully the functioning of ecosystems and adequately analyzing the different variables associated with any significant modification of the environment. Because all creatures are connected, each must be cherished with love and respect, for all of us as living creatures are dependent on one another. Each area is responsible for the care of this family. This will require undertaking a careful inventory of the species which it hosts, with a view to developing programmes and strategies of protection with particular care for safeguarding species heading towards extinction.



Figure 7.10: Pope Francis and Leonardo DiCaprio discussing DiCaprio's important film, "Before the Flood".

7.5 Education for a culture of peace

Federico Mayor Zaragoza and UNESCO

Besides a humane, democratic and just framework of international law and governance, we urgently need a new global ethic, - an ethic where loyalty to family, community and nation will be supplemented by a strong sense of the brotherhood of all humans, regardless of race, religion or nationality. Schiller expressed this feeling in his "Ode to Joy", the text of Beethoven's Ninth Symphony. Hearing Beethoven's music and Schiller's words, most of us experience an emotion of resonance and unity with the message: All humans are brothers and sisters - not just some - all! It is almost a national anthem of humanity. The feelings that the music and words provoke are similar to patriotism, but broader. It is this sense of a universal human family that we need to cultivate in education, in the mass media, and in religion.

Educational reforms are urgently needed, particularly in the teaching of history. As it is taught today, history is a chronicle of power struggles and war, told from a biased national standpoint. Our own race or religion is superior; our own country is always heroic and in the right.

We urgently need to replace this indoctrination in chauvinism by a reformed view of history, where the slow development of human culture is described, giving adequate credit to all who have contributed. Our modern civilization is built on the achievements of many



Figure 7.11: Federico Mayor Zaragoza.



Figure 7.12: Logo for the United Nations Decade for a Culture of Peace.

ancient cultures. China, Japan, India, Mesopotamia, Egypt, Greece, the Islamic world, Christian Europe, and the Jewish intellectual traditions all have contributed. Potatoes, corn and squash are gifts from the American Indians. Human culture, gradually built up over thousands of years by the patient work of millions of hands and minds, should be presented as a precious heritage - far too precious to be risked in a thermonuclear war.

The teaching of history should also focus on the times and places where good government and internal peace have been achieved, and the methods by which this has been accomplished. Students should be encouraged to think about what is needed if we are to apply the same methods to the world as a whole. In particular, the histories of successful federations should be studied, for example the Hanseatic League, the Universal Postal Union, the federal governments of Australia, Brazil, Germany, Switzerland, the United States, Canada, and so on. The recent history of the European Union provides another extremely important example. Not only the successes, but also the problems of federations should be studied in the light of the principle of subsidiarity⁶. The essential features of federations should be clarified⁷, as well as the reasons why weaker forms of union have proved to be unsuccessful.

Reform is also urgently needed in the teaching of economics and business: Classical economics developed during the 18th and 19th centuries, when the global supply of land and raw materials seemed unlimited (at least within the foreseeable future), and when the only limitation to economic development was the shortage of capital. This might be called an “open world” situation, a situation in which growth became the Holy Grail of all economists. Today we are in a “closed world” situation. The possibility of development is limited, not by the availability of capital, but by shrinking supplies of arable land, water and nonrenewable resources, and by the finite carrying capacity of the global environment. Nevertheless economics continues to be taught along classical lines and for this reason, economists continue to worship growth. We urgently need to introduce biology and ecology into the education of economists. The economics of growth must be replaced by equilibrium economics, where considerations of ecology, carrying capacity, and sustainability are given their proper weight, and where the quality of life of future generations has as much importance as present profits.

Secondly, the education of economists and businessmen needs to face the problems of global poverty - the painful contrast between the affluence and wastefulness of the industrial North and the malnutrition, disease and illiteracy endemic in the South. Students of economics and business must look for the roots of poverty not only in population growth and war, but also in the history of colonialism and neocolonialism, and in defects in global financial institutions and trade agreements. They must be encouraged to formulate proposals for the correction of North-South economic inequality.

⁶The principle of subsidiarity states that within a federation, decisions should be taken at the lowest level at which there are no important externalities. Thus, for example, decisions affecting air quality within Europe should be taken in Bruxelles because winds blow freely across national boundaries, but decisions affecting only the local environment should be taken locally.

⁷One of the most important of these features is that federations have the power to make and enforce laws that are binding on individuals, rather than trying to coerce their member states.

Not only economists, but also students of business administration should be made conscious of the negative effects of globalization as well as the positive ones, and they should consider the measures that will be needed to correct the negative effects. Students of business administration should be helped to develop an attitude of responsibility towards the less developed countries of the world, so that if they later become administrators in multinational corporations, they will choose generous and enlightened policies rather than exploitative ones.

The economic impact of war and preparation for war should be included in the training of economists. Both the direct and indirect costs of war should be studied, for example the effect of unimaginably enormous military budgets in reducing the money available to solve pressing problems posed by the resurgence of infectious disease (e.g. AIDS, and drug-resistant forms of malaria and tuberculosis); the problem of population stabilization; food problems; loss of arable land; future energy problems; the problem of finding substitutes for vanishing nonrenewable resources, and so on. Many of these problems were discussed at a recent conference of economists in Copenhagen, but the fact that all such global emergencies could be adequately addressed with a fraction of the money wasted on military budgets was not discussed.

Finally, economics curricula should include the problems of converting war-related industries to peaceful ones - the problem of beating swords into plowshares. It is often said that our economies are dependent on arms industries. If this is so, it is an unhealthy dependence, analogous to drug addiction, since arms industries do not contribute to future-oriented infrastructure. The problem of conversion is an important one. It is the economic analog of the problem of ending a narcotics addiction, and it ought to be given proper weight in the education of economists.

Law students should be made aware of the importance of international law. They should be familiar with its history, starting with Grotius and the Law of the Sea. They should know the histories of the International Court of Justice and the Nuremberg Principles. They should study the United Nations Charter (especially the articles making war illegal) and the Universal Declaration of Human Rights, as well as the Rome Treaty and the foundation of the International Criminal Court. They should be made aware of a deficiency in the present United Nations - the lack of a legislature with the power to make laws that are binding on individuals.

Students of law should be familiar with all of the details of the World Court's historic Advisory Opinion on Nuclear Weapons, a decision that makes the use or threat of use of nuclear weapons illegal. They should also study the Hague and Geneva Conventions, and the various international treaties related to nuclear, chemical and biological weapons. The relationship between the laws of the European Union and those of its member states should be given high importance. The decision by the British Parliament that the laws of the EU take precedence over British law should be a part of the curriculum.

Professors of theology should emphasize three absolutely central components of religious ethics: the duty to love and forgive one's enemies, the prohibition against killing, and the concept of universal human brotherhood. They should make their students conscious of a responsibility to give sermons that are relevant to the major political problems of the

modern world, and especially to relate the three ethical principles just mentioned to the problem of war. Students of theology should be made conscious of their responsibility to soften the boundaries between ethnic groups, to contribute to interreligious understanding, and to make marriage across racial and religious boundaries more easy and frequent.

In teaching science too, reforms are needed. Graduates in science and engineering should be conscious of their responsibilities. They must resolve never to use their education in the service of war, nor for the production of weapons, nor in any way that might be harmful to society or to the environment.

Science and engineering students ought to have some knowledge of the history and social impact of science. They could be given a course on the history of scientific ideas; but in connection with modern historical developments such as the industrial revolution, the global population explosion, the development of nuclear weapons, genetic engineering, and information technology, some discussion of social impact could be introduced. One might hope to build up in science and engineering students an understanding of the way in which their own work is related to the general welfare of humankind, and a sense of individual social and ethical responsibility. These elements are needed in science education if rapid technological progress is to be beneficial to society rather than harmful.

The changes just mentioned in the specialized university training of historians, economists, businessmen, lawyers, theologians, scientists and engineers should have a counterpart in elementary education. The basic facts about peace and war should be communicated to children in simple language, and related to the everyday experiences of children. Teachers' training colleges ought to discuss with their student-teachers the methods that can be used to make peace education a part of the curriculum at various levels, and how it can be related to familiar concepts. They should also discuss the degree to which the painful realities of war can be explained to children of various ages without creating an undesirable amount of anxiety.

Peace education can be made a part of the curriculum of elementary schools through (for example) theme days or theme weeks in which the whole school participates. This method has been used successfully in many European schools. During the theme days the children have been encouraged to produce essays, poems and drawings illustrating the difference between peace and war, and between negative peace and positive peace⁸. Another activity has been to list words inspired by the concept "peace", rapidly and by free association, and to do the same for the concept "war". Drama has also been used successfully in elementary school peace education, and films have proved to be another useful teaching aid.

The problems of reducing global inequalities, of protecting human rights, and of achieving a war-free world can be introduced into grade school courses in history, geography, religion and civics. The curriculum of these courses is frequently revised, and advocates of peace education can take curriculum revisions as opportunities to introduce much-needed

⁸Negative peace is merely the absence of war. In positive peace, neighboring nations are actively engaged in common projects of mutual benefit, in cultural exchanges, in trade, in exchanges of students and so on.

reforms that will make the students more international in their outlook. The argument (a true one) should be that changes in the direction of peace education will make students better prepared for a future in which peace will be a central issue and in which they will interact with people of other nations to a much greater extent than was the case in previous generations. The same can be said for curriculum revisions at the university level.

UNESCO and the Culture of Peace

Advocates of education for peace can obtain important guidance and encouragement from UNESCO - the United Nations Educational, Scientific and Cultural Organization. The Constitution of UNESCO, was written immediately after the end of the Second World War, during which education had been misused (especially in Hitler's Germany) to indoctrinate students in such a way that they became uncritical and fanatical supporters of military dictatorships. The founders of the United Nations were anxious to correct this misuse, and to make education instead one of the foundations of a peaceful world. One can see this hope in the following paragraph from UNESCO's Constitution:

"The purpose of the Organization is to contribute to peace and security by promoting collaboration among nations through education, science and culture in order to further universal respect for justice, for the rule of law and for the human rights and fundamental freedoms which are affirmed for the peoples of the world, without distinction of race, sex, language or religion, by the Charter of the United Nations."

In other words, UNESCO was given the task of promoting education for peace, and of promoting peace through international cooperation in education.

In 1946 the General Conference of UNESCO adopted a nine-point resolution concerning the improvement of textbooks in such a way as to make them support international understanding, paying particular attention to history teaching and civic education. During the next decade, UNESCO produced publications and hosted seminars to promote improvements in the teaching of history, geography and modern languages, so that these subjects could be more instrumental in developing mutual understanding between nations and between cultures. A meeting of French, German, British and American teachers was organized in 1952, with the goal of removing national prejudices from textbooks. Every two years after this date bilateral and multilateral consultations of history teachers have taken place under the auspices of UNESCO.

Here are a few voices that express the aims and ideals of UNESCO over the years:

- Ellen Wilkinson (United Kingdom) (Former UK Minister of Education, Chairwoman of the conference establishing UNESCO in 1945): *What can this organization do? Can we replace nationalist teaching by a conception of humanity that trains children to have a sense of mankind as well as of national citizenship? That means working for international understanding*
- Maria Montessori (Italy), pioneer of modern education and education for peace, Fourth Session of the General Conference of UNESCO, Florence 1950: *If one day*

UNESCO resolved to involve children in the reconstruction of the world and building peace, if it chose to call on them, to discuss with them, and recognize the value of all the revaluations they have for us, it would find them of immense help in infusing new life into this society which must be founded on the cooperation of all.

- Jamie Torres Bodet (Mexico), Director-General of UNESCO, 1948-1952, (The UNESCO Courier, 1951): *Knowledge and understanding of the principles of the Universal Declaration of Human Rights and their practical application must begin during childhood. Efforts to make known the rights and duties they imply will never be fully effective unless schools in all countries make teaching about the declaration a regular part of their curriculum...*
- Lionel Elvin (United Kingdom), Director of the Department of Education of UNESCO, 1950-1956 (UNESCO Courier, 1953): *If UNESCO were only an office in Paris, its task would be impossible. It is more than that: it is an association of some sixty-five countries which have pledged themselves to do all they can, not only internationally but within their own boundaries, to advance the common aim of educating for peace. The international side comes in because we shall obviously do this faster and better and with more mutual trust if we do it together.*
- Jawaharlal Nehru (India) Prime Minister, 1947-1964 (Address on a visit to UNESCO, 1962): *It is then the minds and hearts of men that have to be approached for mutual understanding, knowledge and appreciation of each other and through the proper kind of education... But we have seen that education by itself does not lead to a conversion of minds towards peaceful purposes. Something more is necessary, new standards, new values and perhaps a kind of spiritual background and a feeling of commonness of mankind.*
- James P. Grant (United States). Executive Director of UNICEF, 1980-1995, (International Conference on Education, Geneva, 1994): *Education for peace must be global, for as the communications revolution transforms the world into a single community, everyone must come to understand that they are affected by what happens elsewhere, and that their lives, too, have an impact. Solidarity is a survival strategy in the global village.*

During the time when he was Secretary-General of UNESCO, Federico Mayor Zaragoza of Spain introduced the concept of a *Culture of Peace*. He felt, as many did, that civilization was entering a period of crisis. Federico Mayor believed this crisis to be as much spiritual as it was economic and political. It was necessary, he felt, to counteract our present power-worshipping culture of violence with a Culture of Peace, a set of ethical and aesthetic values, habits and customs, attitudes towards others, forms of behaviour and ways of life that express

- Respect for life and for the dignity and human rights of individuals.

- Rejection of violence.
- Recognition of equal rights for men and women.
- Upholding the principles of democracy, freedom, justice, solidarity, tolerance and the acceptance of differences.
- Understanding between nations and countries and between ethnic, religious, cultural and social groups.

Mayor and UNESCO implemented this idea by designating the year 2000 as the International Year of the Culture of Peace. In preparation for this year, a meeting of Nobel Peace Prize Laureates launched *Manifesto 2000*, a campaign in which the following pledge of the Culture of Peace was widely circulated and signed:

Recognizing my share of responsibility for the future of humanity, especially for today's children and those of future generations, I pledge - in my daily life, in my family, my work, my community, my country and my region - to:

1. *respect the life and dignity of every person without discrimination or prejudice;*
2. *practice active non-violence, rejecting violence in all its forms: physical, sexual, psychological, economical and social, in particular towards the most deprived and vulnerable such as children and adolescents;*
3. *share my time and material resources in a spirit of generosity to put an end to exclusion, injustice and political and economic oppression;*
4. *defend freedom of expression and cultural diversity, giving preference always to dialogue and listening without engaging in fanaticism, defamation and the rejection of others;*
5. *promote consumer behaviour that is responsible and development practices that respect all forms of life and preserve the balance of nature on the planet;*
6. *contribute to the development of my community, with the full participation of women and respect for democratic principles, in order to create together new forms of solidarity.*

In addition, Federico Mayor and UNESCO initiated a Campaign for the Children of the World, and this eventually developed into the International Decade for a Culture of Peace and Non-Violence for the Children of the World (2001-2010). In support of this work, the UN General Assembly drafted a Program of Action on a Culture of Peace (53rd Session, 2000). The Program of Action obliges its signatories to “ensure that children, from an early age, benefit from education on the values, attitudes, modes of behavior and ways of life to enable them to resolve any dispute peacefully and in a spirit of respect for human dignity

and of tolerance and non-discrimination”, and to “encourage the revision of educational curricula, including textbooks...”

Just as this program was starting, the September 11 terrorist attacks gave an enormous present to the culture of violence and war, and almost silenced the voices speaking for a Culture of Peace. However, military solutions have never provided true security, even for the strongest countries. Expensive and technologically advanced weapons systems may enrich arms manufacturers and military lobbies, but they do not provide security - only an unbelievably expensive case of the jitters. By contrast, the Culture of Peace can give us hope for the future.

7.6 Value-creating education: Soka Gakkai

Soka Gakkai is a large Nichiren Buddhist religious group. Its 12 million members are centered primarily in Japan, but Soka Gakkai International (SGI) has groups in 192 countries. In Japanese, the words “Soka Gakkai” mean “Value-Creating Education”. The organization was started by two Japanese educators, Tsunisaburo Makiguchi and Josei Toda, both of whom were imprisoned by their government during World War II because of their opposition to militarism. Makiguchi died as a result of his imprisonment, but Josei Toda went on to found a large and vigorous educational organization dedicated to culture, humanism, world peace and nuclear abolition.

The SGI-International website states that “For most of his life Makiguchi’s central concern was to reform the education system that, he felt, discouraged independent thinking and stifled students’ happiness and creativity. He believed that education should serve the happiness of the students, rather than the needs of the state. His educational ideas, and his theory of value-creation (soka), which underlies his pedagogy, are explored in his 1930 work *Soka Kyoikugaku Taikei* (The Theory of Value-Creating Pedagogy). Makiguchi’s views completely contradicted the logic of the militarist government, which sought to use education to mold obedient, unquestioning servants of the state...”

“Josei Toda (1900-1958) was an educator, publisher and entrepreneur who, as second president of the Soka Gakkai, revived the lay Buddhist organization after World War II, building it into a dynamic, popular movement.”

The Toda Declaration and Daisaku Ikeda’s Proposals

In 1957, before a cheering audience of 50,000 young Soka Gakkai members, Josei Toda declared nuclear weapons to be an absolute evil. He said that their possession is criminal under all circumstances, and he called the young people present to work untiringly to rid the world of all nuclear weapons.

Toda was the mentor of Daisaku Ikeda, the first president SGI-International. Every year, President Ikeda issues a Peace Proposal, calling for international understanding and dialogue, as well as nuclear abolition, and outlining practical steps by which he believes



Figure 7.13: In 1957, before a cheering audience of 50,000 young Soka Gakkai members, Josei Toda declared nuclear weapons to be an absolute evil. He said that their possession is criminal under all circumstances, and he called on the young people present to work untiringly to rid the world of all nuclear weapons. Source: SGI International

these goals may be achieved. In his 2013 Peace Proposal, Ikeda, noted that 2015 will be the 70th anniversary of the destruction of Hiroshima, and he proposed that the NPT review conference should take place in Hiroshima, rather than in New York. He proposed that this should be followed by “an expanded global summit for a nuclear-weapon-free world”

Ikeda was born in Tokyo, Japan, on January 2, 1928, the fifth of eight children, to a family of seaweed farmers. The devastation and senseless horror he witnessed as a teenager during World War II gave birth to a lifelong passion to work for peace, rooting out the fundamental causes of human conflict.

In 1947, at the age of 19, he met Josei Toda, educator and leader of the Soka Gakkai. Ikeda found in Toda an open and unaffected person, a man of unshakable conviction with a gift for explaining profound Buddhist concepts in logical, accessible terms. He soon found employment at one of Toda’s companies and later completed his education under the tutelage of Toda, who became his mentor in life.

Ikeda was one of the first major Japanese figures to call for normalization of relations with China. His call met with fierce criticism in Japan, but it also caught the attention of those, both in China and in Japan, who sought an easing of tensions between the two countries, including Chinese Premier Zhou Enlai. Today, Ikeda’s statement is widely recognized as having played a catalytic role in the process that culminated in the restoration of diplomatic ties between the two countries in 1972.

In the years after normalization, Ikeda engaged in a form of “citizen diplomacy” among the Cold War rivals, particularly between China and the Soviet Union, which at times seemed on the brink of full-scale conflict. During 1974 and 1975, he repeatedly visited



Figure 7.14: Daisaku Ikeda (born 1928), President of the 12-million-strong Buddhist organization Soka Gakkai International. Throughout his long life he has worked with courage and dedication for peace and international dialogue.

China, the USSR and the US, meeting with Soviet Premier Aleksey Kosygin, Chinese Premier Zhou Enlai, US Secretary of State Henry Kissinger and other key figures. Conveying the concerns and aspirations of the leaders of these hostile powers, as well as the yearning for peace he had felt in his encounters with the ordinary citizens of each society, Ikeda worked to defuse tensions and help build the foundations for mutual understanding and dialogue.

7.7 The Eqbal Ahmed Centre For Public Education

This centre for public education (EACPE) can be reached on the link <http://eacpe.org/> . It was established by the distinguished theoretical physicist Pervez Hoodbhoy and others, and it takes its name from the courageous writer, university professor and activist Eqbal Ahmed.

An article by S.M. Tatar in the Friday Times⁹ states that “The late Eqbal Ahmad was an internationally known and respected Pakistani political scientist, intellectual, scholar and teacher who returned to Islamabad in the 1990’s with a dream. He wanted to build Khaldunia University. Khaldunia could have been a game-changer in Pakistan’s higher education system. Eqbal Ahmad taught at various US universities and was a key political voice in international affairs. He enjoyed the friendship and respect of the likes of Edward Said and Noam Chomsky - who admired his work, his independent thinking and his identification with the causes of oppressed peoples.

“Ahmad was an intellectual with roots in Pakistan, influencing thinking on major world events like the Vietnam war, Algeria’s war of independence and the Palestinian tragedy. He was fully committed to his vision. He was not a desk scholar. He was part of the Algerian liberation movement in the 1960’s and an active opponent of the Vietnam war. Along with others, he was charged with being part of a plot to kidnap Henry Kissinger, in an effort to end the Vietnam war. And he advised the the PLO leadership in Palestine!”

⁹<https://www.thefridaytimes.com/tft/a-dream-rudely-shattered/>

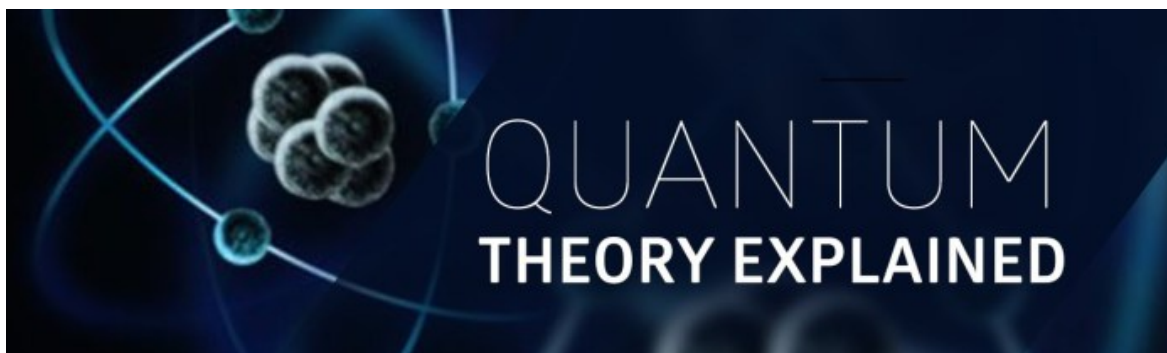


Figure 7.15: A set of freely downloadable lectures on quantum theory by Prof. Hoodbhoy is available on the EACPE website.



Figure 7.16: Another freely downloadable set of lectures by Prof. Hoodbhoy deals with special relativity.

The Eqbal Ahmed Centre for Public Education states that “Knowledge translated into action is the most potent and powerful game-changer known to man. The wedding of computers and telecommunications enables the transportation of ideas, the sharing of knowledge and the promotion of learning on a scale and with a speed that is near miraculous.

“The Eqbal Ahmad Centre for Public Education honours the life and work of Dr. Eqbal Ahmad, a Pakistani academic, social scientist, writer, public intellectual and activist. The Centre’s web site of the same name is a rich mother lode of enlightening content for those who thirst for knowledge. They also keep adding to the content frequently, so the site is always worth a visit.

“We believe the site is a great resource for students as well. Some their content is directed at science students, particularly students of the physical sciences and mathematics. This particular section is rich in video content, and is certain to be helpful in acquiring a solid grounding in the subjects. Apart from such video lectures, there is also a great wealth of video material for those who wish to enhance their knowledge of scientific subjects in general.”



Figure 7.17: Professor Eqbal Ahmed (1933-1999).



Figure 7.18: Professor Pervez Hoodbhoy (born in 1950) is Zohra and Z.Z. Ahmad Distinguished Professor of Physics and Mathematics at Forman Christian College, Lahore. In 2013, he was made a member of the UN Secretary General's Advisory Board on Disarmament. Among the awards he has won are the IEEE Baker Award for Electronics (1968); the Abdus Salam Prize for Mathematics (1984); the UNESCO Kalinga Prize for the popularization of science (2003); the Joseph A. Burton Award (2010) from the American Physical Society and the Jean Meyer Award from Tufts University. In 2011, he was included in the list of 100 most influential global thinkers by Foreign Policy magazine. As the head of Mashal Books in Lahore, Prof. Hoodbhoy leads a major translation effort to produce books in Urdu that promote modern thought, human rights, and emancipation of women.

7.8 Gandhi's message for today's world

2019 is the 150th anniversary of Mahatma Gandhi's birth. Therefore it is appropriate to look at his life and his message for today's world.

If humans are ever to achieve a stable global society in the future, they will have to become much more modest in their economic behavior and much more peaceful in their politics. For both modesty and peace, Gandhi is a useful source of ideas. The problems with which he struggled during his lifetime are extremely relevant to us in the 21st Century, when both nuclear and ecological catastrophes threaten the world.

Avoiding escalation of conflicts

Today we read almost every day of killings that are part of escalating cycles of revenge and counter-revenge, for example in the Middle East. Gandhi's experiences both in South Africa and in India convinced him that such cycles could only be ended by unilateral acts of kindness and understanding from one of the parties in a conflict. He said, "An eye for an eye makes the whole world blind".

Gandhi studies law in England

Mohandas Karamchand Gandhi was born in 1869 in Porbandar, India. His family belonged to the Hindu caste of shopkeepers. (In Gujarati "Gandhi" means "grocer".) However, the family had risen in status, and Gandhi's father, grandfather, and uncle had all served as dewans (i.e. prime ministers) of small principalities in western India.

In 1888, Gandhi sailed for England, where he spent three years studying law at the Inner Temple in London. Before he left India, his mother had made him take a solemn oath not to touch women, wine, or meat. He thus came into contact with the English vegetarians, who included Sir Edward Arnold (translator of the Bhagavad Gita), the Theosophists Madame Blavatsky and Annie Besant, and the Fabians. Contact with this idealistic group of social critics and experimenters helped to cure Gandhi of his painful shyness, and it also developed his taste for social reform and experimentation.

South Africa

Gandhi's exceptionally sweet and honest character won him many friends in England, and he encountered no racial prejudice at all. However, when he traveled to Pretoria in South Africa a few years later, he experienced racism in its worst form. Although he was meticulously well dressed in an English frock coat, and in possession of a first-class ticket, Gandhi was given the choice between traveling third class or being thrown off the train. (He chose the second alternative.) Later in the journey he was beaten by a coach driver because he insisted on his right to sit as a passenger rather than taking a humiliating position on the footboard of the coach.

The legal case which had brought Gandhi to South Africa was a dispute between a wealthy Indian merchant, Dada Abdullah Seth, and his relative, Seth Tyeb (who had refused to pay a debt of 40,000 pounds, in those days a huge sum). Gandhi succeeded in reconciling these two relatives, and he persuaded them to settle their differences out of court. Later he wrote about this experience:

“Both were happy with this result, and both rose in public estimation. My joy was boundless. I had learnt the true practice of law. I had learnt to find out the better side of human nature and to enter men’s hearts. I realized that the true function of a lawyer was to unite parties riven asunder. The lesson was so indelibly burnt into me that a large part of my time during my twenty years of practice as a lawyer was occupied in bringing about compromises of hundreds of cases. I lost nothing thereby - not even money, certainly not my soul.”

Gandhi was about to return to India after the settlement of the case, but at a farewell party given by Abdullah Seth, he learned of a bill before the legislature which would deprive Indians in South Africa of their right to vote. He decided to stay and fight against the bill.

Gandhi spent the next twenty years in South Africa, becoming the leader of a struggle for the civil rights of the Indian community. In this struggle he tried “...to find the better side of human nature and to enter men’s hearts.” Gandhi’s stay in England had given him a glimpse of English liberalism and English faith in just laws. He felt confident that if the general public in England could be made aware of gross injustices in any part of the British Empire, reform would follow. He therefore organized non-violent protests in which the protesters sacrificed themselves so as to show as vividly as possible the injustice of an existing law. For example, when the government ruled that Hindu, Muslim and Parsi marriages had no legal standing, Gandhi and his followers voluntarily went to prison for ignoring the ruling.

Gandhi used two words to describe this form of protest: “satyagraha” (the force of truth) and “ahimsa” (non-violence). Of these he later wrote: “I have nothing new to teach the world. Truth and non-violence are as old as the hills. All that I have done is to try experiments in both on as vast a scale as I could. In so doing, I sometimes erred and learnt by my errors. Life and its problems have thus become to me so many experiments in the practice of truth and non-violence.”

In his autobiography, Gandhi says: “Three moderns have left a deep impression on my life and captivated me: Raychandbhai (the Indian philosopher and poet) by his living contact; Tolstoy by his book ‘The Kingdom of God is Within You’; and Ruskin by his book ‘Unto This Last’.”

Ruskin’s book, “Unto This Last”, which Gandhi read in 1904, is a criticism of modern industrial society. Ruskin believed that friendships and warm interpersonal relationships are a form of wealth that economists have failed to consider. He felt that warm human contacts are most easily achieved in small agricultural communities, and that therefore the modern tendency towards centralization and industrialization may be a step backward in terms of human happiness. While still in South Africa, Gandhi founded two religious Utopian communities based on the ideas of Tolstoy and Ruskin. Phoenix Farm (1904) and Tolstoy Farm (1910). At this time he also took an oath of chastity (“bramacharya”),



Figure 7.19: Gandhi and his wife, Kasturba, in 1902.

partly because his wife was unwell and he wished to protect her from further pregnancies, and partly in order to devote himself more completely to the struggle for civil rights.

The struggle for Indian independence

Because of his growing fame as the leader of the Indian civil rights movement in South Africa, Gandhi was persuaded to return to India in 1914 and to take up the cause of Indian home rule. In order to reacquaint himself with conditions in India, he traveled tirelessly, now always going third class as a matter of principle.

During the next few years, Gandhi worked to reshape the Congress Party into an organization which represented not only India's Anglicized upper middle class but also the millions of uneducated villagers who were suffering under an almost intolerable burden of poverty and disease. In order to identify himself with the poorest of India's people, Gandhi began to wear only a white loincloth made of rough homespun cotton. He traveled to the remotest villages, recruiting new members for the Congress Party, preaching non-violence and "firmness in the truth", and becoming known for his voluntary poverty and humility. The villagers who flocked to hear him began to call him "Mahatma" (Great Soul).

Disturbed by the spectacle of unemployment and poverty in the villages, Gandhi urged the people of India to stop buying imported goods, especially cloth, and to make their own. He advocated the reintroduction of the spinning wheel into village life, and he often spent some hours spinning himself. The spinning wheel became a symbol of the Indian independence movement, and was later incorporated into the Indian flag.

The movement for boycotting British goods was called the "Swadeshi movement". The word Swadeshi derives from two Sanskrit roots: *Swa*, meaning self, and *Desh*, meaning country. Gandhi described Swadeshi as "a call to the consumer to be aware of the violence

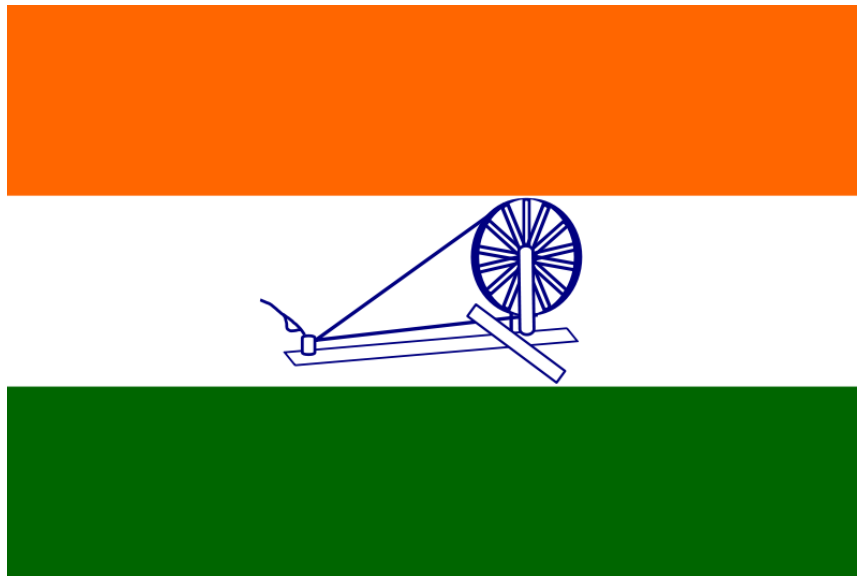


Figure 7.20: **Gandhi's spinning wheel was incorporated into the flag of the Congress Party and later into the national flag of an independent India.**

he is causing by supporting those industries that result in poverty, harm to the workers and to humans or other creatures.”

Gandhi tried to reconstruct the crafts and self-reliance of village life that he felt had been destroyed by the colonial system. “I would say that if the village perishes India will perish too”, he wrote, “India will be no more India. Her own mission in the world will get lost. The revival of the village is only possible when it is no more exploited. Industrialization on a mass scale will necessarily lead to passive or active exploitation of the villagers as problems of competition and marketing come in. Therefore we have to concentrate on the village being self-contained, manufacturing mainly for use. Provided this character of the village industry is maintained, there would be no objection to villagers using even the modern machines that they can make and can afford to use. Only they should not be used as a means of exploitation by others.”

“You cannot build nonviolence on a factory civilization, but it can be built on self-contained villages... Rural economy as I have conceived it, eschews exploitation altogether, and exploitation is the essence of violence... We have to make a choice between India of the villages that are as ancient as herself and India of the cities which are a creation of foreign domination...”

“Machinery has its place; it has come to stay. But it must not be allowed to displace necessary human labour. An improved plow is a good thing. But if by some chances, one man could plow up, by some mechanical invention of his, the whole of the land of India, and control all the agricultural produce, and if the millions had no other occupation, they would starve, and being idle, they would become dunces, as many have already become. There is hourly danger of many being reduced to that unenviable state.”

In these passages we see Gandhi not merely as a pioneer of nonviolence; we see him also as an economist. Faced with misery and unemployment produced by machines, Gandhi tells us that social goals must take precedence over blind market mechanisms. If machines are causing unemployment, we can, if we wish, use labor-intensive methods instead. With Gandhi, the free market is not sacred - we can do as we wish, and maximize human happiness, rather than maximizing production and profits.

Gandhi also organized many demonstrations whose purpose was to show the British public that although the British raj gave India many benefits, the toll exacted was too high, not only in terms of money, but also in terms of India's self-respect and self-sufficiency. All of Gandhi's demonstrations were designed to underline this fact. For example, in 1930 Gandhi organized a civil-disobedience campaign against the salt laws. The salt laws gave the Imperial government a monopoly and prevented Indians from making their own salt by evaporating sea water. The majority of Indians were poor farmers who worked long hours in extreme heat, and salt was as much a necessity to them as bread. The tax on salt was essentially a tax on the sweat of the farmers.

Before launching his campaign, Gandhi sent a polite letter to the Viceroy, Lord Irwin, explaining his reasons for believing that the salt laws were unjust, and announcing his intention of disregarding them unless they were repealed. Then, on March 12 1930, Gandhi and many of his followers, accompanied by several press correspondents, started on a march to the sea to carry out their intention of turning themselves into criminals by making salt. Every day, Gandhi led the procession about 12 miles, stopping at villages in the evenings to hold prayer meetings. Many of the villagers joined the march, while others cast flower petals in Gandhi's path or sprinkled water on his path to settle the dust.

On April 5 the marchers arrived at the sea, where they spent the night in prayer on the beach. In the morning they began to make salt by wading into the sea, filling pans with water, and letting it evaporate in the sun. Not much salt was made in this way, but Gandhi's action had a strong symbolic power. A wave of non-violent civil disobedience demonstrations swept over India, so extensive and widespread that the Imperial government, in danger of losing control of the country, decided to arrest as many of the demonstrators as possible. By midsummer, Gandhi and a hundred thousand of his followers were in prison, but nevertheless the civil disobedience demonstrations continued.

In January, 1931, Gandhi was released from prison and invited to the Viceroy's palace to talk with Lord Irwin. They reached a compromise agreement: Gandhi was to call off the demonstrations and would attend a Round Table Conference in London to discuss Indian home rule, while Lord Irwin agreed to release the prisoners and would change the salt laws so that Indians living near to the coast could make their own salt.

The salt march was typical of Gandhi's non-violent methods. Throughout the demonstrations he tried to maintain a friendly attitude towards his opponents, avoiding escalation of the conflict. Thus at the end of the demonstrations, the atmosphere was one in which a fair compromise solution could be reached. Whenever he was in prison, Gandhi regarded his jailers as his hosts. Once, when he was imprisoned in South Africa, he used the time to make a pair of sandals, which he sent to General Smuts, the leader of the South African government. Thus Gandhi put into practice the Christian principle, "Love your enemies;

do good to them that hate you.”

Mahatma Gandhi's message for us today

Gandhi believed that human nature is essentially good, and that it is our task to find and encourage whatever is good in the character of others. During the period when he practiced as a lawyer, Gandhi's aim was “to unite parties riven asunder,” and this was also his aim as a politician. In order for reconciliation to be possible in politics, it is necessary to avoid escalation of conflicts. Therefore Gandhi used non-violent methods, relying only on the force of truth. “It is my firm conviction,” he wrote, “that nothing can be built on violence.”

To the insidious argument that “the end justifies the means,” Gandhi answered firmly: “They say ‘means are after all means’. I would say ‘means are after all everything’. As the means, so the end. Indeed the Creator has given us control (and that very limited) over means, none over end. ... The means may be likened to a seed, and the end to a tree; and there is the same inviolable connection between the means and the end as there is between the seed and the tree. Means and end are convertible terms in my philosophy of life.” In other words, a dirty method produces a dirty result; killing produces more killing; hate leads to more hate. But there are positive feedback loops as well as negative ones. A kind act produces a kind response; a generous gesture is returned; hospitality results in reflected hospitality. Hindus and Buddhists call this principle “the law of karma”.

Gandhi believed that the use of violent means must inevitably contaminate the end achieved. Because Gandhi's methods were based on love, understanding, forgiveness and reconciliation, the non-violent revolution which he led left very little enmity in its wake. When India finally achieved its independence from England, the two countries parted company without excessive bitterness. India retained many of the good ideas which the English had brought - for example the tradition of parliamentary democracy - and the two countries continued to have close cultural and economic ties.

Gandhi's insight can be applied to the argument that the nuclear bombings that destroyed Hiroshima and Nagasaki helped to end World War II and were therefore justified. In fact, these terrible events lead to a nuclear arms race that still casts an extremely dark shadow over the future of human civilization. In this case, as in many others, the end achieved was contaminated by the evil methods used to achieve it.

Today, as in Gandhi's lifetime, we need a revolution. We urgently need to end the institution of war. We need to restore democracy in our own countries when it has been replaced by oligarchy. To save the future, we must act promptly to prevent catastrophic climate change, thermonuclear war and a large-scale global famine. But this revolution must be a non-violent one, like Gandhi's revolutions in South Africa and India.

We must stop using material possessions for social competition

Mahatma Gandhi was assassinated by a Hindu extremist on January 30, 1948. After his death, someone collected and photographed all his worldly goods. These consisted of a

pair of glasses, a pair of sandals and a white homespun loincloth. That was all. Here, as in the Swadeshi movement, we see Gandhi as a pioneer of economics. He deliberately reduced his possessions to an absolute minimum in order to demonstrate that there is no connection between personal merit and material goods. Like Veblen, Mahatma Gandhi told us that we must stop using material goods as a means of social competition. We must start to judge people not by what they have, but by what they are.

7.9 We stand on each other's shoulders

Cultural evolution depends on the non-genetic storage, transmission, diffusion and utilization of information. The development of human speech, the invention of writing, the development of paper and printing, and finally, in modern times, mass media, computers and the Internet: all these have been crucial steps in society's explosive accumulation of information and knowledge. Human cultural evolution proceeds at a constantly-accelerating speed, so great in fact that it threatens to shake society to pieces.

In many respects, our cultural evolution can be regarded as an enormous success. However, at the start of the 21st century, most thoughtful observers agree that civilization is entering a period of crisis. As all curves move exponentially upward, population, production, consumption, rates of scientific discovery, and so on, one can observe signs of increasing environmental stress, while the continued existence and spread of nuclear weapons threaten civilization with destruction. Thus, while the explosive growth of knowledge has brought many benefits, the problem of achieving a stable, peaceful and sustainable world remains serious, challenging and unsolved.

Our modern civilization has been built up by means of a worldwide exchange of ideas and inventions. It is built on the achievements of many ancient cultures. China, Japan, India, Mesopotamia, Egypt, Greece, the Islamic world, Christian Europe, and the Jewish intellectual traditions, all have contributed. Potatoes, corn, squash, vanilla, chocolate, chili peppers, and quinine are gifts from the American Indians.

The sharing of scientific and technological knowledge is essential to modern civilization. The great power of science is derived from an enormous concentration of attention and resources on the understanding of a tiny fragment of nature. It would make no sense to proceed in this way if knowledge were not permanent, and if it were not shared by the entire world.

Science is not competitive. It is cooperative. It is a great monument built by many thousands of hands, each adding a stone to the cairn. This is true not only of scientific knowledge but also of every aspect of our culture, history, art and literature, as well as the skills that produce everyday objects upon which our lives depend. Civilization is cooperative. It is not competitive.

Our cultural heritage is not only immensely valuable; it is also so great that no individual comprehends all of it. We are all specialists, who understand only a tiny fragment of the enormous edifice. No scientist understands all of science. Perhaps Leonardo da Vinci could come close in his day, but today it is impossible. Nor do the vast majority people

who use cell phones, personal computers and television sets every day understand in detail how they work. Our health is preserved by medicines, which are made by processes that most of us do not understand, and we travel to work in automobiles and buses that we would be completely unable to construct.

The fragility of modern society

As our civilization has become more and more complex, it has become increasingly vulnerable to disasters. We see this whenever there are power cuts or transportation failures due to severe storms. If electricity should fail for a very long period of time, our complex society would cease to function. The population of the world is now so large that it is completely dependent on the high efficiency of modern agriculture. We are also very dependent on the stability of our economic system.

The fragility of modern society is particularly worrying, because, with a little thought, we can predict several future threats which will stress our civilization very severely. We will need much wisdom and solidarity to get safely through the difficulties that now loom ahead of us.

We can already see the the problem of famine in vulnerable parts of the world. Climate change will make this problem more severe by bringing aridity to parts of the world that are now large producers of grain, for example the Middle West of the United States. Climate change has caused the melting of glaciers in the Himalayas and the Andes. When these glaciers are completely melted, China, India and several countries in South America will be deprived of their summer water supply. Water for irrigation will also become increasingly problematic because of falling water tables. Rising sea levels will drown many rice-growing areas in South-East Asia. Finally, modern agriculture is very dependent on fossil fuels for the production of fertilizer and for driving farm machinery. In the future, high-yield agriculture will be dealt a severe blow by the rising price of fossil fuels.

Economic collapse is another threat that we will have to face in the future. Our present fractional reserve banking system is dependent on economic growth. But perpetual growth of industry on a finite planet is a logical impossibility. Thus we are faced with a period of stress, where reform of our growth-based economic system and great changes of lifestyle will both become necessary.

How will we get through the difficult period ahead? I believe that solutions to the difficult problems of the future are possible, but only if we face the problems honestly and make the adjustments which they demand. Above all, we must maintain our human solidarity.

The great and complex edifice of human civilization is far too precious to be risked in a thermonuclear war. It has been built by all humans, working together. And by working together, we must now ensure that it is handed on intact to our children and grandchildren.

7.10 The collective human consciousness

No man is an island entire of itself; every man is a piece of the continent, a part of the main, John Donne (1572-1631)

If I have seen further it is by standing on ye shoulders of Giants, Isaac Newton (1643-1727)

One needs an exceptional stupidity even to question the urgency we are under to establish some effective World Pax, before gathering disaster overwhelms us. The problem of reshaping human affairs on a world-scale, this World problem, is drawing together an ever-increasing multitude of minds. H.G. Wells (1866-1946)

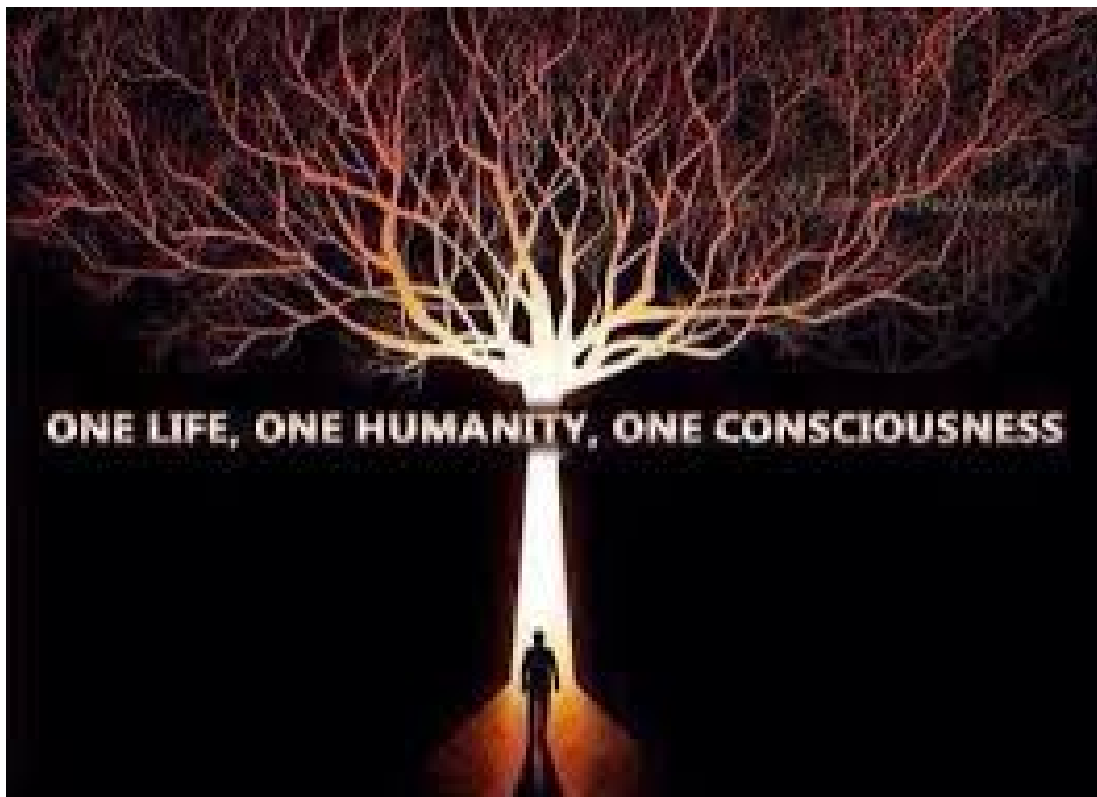
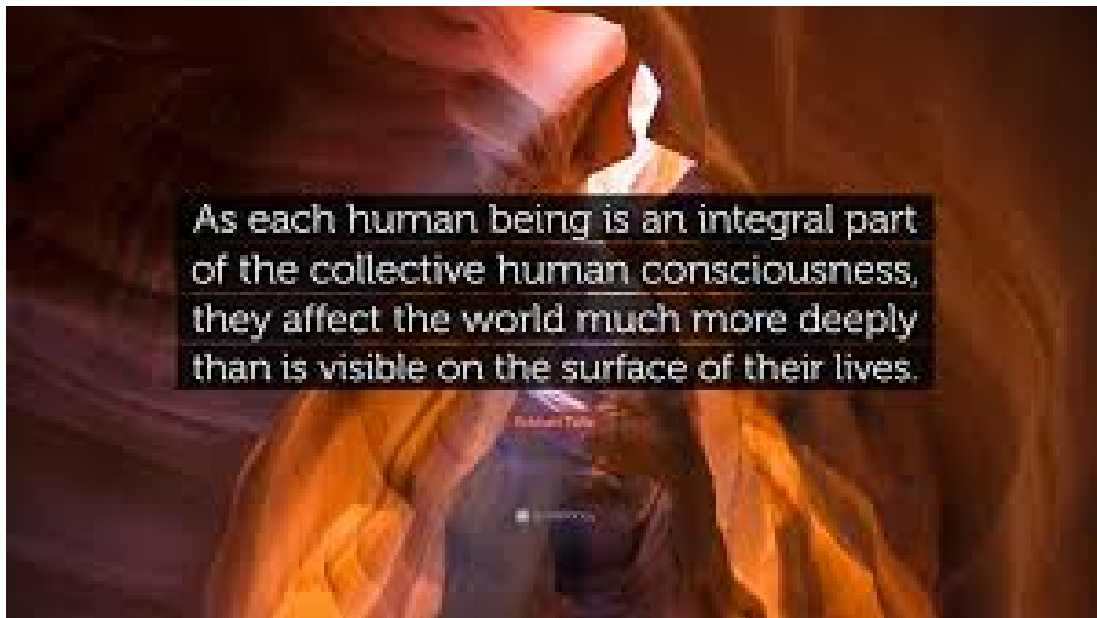
The Open Access Movement has fought valiantly to ensure that scientists do not sign their copyrights away but instead ensure their work is published on the Internet, under terms that allow anyone to access it., Aaron Schwartz (1986-2013)

Sharp qualitative discontinuities have occurred several times before during the earth's 4-billion year evolutionary history: A dramatic change occurred when autocatalytic systems first became surrounded by a cell membrane. Another sharp transition occurred when photosynthesis evolved, and a third when the enormously more complex eukaryotic cells developed from the prokaryotes. The evolution of multicellular organisms also represents a sharp qualitative change. Undoubtedly the change from molecular information transfer to cultural information transfer is an even more dramatic shift to a higher mode of evolution than the four sudden evolutionary gear-shifts just mentioned. Human cultural evolution began only an instant ago on the time-scale of genetic evolution. Already it has completely changed the planet. We have no idea where it will lead.

The whole is greater than the sum of its parts. Human society is a superorganism, far greater than any individual in history or in the present. The human superorganism has a supermind, a collective consciousness far greater than the consciousness of individuals. Each individual contributes a stone to the cairn of civilization, but our astonishing understanding of the universe is a collective achievement.

Science derives its great power from the concentration of enormous resources on a tiny fragment of reality. It would make no sense to proceed in this way if knowledge were not permanent and if information were not shared globally. But scientists of all nations pool their knowledge at international conferences and through international publications. Scientists stand on each other's shoulders. Their shared knowledge is far greater than the fragments that each contributes.

Other aspects of culture are also cooperative and global. For example, Japanese woodblock printers influenced the French Impressionists. The nonviolent tradition of Shelly, Thoreau, Tolstoy, Gandhi, Martin Luther King and Nelson Mandela is international. Culture is cooperative. It is not competitive. Global cultural cooperation can lead us to a sustainable and peaceful society. Our almost miraculous modern communications media, if properly used, can give us a stable, prosperous and cooperative future society.





Suggestions for further reading

1. R. Axelrod, *The Evolution of Cooperation*, Basic Books, New York, (1984).
2. W. Brandt, *World Armament and World Hunger: A Call for Action*, Victor Gollanz Ltd., London, (1982).
3. E. Chivian, and others (eds.), *Last Aid: The Medical Dimensions of Nuclear War*, W.H. Freeman, San Fransisco, (1982).
4. I. Eibl-Eibesfeldt, *The Biology of War and Peace*, Thames and Hudson, New York, (1979).
5. R.A. Hinde, *Biological Basis for Human Social Behaviour*, McGraw-Hill, New York, (1977).
6. R.A. Hinde, *Towards Understanding Relationships*, Academic Press, London, (1979).
7. M. Khanert and others (eds.), *Children and War*, Peace Union of Finland, Helsinki, (1983).
8. K. Lorentz, *On Aggression*, Bantam Books, New York, (1977).
9. Medical Association's Board of Science and Education, *The Medical Effects of Nuclear War*, Wiley, (1983).
10. M. Renner, *Swords into Plowshares: Converting to a Peace Economy*, Worldwatch Paper 96, Worldwatch Institute, Washington D.C., (1990).
11. J. Rotblat (ed.), *Shaping Our Common Future: Dangers and Opportunities (Proceedings of the Forty-Second Pugwash Conference on Science and World Affairs)*, World Scientific, London, (1994).
12. R.L. Sivard, *World Military and Social Expenditures*, World Priorities, Box 25140, Washington, D.C. 20007, (published annually).
13. J.E. Slater, *Governance*, Aspen Institute for Humanistic Studies, New York, (1976).
14. 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).
15. A. Szent-Györgyi, *The Crazy Ape*, Philosophical Library, New York, (1970).
16. J. Tinbergen (coordinator), *Reshaping the International Order*, Dutton, New York, (1976).
17. C. Zahn-Waxler, *Altruism and Aggression: Biological and Social Origins*, Cambridge University Press, (1986).
18. J.L. Henderson, *Hiroshima*, Longmans (1974).
19. A. Osada, *Children of the A-Bomb, The Testament of Boys and Girls of Hiroshima*, Putnam, New York (1963).
20. M. Hachiya, M.D., *Hiroshima Diary*, The University of North Carolina Press, Chapel Hill, N.C. (1955).
21. M. Yass, *Hiroshima*, G.P. Putnam's Sons, New York (1972).
22. R. Jungk, *Children of the Ashes*, Harcourt, Brace and World (1961).
23. B. Hirschfield, *A Cloud Over Hiroshima*, Baily Brothers and Swinfin Ltd. (1974).
24. J. Hersey, *Hiroshima*, Penguin Books Ltd. (1975).
25. R. Rhodes, *Dark Sun: The Making of the Hydrogen Bomb*, Simon and Schuster, New York, (1995)

26. R. Rhodes, *The Making of the Atomic Bomb*, Simon and Schuster, New York, (1988).
27. D.V. Babst et al., *Accidental Nuclear War: The Growing Peril*, Peace Research Institute, Dundas, Ontario, (1984).
28. S. Britten, *The Invisible Event: An Assessment of the Risk of Accidental or Unauthorized Detonation of Nuclear Weapons and of War by Miscalculation*, Menard Press, London, (1983).
29. M. Dando and P. Rogers, *The Death of Deterrence*, CND Publications, London, (1984).
30. N.F. Dixon, *On the Psychology of Military Incompetence*, Futura, London, (1976).
31. D. Frei and C. Catrina, *Risks of Unintentional Nuclear War*, United Nations, Geneva, (1982).
32. H. L'Etang, *Fit to Lead?*, Heinemann Medical, London, (1980).
33. SPANW, *Nuclear War by Mistake - Inevitable or Preventable?*, Swedish Physicians Against Nuclear War, Lulea, (1985).
34. J. Goldblat, *Nuclear Non-proliferation: The Why and the Wherefore*, (SIPRI Publications), Taylor and Francis, (1985).
35. IAEA, *International Safeguards and the Non-proliferation of Nuclear Weapons*, International Atomic Energy Agency, Vienna, (1985).
36. J. Schear, ed., *Nuclear Weapons Proliferation and Nuclear Risk*, Gower, London, (1984).
37. D.P. Barash and J.E. Lipton, *Stop Nuclear War! A Handbook*, Grove Press, New York, (1982).
38. C.F. Barnaby and G.P. Thomas, eds., *The Nuclear Arms Race: Control or Catastrophe*, Francis Pinter, London, (1982).
39. L.R. Beres, *Apocalypse: Nuclear Catastrophe in World Politics*, Chicago University press, Chicago, IL, (1980).
40. F. Blackaby et al., eds., *No-first-use*, Taylor and Francis, London, (1984).
41. NS, ed., *New Statesman Papers on Destruction and Disarmament* (NS Report No. 3), New Statesman, London, (1981).
42. H. Caldicot, *Missile Envy: The Arms Race and Nuclear War*, William Morrow, New York, (1984).
43. R. Ehrlich, *Waging the Peace: The Technology and Politics of Nuclear Weapons*, State University of New York Press, Albany, NY, (1985).
44. W. Epstein, *The Prevention of Nuclear War: A United Nations Perspective*, Gunn and Hain, Cambridge, MA, (1984).
45. W. Epstein and T. Toyoda, eds., *A New Design for Nuclear Disarmament*, Spokesman, Nottingham, (1975).
46. G.F. Kennan, *The Nuclear Delusion*, Pantheon, New York, (1983).
47. R.J. Lifton and R. Falk, *Indefensible Weapons: The Political and Psychological Case Against Nuclearism*, Basic Books, New York, (1982).
48. J.R. Macy, *Despair and Personal Power in the Nuclear Age*, New Society Publishers, Philadelphia, PA, (1983).

49. A.S. Miller et al., eds., *Nuclear Weapons and Law*, Greenwood Press, Westport, CT, (1984).
50. MIT Coalition on Disarmament, eds., *The Nuclear Almanac: Confronting the Atom in War and Peace*, Addison-Wesley, Reading, MA, (1984).
51. UN, *Nuclear Weapons: Report of the Secretary-General of the United Nations*, United Nations, New York, (1980).
52. IC, *Proceedings of the Conference on Understanding Nuclear War*, Imperial College, London, (1980).
53. B. Russell, *Common Sense and Nuclear Warfare*, Allen and Unwin, London, (1959).
54. F. Barnaby, *The Nuclear Age*, Almqvist and Wiksell, Stockholm, (1974).
55. D. Albright, F. Berkhout and W. Walker, *Plutonium and Highly Enriched Uranium 1996: World Inventories, Capabilities and Policies*, Oxford University Press, Oxford, (1997).
56. G.T. Allison et al., *Avoiding Nuclear Anarchy: Containing the Threat of Loose Russian Nuclear Weapons and Fissile Material*, MIT Press, Cambridge MA, (1996).
57. B. Bailin, *The Making of the Indian Atomic Bomb: Science, Secrecy, and the Post-colonial State*, Zed Books, London, (1998).
58. G.K. Bertsch and S.R. Grillot, (Eds.), *Arms on the Market: Reducing the Risks of Proliferation in the Former Soviet Union*, Routledge, New York, (1998).
59. P. Bidawi and A. Vanaik, *South Asia on a Short Fuse: Nuclear Politics and the Future of Global Disarmament*, Oxford University Press, Oxford, (2001).
60. F.A. Boyle, *The Criminality of Nuclear Deterrence: Could the U.S. War on Terrorism Go Nuclear?*, Clarity Press, Atlanta GA, (2002).
61. G. Burns, *The Atomic Papers: A Citizen's Guide to Selected Books and Articles on the Bomb, the Arms Race, Nuclear Power, the Peace Movement, and Related Issues*, Scarecrow Press, Metuchen NJ, (1984).
62. L. Butler, *A Voice of Reason*, The Bulletin of Atomic Scientists, **54**, 58-61, (1998).
63. R. Butler, *Fatal Choice: Nuclear Weapons and the Illusion of Missile Defense*, Westview Press, Boulder CO, (2001).
64. R.P. Carlisle (Ed.), *Encyclopedia of the Atomic Age*, Facts on File, New York, (2001).
65. G.A. Cheney, *Nuclear Proliferation: The Problems and Possibilities*, Franklin Watts, New York, (1999).
66. A. Cohen, *Israel and the Bomb*, Columbia University Press, New York, (1998).
67. S.J. Diehl and J.C. Moltz, *Nuclear Weapons and Nonproliferation: A Reference Handbook*, ABC-Clio Information Services, Santa Barbara CA, (2002).
68. H.A. Feiveson (Ed.), *The Nuclear Turning Point: A Blueprint for Deep Cuts and De-alerting of Nuclear Weapons*, Brookings Institution Press, Washington D.C., (1999).
69. R. Forsberg et al., *Nonproliferation Primer: Preventing the Spread of Nuclear, Chemical and Biological Weapons*, MIT Press, Cambridge, (1995).
70. R. Hilsman, *From Nuclear Military Strategy to a World Without War: A History and a Proposal*, Praeger Publishers, Westport, (1999).

71. International Physicians for the Prevention of Nuclear War and The Institute for Energy and Environmental Research *Plutonium: Deadly Gold of the Nuclear Age*, International Physicians Press, Cambridge MA, (1992).
72. R.W. Jones and M.G. McDonough, *Tracking Nuclear Proliferation: A Guide in Maps and Charts, 1998*, The Carnegie Endowment for International Peace, Washington D.C., (1998).
73. R.J. Lifton and R. Falk, *Indefensible Weapons: The Political and Psychological Case Against Nuclearism*, Basic Books, New York, (1982).
74. J. Rotblat, J. Steinberger and B. Udgaonkar (Eds.), *A Nuclear-Weapon-Free World: Desirable? Feasible?*, Westview Press, (1993).
75. The United Methodist Council of Bishops, *In Defense of Creation: The Nuclear Crisis and a Just Peace*, Graded Press, Nashville, (1986).
76. S.R. Weart, *Nuclear Fear: A History of Images*, Harvard University Press, (1988).
77. C. Langley, *Soldiers in the Laboratory: Military Involvement in Science and Technology and Some Alternatives*, Scientists for Global Responsibility, (2005).
78. M.T. Klare, *Blood and Oil: The Dangers and Consequences of America's Growing Dependency on Imported Petroleum*, Metropolitan Books, New York, (2004); paperback, Owl Books, (2005).
79. M.T. Klare, *Resource Wars: The New Landscape of Global Conflict*, reprint edition, Owl Books, New York, (2002).
80. M. Renner, *The Anatomy of Resource Wars*, Worldwatch Paper #162, Worldwatch Institute, (2002).
81. W.B. Gallie, *Understanding War: Points of Conflict*, Routledge, London, (1991).
82. R. Falk and S.S. Kim, eds., *The War System: An Interdisciplinary Approach*, Westview, Boulder, CO, (1980).
83. J.D. Clarkson and T.C. Cochran, eds., *War as a Social Institution*, Columbia University Press, New York, (1941).
84. S. Melman, *The Permanent War Economy*, Simon and Schuster, (1974).
85. B. Broms, *United Nations*, Suomalainen Tiedeakatemia, Helsinki, (1990).
86. S. Rosenne, *The Law and Practice at the International Court*, Dordrecht, (1985).
87. S. Rosenne, *The World Court - What It Is and How It Works*, Dordrecht, (1995).
88. J. D'Arcy and D. Harris, *The Procedural Aspects of International Law (Book Series), Volume 25*, Transnational Publishers, Ardsley, New York, (2001).
89. H. Cullen, *The Collective Complaints Mechanism Under the European Social Charter*, European Law Review, Human Rights Survey, p. 18-30, (2000).
90. S.D. Bailey, *The Procedure of the Security Council*, Oxford, (1988).
91. R.A. Akindale, *The Organization and Promotion of World Peace: A Study of Universal-Regional Relationships*, Univ. Toronto Press, Toronto, Ont., (1976).
92. J.S. Applegate, *The UN Peace Imperative*, Vantage Press, New York, (1992).
93. S.E. Atkins, *Arms Control, Disarmament, International Security and Peace: An Annotated Guide to Sources, 1980-1987*, Clio Press, Santa Barbara, CA, (1988).
94. N. Ball and T. Halevy, *Making Peace Work: The Role of the International Development Community*, Overseas Development Council, Washington DC, (1996).

95. F. Barnaby, Ed., *The Gaia Peace Atlas: Survival into the Third Millennium*, Doubleday, New York, (1988)
96. J.H. Barton, *The Politics of Peace: An Evaluation of Arms Control*, Stanford Univ. Press, Stanford, CA, (1981).
97. W. Bello, *Visions of a Warless World*, Friends Committee on National Education Fund, Washington DC, (1986).
98. A. Boserup and A. Mack, *Abolishing War: Cultures and Institutions; Dialogue with Peace Scholars Elise Boulding and Randall Forsberg*, Boston Research Center for the Twenty-first Century, Cambridge, MA, (1998).
99. E. Boulding et al., *Bibliography on World Conflict and Peace*, Westview Press, Boulder, CO, (1979).
100. E. Boulding et al., Eds., *Peace, Culture and Society: Transnational Research Dialogue*, Westview Press, Boulder, CO, (1991).
101. A.T. Bryan et al., Eds., *Peace, Development and Security in the Caribbean*, St. Martins Press, New York, (1988).
102. A.L. Burns and N. Heathcote, *Peace-Keeping by UN Forces from Suez to Congo*, Praeger, New York, (1963).
103. F. Capra and C. Spretnak, *Green Politics: The Global Promise*, E.P. Dutton, New York, (1986).
104. N. Carstarphen, *Annotated Bibliography of Conflict Analysis and Resolution*, Inst. for Conflict Analysis and Resolution, George Mason Univ., Fairfax, VA, (1997).
105. N. Chomsky, *Peace in the Middle East? Reflections on Justice and Nationhood*, Vintage Books, New York, (1974).
106. G. Clark and L. Sohn, *World Peace Through World Law*, World Without War Pubs., Chicago, IL, (1984).
107. K. Coates, *Think Globally, Act Locally: The United Nations and the Peace Movements*, Spokesman Books, Philadelphia, PA, (1988).
108. G. De Marco and M. Bartolo, *A Second Generation United Nations: For Peace and Freedom in the 20th Century*, Columbia Univ. Press, New York, (1997).
109. F.M. Deng and I.W. Zartman, Eds., *Conflict Resolution in Africa*, Brookings Institution, Washington, DC, (1991).
110. W. Desan, *Let the Future Come: Perspectives for a Planetary Peace*, Georgetown Univ. Press, Washington, DC, (1987).
111. D. Deudney, *Whole Earth Security. A Geopolitics of Peace*, Worldwatch paper 55. Worldwatch Institute, Washington, DC, (1983).
112. A.J. Donovan, *World Peace? A Work Based on Interviews with Foreign Diplomats*, A.J. Donovan, New York, (1986).
113. R. Duffey, *International Law of Peace*, Oceania Pubs., Dobbs Ferry, NY, (1990).
114. L.J. Dumas, *The Socio-Economics of Conversion From War to Peace*, M.E. Sharpe, Armonk, NY, (1995).
115. W. Durland, *The Illegality of War*, National Center on Law and Pacifism, Colorado Springs, CO, (1982).

116. F. Esack, *Qur'an, Liberation and Pluralism: An Islamic Perspective on Interreligious Solidarity Against Oppression*, Oxford Univ. Press, London, (1997).
117. I. Hauchler and P.M. Kennedy, Eds., *Global Trends: The World Almanac of Development and Peace*, Continuum Pubs., New York, (1995).
118. H.B. Hollins et al., *The Conquest of War: Alternative Strategies for Global Security*, Westview Press, Boulder, CO, (1989).
119. H.J. Morgenthau, *Peace, Security and the United Nations*, Ayer Pubs., Salem, NH, (1973).
120. C.C. Moskos, *Peace Soldiers: The Sociology of a United Nations Military Force*, Univ. of Chicago Press, Chicago, IL, (1976).
121. L. Pauling, *Science and World Peace*, India Council for Cultural Relations, New Delhi, India, (1967).
122. C. Peck, *The United Nations as a Dispute Resolution System: Improving Mechanisms for the Prevention and Resolution of Conflict*, Kluwer, Law and Tax, Cambridge, MA, (1996).
123. D. Pepper and A. Jenkins, *The Geography of Peace and War*, Basil Blackwell, New York, (1985).
124. J. Perez de Cuellar, *Pilgrimage for Peace: A Secretary General's Memoir*, St. Martin's Press, New York, (1997).
125. R. Pickus and R. Woito, *To End War: An Introduction to the Ideas, Books, Organizations and Work That Can Help*, World Without War Council, Berkeley, CA, (1970).
126. S.R. Ratner, *The New UN Peacekeeping: Building Peace in Lands of Conflict after the Cold War*, St. Martins Press, New York, (1995).
127. I.J. Rikhye and K. Skjelsbaek, Eds., *The United Nations and Peacekeeping: Results, Limitations and Prospects: The Lessons of 40 Years of Experience*, St. Martins Press, New York, (1991).
128. J. Rotblat, Ed., *Scientists in Quest for Peace: A History of the Pugwash Conferences*, MIT Press, Cambridge, MA, (1972).
129. J. Rotblat, Ed., *Scientists, The Arms Race, and Disarmament*, Taylor and Francis, Bristol, PA, (1982).
130. J. Rotblat, Ed., *Striving for Peace, Security and Development in the World*, World Scientific, River Edge, NJ, (1991).
131. J. Rotblat, Ed., *Towards a War-Free World*, World Scientific, River Edge, NJ, (1995).
132. J. Rotblat, Ed., *Nuclear Weapons: The Road to Zero*, Westview, Boulder, CO, (1998).
133. J. Rotblat and L. Valki, Eds., *Coexistence, Cooperation and Common Security*, St. Martins Press, New York, (1988).
134. United Nations, *Peaceful Settlement of Disputes between States: A Select Bibliography*, United Nations, New York, (1991).
135. United States Arms Control and Disarmament Agency, *Arms Control and Disarmament Agreements: Texts and Histories of Negotiations*, USACDA, Washington, DC, (updated annually)

136. D. Fahrni, *An Outline History of Switzerland - From the Origins to the Present Day*, Pro Helvetia Arts Council of Switzerland, Zurich, (1994).
137. J.M. Luck, *A History of Switzerland*, Sposs, Palo Alto, CA, (1985).
138. T. Jackson, *Material Concerns: Pollution, Profit and the Quality of Life*, Routledge, (2004).
139. T. Jackson, *Motivating Sustainable Consumption*, Report to the Sustainable Development Research Network, January (2005).
140. T. Jackson, *The Earthscan Reader in Sustainable Consumption*, Earthscan, (2006).
141. J.S. Avery, *Information Theory and Evolution, 2nd Edition*, World Scientific, (2012).
142. A.J. Lotka, *Elements of Mathematical Biology*, Dover, (1956).
143. E.O. Wilson *Sociobiology: The New Synthesis*, Harvard University Press, (1975).
144. E.O. Wilson, *The Superorganism: The Beauty, Elegance, and Strangeness of Insect Societies*, W.W. Norton, (2009).
145. F. Soddy, *Wealth, Virtual Wealth and Debt. The solution of the economic paradox*, George Allen and Unwin, (1926).
146. F. Soddy, *The Role of Money*, George Routledge and Sons, London, (1934)
147. N. Georgescu-Roegen, *Energy and Economic Myths : Institutional and Analytical Economic Essays*, Pergamon Press, (1976).
148. N. Georgescu-Roegen, *The Entropy Law and the Economic Process*, Harvard University Press, (1971).
149. J. Rifkin and T. Howard, *Entropy: A New World View* The Viking Press, New York (1980).
150. P. Bartelmus, *Environment, Growth and Development: The Concepts and Strategies of Sustainability*, Routledge, New York, (1994).
151. H.E. Daly and K.N. Townsend, (editors), *Valuing the Earth. Economics, Ecology, Ethics*, MIT Press, Cambridge, Massachusetts, (1993)
152. C. Flavin, *Slowing Global Warming: A Worldwide Strategy*, Worldwatch Paper 91, Worldwatch Institute, Washington D.C., (1989).
153. S.H. Schneider, *The Genesis Strategy: Climate and Global Survival*, Plenum Press, (1976).
154. WHO/UNFPA/UNICEF, *The Reproductive Health of Adolescents: A Strategy for Action*, World Health Organization, Geneva, (1989).
155. World Commission on Environment and Development, *Our Common Future*, Oxford University Press, (1987).
156. W. Jackson, *Man and the Environment*, W.C. Brown, Dubuque, Iowa, (1971).
157. T. Berry, *The Dream of the Earth*, Sierra Club Books, San Francisco, (1988).
158. T.M. Swanson, ed., *The Economics and Ecology of Biodiversity Decline: The Forces Driving Global Change*, Cambridge University Press, (1995).
159. F.H. Bormann, *Unlimited Growth: Growing, Growing, and Gone?*, BioScience 22: 706-9, (1972).
160. L.G. Brookes, *A Low-Energy Strategy for the United Kingdom*, Atom 269: 73-8, (1979).

161. J. Cherfas, *Skeptics and Visionaries Examine Energy Saving*, *Science* 251: 154-6, (1991).
162. C.J. Cleveland, *Energy Quality and Energy Surplus in the Extraction of Fossil Fuels in the US*, *Ecological Economics* 6: 139-62, (1992).
163. 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).
164. P. Cloud, *Entropy, Materials, and Prosperity*, *Geologische Rundschau* 66: 678-96, (1978).
165. 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).
166. H.E. Daly, *On Nicholas Georgescu-Roegen's Contributions to Economics: An Obituary Essay*, *Ecological Economics* 13: 149-54, (1995).
167. H.E. Daly, *Georgescu-Roegen versus Solow/Stiglitz*, *Ecological Economics* 22: 267-8, (1997).
168. M. Eigen, *Selforganization of Matter and the Evolution of Biological Macro- molecules*, *Naturwissenschaften* 58(10): 465-523, (1971).
169. S.O. Funtowicz and Jerry R. Ravetz, *Post Normal Science: A New Science for New Times*, *Scientific European* 266: 20-2, (1990).
170. N. Georgescu-Roegen, *Fixed Coefficients of Production and the Marginal Productivity Theory*, *Review of Economic Studies* 3: 40-9, (1935a).
171. N. Georgescu-Roegen, (1935b) *Note on a Proposition of Pareto*, *Quarterly Journal of Economics* 49: 706-14.
172. N. Georgescu-Roegen, *Marginal Utility of Money and Elasticities of Demand*, *Quarterly Journal of Economics* 50: 533-9, (1936a).
173. N. Georgescu-Roegen, *The Pure Theory of Consumer's Behavior*, *Quarterly Journal of Economics* 50: 545-93, (1936b).
174. 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).
175. N. Georgescu-Roegen, *The Entropy Law and the Economic Process*, Cambridge, MA: Harvard University Press, (1971).
176. N. Georgescu-Roegen, *Energy and Economic Myths*, *Southern Economic Journal* 41: 347-81, (1975).
177. N. Georgescu-Roegen, *Energy and Economic Myths*. New York: Pergamon Press, (1976).
178. N. Georgescu-Roegen, *Inequality, Limits and Growth from a Bioeconomic Viewpoint*, *Review of Social Economy* 35: 361-75, (1977a).
179. N. Georgescu-Roegen, *The Steady State and Ecological Salvation: A Thermodynamic Analysis*, *BioScience* 27: 266-70, (1977b).
180. N. Georgescu-Roegen, *Energy Analysis and Economic Valuation*, *Southern Economic Journal* 45: 1023-58, (1979a).

181. N. Georgescu-Roegen, *Methods in Economic Science*, Journal of Economic Issues 13 (2): 317-28, (1979b).
182. N. Georgescu-Roegen, *Methods in Economic Science: A Rejoinder*, Economic Issues 15: 188-93, (1981).
183. N. Georgescu-Roegen, *The Promethean Condition of Viable Technologies*, Materials and Society 7: 425-35, (1983).
184. 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).
185. N. Georgescu-Roegen, *An Emigrant from a Developing Country: Autobiographical Notes-I*, Banca Nazionale del Lavoro Quarterly Review 164: 3-31, (1988a).
186. 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).
187. 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).
188. 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).
189. 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).
190. M. Giampietro, *Sustainability and Technological Development in Agriculture: A Critical Appraisal of Genetic Engineering*, BioScience 44(10): 677-89, (1994).
191. M. Giampietro and Kozo Mayumi, *Another View of Development, Ecological Degradation and North-South Trade*, Review of Social Economy 56: 21-37, (1998).
192. M. Giampietro and Kozo Mayumi, *The Biofuel Delusion: The Fallacy of Large Scale Agro-biofuel Production*, London: Earthscan, (2009).
193. R. Goldschmidt, *Some Aspects of Evolution*, Science 78: 539-47, (1933).
194. S.J. Gould, *The Return to Hopeful Monsters*, Natural History 86: 22-30, (1977).
195. S.J. Gould and Niles Eldredge, *Punctuated Equilibria: The Tempo and Mode of Evolution Reconsidered*, Paleobiology 3: 115-51, (1977).
196. J. Gowdy, *The Value of Biodiversity: Markets, Society and Ecosystems*, Land Economics 73(1): 25-41, (1997).
197. J. Gribbin, *The Death of the Sun* New York: Delacorte Press, (1980).
198. C.A.S. Hall, Cutler J. Cleveland and Robert Kaufman, *Energy and Resource Quality* New York: John Wiley and Sons, (1986).
199. S.R. Ichtiaque and Stephen H. Schneider, *Atmospheric Carbon Dioxide and Aerosols: Effects of Large Increases on Global Climate*, Science 173: 138-41, (1971).
200. 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).

201. F. Jevons, *Greenhouse: A Paradox*, Search 21: 171-2, (1990).
202. W.S. Jevons, *The Coal Question* (reprint of 3rd edn, 1906). New York: Augustus M. Kelley, (1965).
203. N. Kawamiya, *Entropii to Kougyoushakai no Sentaku (Entropy and Future Choices for the Industrial Society)*, Tokyo: Kaimei, (1983).
204. J.D. Khazzoom, *Economic Implications of Mandated Efficiency Standards for Household Appliances*, Energy Journal 1: 21-39, (1980).
205. J.D. Khazzoom, *Energy Saving Resulting from the Adoption of More Efficient Appliances*, Energy Journal 8: 85-9, (1987).
206. T.C. Koopmans, *Three Essays on the State of Economic Science*, New York: McGraw-Hill Book Company, (1957).
207. T.S. Kuhn, *The Structure of Scientific Revolutions*, Chicago, IL: The University of Chicago Press, (1962).
208. J. von Liebig, *Letters on Modern Agriculture* (J. Blyth ed.). New York: John Wiley, (1959).
209. A.J. Lotka, *Elements of Mathematical Biology*, New York: Dover Publications, (1956).
210. G. Luft, *Fueling the Dragon: China's Race Into the Oil Market*. <http://www.iags.org/china.htm>, (2007).
211. K. Mayumi, *The Origins of Ecological Economics: The Bioeconomics of Georgescu-Roegen*, London: Routledge, (2001).
212. 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).
213. 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).
214. 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).
215. Newman, Peter, *Greenhouse, Oil and Cities*, Futures May: 335-48, (1991).
216. D. Pearce, *Substitution and Sustainability: Some Reflections on Georgescu-Roegen*, Ecological Economics 22: 295-7, (1997).
217. D. Pearce, Edward Barbier and Anil Markandya, *Sustainable Development*, Hampshire: Edward Elgar, (1990).
218. J. Polimeni, Kozo Mayumi, Mario Giampietro and Blake Alcott, *The Jevons Paradox and the Myth of Resource Efficiency Improvements*, London: Earthscan, (2008).
219. J.F. Randolph, *Basic Real and Abstract Analysis*, New York: Academic Press, (1968).
220. 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).
221. E. Schrödinger, *What is Life? With Mind and Matter and Autobiographical Sketches*, Cambridge: Cambridge University Press, (1967).

222. J.A. Schumpeter, *The Theory of Economic Development*, Cambridge, MA: Harvard Economic Press, (1951).
223. 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).
224. M.R. Simmons, *Twilight in the Desert: The Coming Saudi Oil Shock and the World Economy* New Jersey: John Wiley and Sons, Inc., (2005).
225. B.J. Skinner, *Earth Resource (3rd edn)*, New Jersey: Prentice Hall, (1986).
226. V. Smil, *Global Catastrophes and Trends: The Next Fifty Years* Cambridge, MA: MIT Press, (2008).
227. R. Solow, *Technical Change and the Aggregate Production Function*, *Review of Economics and Statistics* 39: 312-20, (1957).
228. R. Solow, *The Economics of Resources or the Resources of Economics*, *American Economic Review* 64: 1-14, (1974).
229. R.E. Ulanowicz, *Growth and Development: Ecosystem Phenomenology* New York: Springer-Verlag, (1986).
230. US Geological Survey, *Commodity Statistics and Information*, (2005).
231. G.K. Zipf, *National Unity and Disunity: The Nation as a Bio-social Organism*. Bloomington, IN: Principia Press, (1941).

Appendix A

SVANTE ARRHENIUS AND CLIMATE SCIENCE

Svante Augustus Arrhenius was born in Wik Castle, Sweden in 1859, the son of Svante Gustav and Carolina Thunberg Arrhenius. He was a child prodigy, who without encouragement from his parents, taught himself to read at the age of 3. As a very young child, he also became an arithmetical prodigy by watching his father add numbers in his account books.

Arrhenius started research at the University of Uppsala, but he was dissatisfied with the instruction in physics and chemistry. In 1881 he moved to the Swedish Academy of Sciences in Stockholm. There he produced a Ph.D. dissertation which focused on conductivity of electrolytes. The dissertation was so contrary to the chemical ideas of the time that it was accepted only grudgingly by the committee judging it, and Arrhenius was only granted a 4th class degree. Nevertheless, the 56 propositions put forward in the dissertation are universally accepted today, almost entirely without modification, and they won Arrhenius the 1903 Nobel Prize in Chemistry.

Michael Faraday (1791-1867) had previously shown that charged particles, which he named “ions”, could carry an electrical current through a solution. Arrhenius developed Faraday’s concept of ions by demonstrating that when salts are dissolved in water, ions are present even without an electrical current. He also defined acids to be substances which produce solutions in which H^+ ions predominate, while in bases, when dissolved, produce solutions in which OH^- ions predominate.

In chemical reaction theory, Arrhenius introduced the idea of an activation energy, E_a , which can be thought of as the height of an energy barrier which must be surmounted in order for the reaction to take place. Thus most chemical reactions become more probable when the temperature T is raised, since the rapid motion of the reactants at higher temperatures can supply the energy needed to overcome the reaction barrier E_a . Arrhenius connected the concept of activation energy with the statistical mechanics of Ludwig Boltzmann (1844-1906) by means of his famous equation:

$$k = A e^{-E_a/RT}$$



Figure A.1: Svante Arrhenius (1859-1927) was one of the main founders of physical chemistry and a pioneer of climate science. He was related to climate activist Greta Thunberg, and Greta's father is named after him.

In the Arrhenius equation, k is the reaction rate, A is a constant proportional to the frequency of reactant collisions with the proper orientation, T is the absolute temperature, and R is the constant that appears in the equation of state of a perfect gas, $PV = nRT$.

Climate science

Wikipedia states that “In developing a theory to explain the ice ages, Arrhenius, in 1896, was the first to use basic principles of physical chemistry to calculate estimates of the extent to which increases in atmospheric carbon dioxide (CO₂) will increase Earth's surface temperature through the greenhouse effect.

“These calculations led him to conclude that human-caused CO₂ emissions, from fossil-fuel burning and other combustion processes, are large enough to cause global warming. This conclusion has been extensively tested, winning a place at the core of modern climate science.

“Arrhenius, in this work, built upon the prior work of other famous scientists, including Joseph Fourier, John Tyndall and Claude Pouillet. Arrhenius wanted to determine whether greenhouse gases could contribute to the explanation of the temperature variation between glacial and inter-glacial periods. Arrhenius used infrared observations of the moon - by Frank Washington Very and Samuel Pierpont Langley at the Allegheny Observatory in Pittsburgh - to calculate how much of infrared (heat) radiation is captured by CO₂ and water (H₂O) vapour in Earth's atmosphere...

“Based on information from his colleague Arvid Högbom, Arrhenius was the first person to predict that emissions of carbon dioxide from the burning of fossil fuels and other combustion processes were large enough to cause global warming. In his calculation Arrhenius included the feedback from changes in water vapor as well as latitudinal effects, but he omitted clouds, convection of heat upward in the atmosphere, and other essential factors. His work is currently seen less as an accurate quantification of global warming than as the first demonstration that increases in atmospheric CO₂ will cause global warming, everything else being equal.”

Appendix B

HUMANITY UNITED FOR UNIVERSAL DEMILITARIZATION

World-class pianist talks about the dangers of militarism and the need for an economy of peace, by Miguel Salvado, May 20, 2016

Alfredo Portugheis gave us an interview in Trafalgar Square during the living peace sign rally which took place that afternoon.

Mr. Portugheis has had a successful international career. He's a prominent pianist, masterclass teacher, published author and humanist.

Mr. Portugheis also takes part in several organizations and activities. He founded Opus Musica, co-Founded the Beethoven Piano Society of Europe, is the vice-chairman of the International Society for the Study of Tension in Performance and co-founded the Iberian & Latin American Music Society.

In this interview, Mr. Portugheis talks about the need for the demilitarization of the world, the power struggle that gets people killed in wars, the World War 3 possibility, the hunger in the world, and the need to protect children.

Alfredo Portugheis: Having studied the problems of the world on war and peace, practically since I was born, I realized there is no way we can achieve peace if we continue to produce and sell weapons.

When the president of one country agrees with the president of another to have a war, why should thousands of young soldiers kill and die because of that decision?

Tell us about the HUFUD organization and your role in it.

I'm the founder and president of HUFUD (Humanity United for Universal Demilitarization). Having studied the problems of the world on war and peace, practically since I was born, I realized there is no way we can achieve peace if we continue to produce and sell weapons. Unless we made all toy weapons, but real ones are made for killing.

It's a big lie of government to tell us that weapons are a deterrent, they are not a

deterrent at all. If weapons were a deterrent, we would be giving them to all children in school, so there is never a fight. But we know that this is not true. Because once people have weapons, instead of solving disagreements through dialogue, they just use weapons. I'm entirely opposed to militarism.

I understand the police could have weapons, when necessary. If a criminal runs faster than the police officer, they can stop him with a bullet to the leg. But when the president of one country agrees with the president of another to have a war, why should thousands of young soldiers kill and die just because of that decision? I find that very unfair.

ISIS wouldn't exist. They couldn't be invading towns. They couldn't do anything about what they do if we didn't promote the military trade.

What concrete steps is your organization taking towards that goal?

What I hope is I educate the world to understand that the weapons are never a solution, and people should refuse to participate in these war games that politicians organize for us.

We never ask for wars. You never see a demonstration, in front of government building, of people asking the president to organize a war for them. On the contrary, people are always asking for peace. But governments use propaganda, the public relations machine, to lead us into a war that we don't want.

I hope that all parents will tell their government: we don't make children for you to send them to kill others and deliver our children back to us in a coffin. We have to tell them that enough is enough. Finish with this game of war that you are playing with our children. If you like to have a war, you should have it yourself. Have a duel between one president and another. Why should thousands of people die just because their governments decided to have a war?

Also, the excuse that we're trying to get rid of terrorism is another lie, because we promote terrorism. We sell the weapons to terrorism. We train them. If there were no weapons, even terrorists couldn't organize themselves. ISIS wouldn't exist. They couldn't be invading towns. They couldn't do anything about what they do if we didn't promote the military trade.

Tell us about your background. What brought you to this cause?

I was born in Argentina in a family that escaped World War 2. I spent my childhood and adolescence watching all my family cry because of all the family they lost in the war. The people who were not lucky like them, who managed to escape, and ended up dead.

As a child, I didn't think that some people like my family and others who immigrated to South-America, liked wars. I realized nobody likes wars. I came to Europe and asked everybody, and they didn't like wars. So I started to think, how come if nobody likes wars we have wars all the time? When in studying why I realized that it's business. A fight for power of certain families, royal families, of people wanting to be rich, much more than what they need. They make so much more money than the time to spend it.

Do you believe money is “the root of all evil,” when it comes to this war issue?

When it comes to this, yes. I’m not against money. If politicians want to make money and have a friend who makes trains and he gets him a contract for millions of Pounds and get paid a commission, I’m not against that because he doesn’t have to kill people. He can become rich, but people don’t have to die so that he becomes rich. But if you sell bombs, rockets, tanks, drones, Apache helicopters, all you’re doing is creating unnecessary death and suffering of millions. We’re also creating hunger. So many governments have no money to help the poor people because they spend it on weapons.

We have it even in this country, the UK, you have hospitals closing down, schools in need of money for repairs, libraries closing down. But more money is being spent on militarism all the time.

That’s easy money made by politicians. They send the country into bankruptcy because the weapons, fighters, and warships get bought with money that’s not their own. But the money they make on commissions, that is their money. They take the country into bankruptcy, but they make a personal fortune. I don’t mind the fact that they make money, but that so many people have to die because of this business.

If things don’t change soon, we have to prepare ourselves for World War 3

What are your organization’s prospects for the future?

I hope I find one day a benefactor who can allow me to have a radio station, or even better a TV channel because I want to educate the world. I wrote two books that have been read by many people, but that is not enough. I need to reach many who know nothing about books, not only because they are not interested in reading but because they cannot read and write. Since there are countries with a big percentage of illiteracy, a television program could be heard by people.

I need people to understand, people who are in Sudan, Nigeria, Angola, Uganda, and Kenya. They don’t know why the situation is so bad. They don’t understand how exploited they are by their politicians, by foreigners and many organizations. They are all starving while we are eating in the UK all the food that they produce for us. It’s discussing what’s happening in the world.

And the millions of children, who die every year, that don’t reach the age of four or five. They die because they have no food or medical care. All this could stop if we had no militarism.

We need clever economists who can transform the economy of war into an economy of peace.

How would you like to be remembered?

I hope I’ll produce a change one day in the world. I hope I’m planting the seed that will flourish, hopefully in not too long. Because if things don’t change soon, we have to prepare ourselves for WW3. It’s what our governments want. They are leading us into that. I

need to be heard by many people, not for the sake of being heard, but to make them think and act. It's not enough for me to be opposed to militarism, we need the world to be opposed to it. Even if that will create an economic problem for all the people employed in the military industry. We need clever economists who can transform the economy of war into an economy of peace.

I speak with people who manufacture bombs, and I know. Even they tell me personally they also hate wars. But when a war happens they are very happy because they know that more orders are coming.

I want those who hear me, to think about what I say. And of course, anybody who wants to join me or start in their country, wherever they are, or movement, to continue this work, I'll be very happy to hear from them.

What's the best way to contact your organization?

Through HUFUD.org.



Figure B.1: Peace is possible!



Figure B.2: Alfredo Portugheis.

Appendix C

THE NUCLEAR AGE PEACE FOUNDATION

An interview with Dr. David Krieger, Founder and President of the Nuclear Age Peace Foundation, by J.S. Avery, December, 2018

A series of interviews of outstanding people in the peace movement has been commissioned by the Internet journal *Countercurrents*. Besides being published in *Countercurrents*, the series will also be published as a book. The interview with Dr. David Krieger is part of this series. For practical reasons, it was made by e-mail, rather than face-to-face.

David Krieger, Ph.D. is founder and president of the Nuclear Age Peace Foundation. Amongst several of his wide-spanning leadership endeavors in global peacebuilding, he is a founder and a member of the Global Council of Abolition 2000, councilor on the World Future Council, and is the chair of the Executive Committee of the International Network of Engineers and Scientists for Global Responsibility. He has a BA in Psychology and holds MA and Ph.D. degrees in Political Science from the University of Hawaii as well as a J.D. from the Santa Barbara College of Law; he served for 20 years as a judge pro term for the Santa Barbara Municipal and Superior Courts. Dr. Krieger is the author of many books and studies of peace in the Nuclear Age. He has written or edited more than 20 books and hundreds of articles and book chapters. He is a recipient of several awards and honors, including the OMNI Center for Peace, Justice and Ecology Peace Writing Award for Poetry (2010). He has a new collection of poems entitled *Wake Up*. For more visit the Nuclear Age Peace Foundation website: www.wagingpeace.org.

J.A.: I have long admired your dedicated and heroic life-long work for the complete abolition of nuclear weapons. You did me the great honor of making

me an Advisor to the Nuclear Age Peace Foundation (NAPF). You are both the Founder and the President of the NAPF. Could you tell us a little about your family, and your early life and education? What are the steps that led you to become one of the world's most famous advocates of the complete abolition of nuclear weapons?

D.K.: John, you have honored us by being an advisor to the Nuclear Age Peace Foundation. You are one of the most knowledgeable people I know on the dangers of nuclear and other technologies to the future of life on our planet, and you have written brilliantly about these threats.

Regarding my family, early life and education, I was born three years before the cities of Hiroshima and Nagasaki were destroyed by nuclear weapons. My father was a pediatrician, and my mother a housewife and hospital volunteer. Both were very peace oriented, and both rejected militarism unreservedly. I would describe my early years as largely uneventful. I attended Occidental College, where I received a good liberal arts education. After graduating from Occidental, I visited Japan, and was awakened by seeing the devastation suffered by Hiroshima and Nagasaki. I realized that in the US, we viewed these bombings from above the mushroom cloud as technological achievements, while in Japan the bombings were viewed from beneath the mushroom cloud as tragic events of indiscriminate mass annihilation.

After returning from Japan, I went to graduate school at the University of Hawaii and earned a Ph.D. in political science. I was also drafted into the military, but was able to join the reserves as an alternate way of fulfilling my military obligation. Unfortunately, I was later called to active duty. In the military, I refused orders for Vietnam and filed for conscientious objector status. I believed that the Vietnam War was an illegal and immoral war, and I was unwilling as a matter of conscience to serve there. I took my case to federal court and eventually was honorably discharged from the military. My experiences in Japan and in the U.S. Army helped shape my views toward peace and nuclear weapons. I came to believe that peace was an imperative of the Nuclear Age and that nuclear weapons must be abolished.

Humanity and the biosphere are threatened by the danger of an all-destroying thermonuclear war. It could occur through a technical or human failure, or through uncontrollable escalation of a war fought with conventional weapons. Can you say something about this great danger?

There are many ways in which a nuclear war could start. I like to talk about the five "M's." These are: malice, madness, mistake, miscalculation and manipulation. Of these five, only malice is subject to possibly being prevented by nuclear deterrence and of this there is no certainty. But nuclear deterrence (threat of nuclear retaliation) will not be at all effective against madness, mistake, miscalculation or manipulation (hacking). As you suggest, any war in the nuclear age could escalate into a nuclear war. I believe that a nuclear war, no matter how it would start, poses the greatest danger confronting humankind, and can only

be prevented by the total abolition of nuclear weapons, achieved through negotiations that are phased, verifiable, irreversible and transparent.

Can you describe the effects of a nuclear war on the ozone layer, on global temperatures, and on agriculture? Could nuclear war produce a large-scale famine?

My understanding is that a nuclear war would largely destroy the ozone layer allowing extreme levels of ultraviolet radiation to reach the earth's surface. Additionally, a nuclear war would dramatically lower temperatures, possibly throwing the planet into a new Ice Age. The effects of a nuclear war on agriculture would be very marked. Atmospheric scientists tell us that even a "small" nuclear war between India and Pakistan in which each side used 50 nuclear weapons on the other side's cities would put enough soot into the stratosphere to block warming sunlight, shorten growing seasons, and cause mass starvation leading to some two billion human deaths. A major nuclear war would produce even more severe effects, including the possibility of destroying most complex life on the planet.

What about the effects of radiation from fallout? Can you describe the effects of the Bikini tests on the people of the Marshall Islands and other nearby islands?

Radiation fallout is one of the unique dangers of nuclear weapons. Between 1946 and 1958, the U.S. conducted 67 of its nuclear tests in the Marshall Islands, with the equivalent power of detonating 1.6 Hiroshima bombs daily for a twelve year period. Of these tests, 23 were conducted in the Bikini Atoll in the Marshall Islands. Some of these tests contaminated islands and fishing vessels hundreds of miles away from the test sites. Some islands are still too contaminated for the residents to return. The U.S. shamefully treated the people of the Marshall Islands who suffered the effects of radioactive fallout like guinea pigs, studying them to learn more about the effects of radiation on human health.

The Nuclear Age Peace Foundation cooperated with the Marshall Islands in suing all of the nations which signed the Nuclear Nonproliferation Treaty and which currently possess nuclear weapons for violating Article VI of the NPT. Can you describe what has happened? The Marshall Islands' foreign minister, Tony deBrum, received the Right Livelihood Award for his part in the lawsuit. Can you tell us something about this?

The Nuclear Age Peace Foundation consulted with the Marshall Islands on their heroic lawsuits against the nine nuclear-armed countries (U.S., Russia, UK, France, China, Israel, India, Pakistan, and North Korea). The lawsuits in the International Court of Justice (ICJ) in The Hague were against the first five of these countries for their failure to fulfill their disarmament obligations under Article VI of the Non-Proliferation Treaty (NPT) for negotiations to end the nuclear arms race and achieve nuclear disarmament. The other

four nuclear-armed countries, those not parties to the NPT, were sued for the same failures to negotiate, but under customary international law. The U.S. was sued additionally in U.S. federal court.

Of the nine countries, only the UK, India and Pakistan accepted the compulsory jurisdiction of the ICJ. In these three cases the Court ruled that there was not a sufficient controversy between the parties and dismissed the cases without getting to the substance of the lawsuits. The votes of the 16 judges on the ICJ were very close; in the case of the UK the judges split 8 to 8 and the case was decided by the casting vote of the president of the Court, who was French. The case in U.S. federal court was also dismissed before getting to the merits of the case. The Marshall Islands was the only country in the world willing to challenge the nine nuclear-armed states in these lawsuits, and did so under the courageous leadership of Tony de Brum, who received many awards for his leadership on this issue. It was an honor for us to work with him on these lawsuits. Sadly, Tony passed away in 2017.

On July 7, 2017, the Treaty on the Prohibition of Nuclear Weapons (TPNW) was passed by an overwhelming majority by the United Nations General Assembly. This was a great victory in the struggle to rid the world of the danger of nuclear annihilation. Can you tell us something about the current status of the Treaty?

The Treaty is still in the process of attaining signatures and ratifications. It will enter into force 90 days after the 50th country deposits its ratification or accession to it. At present, 69 countries have signed and 19 have ratified or acceded to the treaty, but these numbers change frequently. ICAN and its partner organizations continue to lobby states to join the treaty.

ICAN received a Nobel Peace Prize for its efforts leading to the establishment of the TPNW. The Nuclear Age Peace Foundation is one of the 468 organizations that make up ICAN, and therefore, in a sense, you have already received a Nobel Peace Prize. I have several times nominated you, personally, and the NAPF as an organization for the Nobel Peace Prize. Can you review for us the activities that might qualify you for the award?

John, you have kindly nominated me and NAPF several times for the Nobel Peace Prize, for which I deeply thank you. I would say that my greatest accomplishment has been to found and lead the Nuclear Age Peace Foundation and to have worked steadily and unwaveringly for peace and the total abolition of nuclear weapons. I don't know if this would qualify me for a Nobel Peace Prize, but it has been good and decent work that I am proud of. I also feel that our work at the Foundation, though international, focuses largely on the United States, and that is a particularly difficult country in which to make progress.

But I would say this. It has been gratifying to work for such meaningful goals for all humanity and, in doing such work, I have come across many, many dedicated people who

deserve to receive the Nobel Peace Prize, including you. There are many talented and committed people in the peace and nuclear abolition movements, and I bow to them all. It is the work that is most important, not prizes, even the Nobel, although the recognition that comes with the Nobel can help with making further progress. I think this has been the case with ICAN, which we joined at the beginning and have worked closely with over the years. So, we are happy to share in this award.

Military-industrial complexes throughout the world need dangerous confrontations to justify their enormous budgets. Can you say something about the dangers of the resulting brinkmanship?

Yes, the military-industrial complexes throughout the world are extremely dangerous. It is not only their brinkmanship which is a problem, but the enormous funding they receive that takes away from social programs for health care, education, housing, and protecting the environment. The amount of funds going to the military-industrial complex in many countries, and particularly in the U.S., is obscene.

I have recently been reading a great book, titled *Strength through Peace*, written by Judith Eve Lipton and David P. Barash. It is a book about Costa Rica, a country that gave up its military in 1948 and has lived mostly in peace in a dangerous part of the world since then. The book's subtitle is "How Demilitarization Led to Peace and Happiness in Costa Rica, & What the Rest of the World can Learn from a Tiny Tropical Nation." It is a wonderful book that shows there are better ways of pursuing peace than through military strength. It turns the old Roman dictum on its head. The Romans said, "If you want peace, prepare for war." The Costa Rican example says, "If you want peace, prepare for peace." It is a much more sensible and decent path to peace.

Has Donald Trump's administration contributed to the danger of nuclear war?

I think that Donald Trump himself has contributed to the danger of nuclear war. He is narcissistic, mercurial, and generally uncompromising, which is a terrible combination of traits for someone in charge of the world's most powerful nuclear arsenal. He is also surrounded by Yes men, who generally seem to tell him what he wants to hear. Further, Trump has pulled the U.S. out of the agreement with Iran, and has announced his intention to withdraw from the Intermediate-Range Nuclear Forces Treaty with Russia. Trump's control of the U.S. nuclear arsenal may be the most dangerous threat of nuclear war since the beginning of the Nuclear Age.

Could you say something about the current wildfires in California? Is catastrophic climate change a danger comparable to the danger of a nuclear catastrophe?

The wildfires in California have been horrendous, the worst in California history. These terrible fires are yet another manifestation of global warming, just as are the increased



Figure C.1: **Dr. David Krieger.**

intensity of hurricanes, typhoons and other weather-related events. I believe that catastrophic climate change is a danger comparable to the danger of nuclear catastrophe. A nuclear catastrophe could happen at any time. With climate change we are approaching a point from which there will be no return to normalcy and our sacred earth will become uninhabitable by humans.

Appendix D

THE IMPORTANCE OF ALTERNATIVE MEDIA

The superficiality of today's television

Social critic Neil Postman contrasted the futures predicted in *Nineteen Eighty-Four* and *Brave New World* in the foreword of his 1985 book "Amusing Ourselves to Death". He wrote:

"What Orwell feared were those who would ban books. What Huxley feared was that there would be no reason to ban a book, for there would be no one who wanted to read one. Orwell feared those who would deprive us of information. Huxley feared those who would give us so much that we would be reduced to passivity and egotism. Orwell feared that the truth would be concealed from us. Huxley feared the truth would be drowned in a sea of irrelevance."

Niel Postman's book, "Amusing Ourselves To Death; or Public Discourse in an Age of Show Business" (1985), had its origins at the Frankfurt Book Fair, where Postman was invited to join a panel discussing George Orwell's "Nineteen Eighty-Four". Postman said that our present situation was better predicted by Huxley's "Brave New World". Today, he maintained it is not fear that bars us from truth. Instead, truth is drowned in distractions and the pursuit of pleasure, by the public's addiction to amusement.

Postman sees television as the modern equivalent of Huxley's pleasure-inducing drug, soma, and he maintains that that television, as a medium, is intrinsically superficial and unable to discuss serious issues. Looking at television as it is today, one must agree with him.

The wealth and power of the establishment

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 in general their role is not only

unhelpful - it is often negative. War and conflict are blatantly advertised by television and newspapers.

Newspapers and war

There is a true story about the powerful newspaper owner William Randolph Hearst that illustrates the relationship between the mass media and the institution of war: When an explosion sank the American warship USS Maine in the harbor of Havana, Hearst anticipated (and desired) that the incident would lead to war between the United States and Spain. He therefore sent his best illustrator, Fredrick Remington, to Havana to produce drawings of the scene. After a few days in Havana, Remington cabled to Hearst, "All's quiet here. There will be no war." Hearst cabled back, "You supply the pictures. I'll supply the war." Hearst was true to his words. His newspapers inflamed American public opinion to such an extent that the Spanish-American War became inevitable. During the course of the war, Hearst sold many newspapers, and Remington many drawings. From this story one might almost conclude that newspapers thrive on war, while war thrives on newspapers.

Before the advent of widely-read newspapers, European wars tended to be fought by mercenary soldiers, recruited from the lowest ranks of society, and motivated by financial considerations. The emotions of the population were not aroused by such limited and decorous wars. However, the French Revolution and the power of newspapers changed this situation, and war became a total phenomenon that involved emotions. The media were able to mobilize on a huge scale the communal defense mechanism that Konrad Lorenz called "militant enthusiasm" - self-sacrifice for the defense of the tribe. It did not escape the notice of politicians that control of the media is the key to political power in the modern world. For example, Hitler was extremely conscious of the force of propaganda, and it became one of his favorite instruments for exerting power.

With the advent of radio and television, the influence of the mass media became still greater. Today, state-controlled or money-controlled newspapers, radio and television are widely used by the power elite to manipulate public opinion. This is true in most countries of the world, even in those that pride themselves on allowing freedom of speech. For example, during the US-led invasion of Iraq in 2003, the official version of events was broadcast by CNN, and criticism of the invasion was almost absent from their transmissions.

The mass media and our present crisis

Today we are faced with the task of creating a new global ethic in which loyalty to family, religion and nation will be supplemented by a higher loyalty to humanity as a whole. In case of conflicts, loyalty to humanity as a whole must take precedence. In addition, our present culture of violence must be replaced by a culture of peace. To achieve these essential goals, we urgently need the cooperation of the mass media.

The predicament of humanity today has been called "a race between education and catastrophe": Human emotions have not changed much during the last 40,000 years. Hu-

man nature still contains an element of tribalism to which nationalistic politicians successfully appeal. The completely sovereign nation-state is still the basis of our global political system. The danger in this situation is due to the fact that modern science has given the human race incredibly destructive weapons. Because of these weapons, the tribal tendencies in human nature and the politically fragmented structure of our world have both become dangerous anachronisms.

After the tragedies of Hiroshima and Nagasaki, Albert Einstein said, "The unleashed power of the atom has changed everything except our way of thinking, and thus we drift towards unparalleled catastrophes." We have to learn to think in a new way. Will we learn this in time to prevent disaster? When we consider the almost miraculous power of our modern electronic media, we can be optimistic. Cannot our marvelous global communication network be used to change anachronistic ways of thought and anachronistic social and political institutions in time, so that the system will not self-destruct as science and technology revolutionize our world? If they were properly used, our instantaneous global communications could give us hope.

The success of our species is built on cultural evolution, the central element of which is cooperation. Thus human nature has two sides, tribal emotions are present, but they are balanced by the human genius for cooperation. The case of Scandinavia - once war-torn, now cooperative - shows that education is able to bring out either the kind and cooperative side of human nature, or the xenophobic and violent side. Which of these shall it be? It is up to our educational systems to decide, and the mass media are an extremely important part of education. Hence the great responsibility that is now in the hands of the media.

How do the mass media fulfill 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 need for strengthening the United Nations, and the ways that it could be strengthened? 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 the military-industrial complex and other powerful lobbys. Do they present us with the need for a just system of international law that acts on individuals? On the whole, the subject is neglected. Do they tell of the essentially genocidal nature of nuclear weapons, and the urgent need for their complete abolition? 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 100 or so 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 and environmental catastrophes. 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 hang 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.

Our duty to future generations

The future of human civilization is endangered both by the threat of thermonuclear war and by the threat of catastrophic climate change. It is not only humans that are threatened, but also the other organisms with which we share the gift of life. We must also consider the threat of a global famine of extremely large proportions, when the end of the fossil fuel era, combined with the effects of climate change, reduce our ability to support a growing global population.

We live at a critical moment of history. Our duty to future generations is clear: We must achieve a steady-state economic system. We must restore democracy in our own countries when it has been replaced by oligarchy. We must decrease economic inequality both between nations and within nations. We must break the power of corporate greed. We must leave fossil fuels in the ground. We must stabilize and ultimately reduce the global population. We must eliminate the institution of war; and we must develop new ethics to match our advanced technology, ethics in which narrow selfishness, short-sightedness and nationalism will be replaced by loyalty to humanity as a whole, combined with respect for nature.

Inaction is not an option. We have to act with courage and dedication, even if the odds are against success, because the stakes are so high.

The mass media could mobilize us to action, but they have failed in their duty.

Our educational systems could also wake us up and make us act, but they too has failed us. The battle to save the earth from human greed and folly has to be fought in the alternative media.

The alternative media, and all who work with them deserve both our gratitude and our financial support. They alone, can correct the distorted and incomplete picture of the world that we obtain from the mass media. They alone can show us the path to a future in which our children, grandchildren, and all future generations can survive.

Countercurrents: An outstanding example

The Internet news journal Countercurrents recently described its activities in the following words:

Humanity is facing its greatest existential threat ever with climate change and resource depletion. This is not a crisis waiting to happen in the future, but it is already here and manifests itself in the many resource wars going on in several parts of the world, rising food and fuel prices, growing hunger, natural calamities of horrifying proportions, water scarcity, debt crisis, unemployment, social tensions among communities, growing human rights violations and unprecedented ecological degradation. Unless we take urgent action to change the way we live, trashing our only home, this beautiful planet earth, this crisis

has the potential to wipe out the entire humanity and a majority of the other species from the face of this earth.

The objective of Countercurrents.org is to spread awareness about this crisis and search for meaningful solutions. We believe that energy intensive globalization should end and it must be replaced by a low energy, ecologically sustainable local economies. If humanity is to survive, the destructive system of capitalism and consumerism must be replaced by an economic system which is based on just equitable distribution and need based use of resources. We strive to reach this goal with our motto, which is “Educate! Organize! Agitate!”

Countercurrents.org publishes reports, analyses, experiences, academic debates and campaigns which take a side - the Side of the People! Our objectivity is people’s past, present and future. During 13 years of its existence Countercurrents.org has published over 50,000 articles, fact finding reports, research papers and news items on major social issues around the world.

Countercurrents.org brings news, views and analysis on Climate Change, Peak oil, Palestine, Iraq, Syria... with an in depth and insightful analysis on all the important issues threatening the very existence of life systems on our mother earth. We relentlessly question the vertical and non-inclusive growth-based economy driven by capitalism that is destroying not only dignified human existence and the right to life of future generations but also the lives of all other species on earth. We stand for a sustainable ecological economy and equitable distribution of wealth!

We support the voices and initiatives that attempt to shape a world which ensure the dignified existence of future generations. Countercurrents.org stands for Democracy, Peace, Justice, Liberty and Harmony!

Countercurrents.org is read by about half a million people every month and about 1.5 million pages are read by our readers each month.

Countercurrents.org won 2018 Solidarity Media award for ‘its courageous interventions in upholding Human Rights and Citizen’s Rights’.

As future activities, we plan to translate our articles, produce videos, facilitate screenings on several of the topics that Countercurrents.org deals with to reach out to people who are not active on Internet.



Figure D.1: Binu Mathiew, the heroic founder and editor of Countercurrents. Although the Kerala district of India where he lives has been hit by disastrous floods, he continues to publish Countercurrents every day.

Index

- A billion added every decade, 150
- A new Joan of Arc, 137
- A small number of humans may survive, 96
- Abolition 2000, 284, 365
- Abolition of child labor, 94, 149
- Abolition of nuclear weapons, 232, 325, 366
- Abolition of war, 24, 114, 153, 273, 303
- Abrupt climate change, 75
- Absolute limits, 153, 154
- Absolute limits of carrying capacity, 23
- Absolutely sovereign nation-state, 14
- Accelerated melting, 70
- Accelerating speed of change, 13, 338
- Accidental nuclear war, 32
- Acidification of oceans, 66
- Acids and bases defined, 355
- Act with urgency, 108
- Activation energy, 356
- Acts which even the savage keeps hid, 86
- Adam Smith's invisible hand, 83
- Addicted to growth, 149
- Addiction to amusement, 371
- Addiction to fossil fuels, 110
- Addiction to war, 94
- Adelson, Sheldon, 260
- Advance warning, 33
- Advertisers on mass media, 125
- Advertising, 158, 210
- Advertising denying climate change, 88
- Africa, population projections, 169
- Aggregate income, 208
- Aggressive foreign policies, 87
- Agricultural land, 186
- Agricultural monocultures, 155
- Agricultural output, 154
- Agricultural yields, 178
- Agriculture, 234
- Ahimsa, 333
- Ahmed, Eqbal, 328, 329
- AIDS, 320
- Air pollution, 90
- Air pollution in China, 45
- Akiba, Tadatoshi, 274
- Alaska, 264
- Albedo effect, 20, 39, 63, 70, 75, 92, 93, 98
- Alcohol-driven automobiles, 152
- Alfred Lotka, 215
- Algae, 104
- Algeria, 62
- Alimentary canal, 215
- Alliances, 250, 251
- Allies of death, 303
- Alsace, 250
- Alsace-Lorraine, 256
- Alternative for Germany party, 263
- Alternative media, 112
- Altes, Dr. Edy Korthals, 277
- Always heroic and in the right, 266
- Amazon destruction planned, 120
- Amazon rainforest, 126
- Amazon rainforest dieback, 75
- Ambition, 254
- America's demand for oil, 109
- American Friends Service Committee, 277
- American Security Project, 266
- Amusing Ourselves to Death, 371
- Anachronistic institutions, 281
- Anachronistic political system, 19
- Anachronistic ways of thought, 373
- Ancient Wisdom, Modern World, 280, 305

- Anglican Pacifist Fellowship, 285
 Angola, 62
 Animal products, 175
 Antarctic ice cap, 31
 Antarctic icecap, 154
 Antarctic sea ice, 98
 Antarctic sea ice loss, 75
 Anthropocene Extinction, 69
 Anthropogenic climate change, 23, 94
 Anti-Christian and anti-democratic, 300
 Antibiotics, 15
 Apollo-Gaia Project, 99
 Appalling war-machine, 88
 Appropriate mix of renewable energy, 102
 Aquifers overdrawn, 30, 31, 175, 177, 179, 183, 184
 Arab Spring, 266
 Arable land, 320
 Archduke Francis Ferdinand, 251
 Arctic icecap, 154
 Arctic methane release, 75
 Arctic sea ice loss, 70, 75, 98, 99
 Arctic temperatures, 98
 Are we evil?, 135
 Area of cropland, 179
 Area of irrigated land, 185
 Arid grasslands, 179
 Aridity, 177, 183
 Armistice, 256
 Arms industries, 320
 Arms manufacturers, 87
 Arnold, Sir Edward, 332
 Arrhenius, Svante, 20, 40, 355
 Article VI of the NPT, 367
 Artificial intelligence, 15
 Artificial needs, 158, 210
 Artificial photosynthesis, 100
 Artillery, 254
 Arvid Högbom, 20, 40
 Asphalt melting, 55
 Assassination, 251
 Assumptions of classical economics, 215
 Astonishing turnaround, 238
 Atmospheric concentration of CO₂, 90
 Atmospheric water vapor, 70
 Attenborough, Sir David, 110
 Australia, 268, 319
 Austria, 251
 Austria-Hungary, 250
 Austro-Hungarian Emperor, 255
 Autocatalytic systems, 340
 Automobile worship, a false religion, 295
 Automobiles make our cities unpleasant, 297
 AutoNation, 295
 Availability of water, 180
 Average crop yields, 181
 Bad actions, 305
 Baha'i, 276
 Bailout of banks, 149
 Balance of nature, 324
 Balkan Peninsula, 250
 Bangladesh, 29, 41, 174
 Bangladesh, 30 million refugees, 266
 Bankruptcy because of weapons, 361
 Banks and government too cozy, 149
 Bans on internal combustion engines, 239
 Barbed wire, 254
 Baron Stern of Brentford, 53
 Battleground series, 280
 Bavaria, 257, 258
 Beef is environmentally harmful, 175
 Beef production, 19, 39
 Belgium, 252, 256
 Belt of Tar, 57
 Besant, Annie, 332
 Between 3,000 and 11,000 gigatons, 88
 Bhagavad Gita, 332
 Big lie of governments, 360
 Bikini Atol, 273
 Bilateral agreements, 62
 Billion or more deaths from starvation, 87
 Biodiversity, 122, 154, 155
 Biodiversity conservation, 176
 Biodiversity loss, 66
 Biofuels, 100

- Biogas, 104
Biological annihilation, 69
Biological constraints, 210
Biological diversity, 69, 156
Biological weapons, 269, 320
Biology, 153
Biology of war and Peace, 27
Biomass, 104, 152, 155, 215
Biosphere, 63
Biosphere is being sacrificed, 133
Biotas, 156
Biotechnology, 15
Birth control, 23, 148, 152, 163, 264
Birth control programs, 148
Bismark, Otto von, 250
Blavatsky, Madame, 332
Bloated military budgets, 87
Blood for oil, 62
Bloomberg Technology, 230
Bodet, Jamie Torres, 323
Bolsonaro on homosexuals, 120
Bolsonaro, Jair, 120, 126
Bolton, John, 300
Boltzmann, Ludwig, 356
Bombs, 300
Border wall, 261
Boreal forest dieback, 75
Borel's Statistical Mechanics, 218
Bottomless pit of war, 87
Bought-and-paid-for politicians, 88
Boulding, Kenneth E., 147
Brain mechanism, 15
Bramacharya, 333
Brave New World, 371
Brazil, 120, 152, 268, 319
Brazil's economy, 59
Brazil's offshore oil, 59
Brazil's presalt oil, 63
Bread and circuses, 122, 281
Break the power of corporate greed, 114
Breakdown of civilization, 122
Breton Woods Conference, 208
Brexit and refugees, 261
BRICS, 109
Brinkmanship, 369
British Empire, 333
British North Sea oil, 60
British public, 336
British raj, 336
Brockendorff-Rantzau, Count Ulrich von, 256
Brotherhood of humankind, 303
Brown, Lester, 92
Brown, Lester R., 161, 211
Brundtland Report, 181, 182
Brutal, violent attack, 120
Brutalization, 255
Buddhism, 337
Buddhist philosophy, 305
Bulgaria bans fracking, 57
Burning of rainforests, 154
Burning of tropical rainforests, 90, 93
Business administration, 320
Business as usual, 63
Business cycle, 207
Buying the votes of officials, 149
Bypassing the need for grids, 49
Cairo population conference, 148
Callendar, Guy S., 20, 40
Cambridge University, 149
Campaign for Nuclear Disarmament, 284
Canada, 268, 319
Canadian Arctic, 264
Canadian government, 57
Canadian oil sands, 56
Capital, 153
Capitalism, 199
Capone, Al, 271
Carbon bubble, 41
Carbon budget, 41, 140
Carbon dioxide, 154, 356
Carbon Tracker, 230
Carbon Tracker Initiative, 41
Carbon-rich soils, 184
Care for the elderly, 23
Carr, Mathew, 230

- Carrying capacity, 15, 89, 94, 150, 153, 154, 160, 177, 211, 319
- Catastrophic climate change, 19, 31, 39, 41, 55, 61, 63, 88, 91, 92, 100, 112, 115, 181, 194, 213, 232, 297, 369
- Catastrophic damage, 150
- Catastrophic famine, 152
- Cattle emit methane, 177
- Ceballos, Gerardo, 69
- Cell membrane, 340
- Cellulostic ethanol, 100
- Cement sector, 234
- Centralization, 333
- Challenging and unsolved, 338
- Chance of survival, 232
- Change is coming, 133
- Change the system, 133
- Changed circumstances, 309
- Changes of diet, 264
- Chastity, 333
- Chauvinism, 268, 319
- Chemical energy, 106, 154
- Chemical weapons, 269, 320
- Cheney, Brig. Gen. Stephen, 266
- Chief Standing Bear, 305
- Child labor and slavery, 23
- Child marriage, 23
- Child prodigy, 355
- Childhood, prolonged in humans, 14
- Children can have a huge impact, 137
- China, 30, 107, 109, 148, 163, 169, 174, 209, 238, 239
- China's coal, 63
- China's current population, 163
- China's dynastic census data, 164
- China's economic growth, 164
- China's economic growth rate, 91, 232
- China's falling water table, 183
- China's one-child policy, 163
- China's population growth, 164
- China's population policy, 183
- China's population, historical, 164
- China's strong central government, 163
- China's use of coal, 53
- China, air pollution, 45
- China, rapid industrial expansion, 53
- Chinese public opinion, 45
- Choked with excrementous matter, 85
- Chomsky, Noam, 107, 122, 300, 328
- Christian ethical principles, 336
- Christian ethics, 277
- Christian nationalism, 300
- Christmas, 309
- CIA, 116
- Civics, 270, 322
- Civil disobedience, 336
- Civil rights, 333
- Civil wars, 271
- Civil Works Administration, 194
- Civilian Construction Corps, 194
- Civilization is cooperative, 338
- Classical economics, 207, 208, 319
- Clean energy, 233
- Clean energy economy, 201
- Clean water supplies, 23
- Clemenceau, Georges, 256
- Climate change, 28, 63, 154, 156, 169, 184, 213
- Climate change and agriculture, 183
- Climate change and war, 265
- Climate change denial, 83, 115, 122, 123, 193, 300
- Climate change emission pledges, 66
- Climate crisis, 194, 199
- Climate emergency, 19, 39, 63, 194
- Climate financing, 67
- Climate justice, 135
- Climate Justice Now, 133
- Climate refugees, 264
- Climate science, 355
- Climate tipping points, 75
- Climate-chance denial, 88
- Climate-driven refugees, 126
- Clinton, Hillary, 119
- Clock is ticking, 199
- Closed system, 214

- Closed world economics, 319
 Club of Rome, 159
 CO₂ concentration has passed 400 ppm., 93
 Coal, 31, 239
 Coal generation capacity losing money, 230
 Coal industry's heavy hand, 136
 Coal made into earrings, 137
 Coal per capita, 61
 Coal power plants in India, 111
 Coal prices, 230
 Coal produced in Germany, 59
 Coal produced in Poland, 59
 Coal producers, 61
 Coal production in India, 55
 Coal reserves, 155
 Coal reserves in China, 53
 Coastal cities threatened, 264
 Code Pink, 284
 Coining their own money, 149
 Cold War, 273
 Collective human consciousness, 339, 340
 Colombia, 62
 Colonial system, 335
 Colonialism, 268, 319
 Common Dreams, 282
 Common land, 84
 Common values, 277
 Commoner, Barry, 163
 Communal defense mechanism, 26, 372
 Communal defense response, 24
 Communications media, 271
 Communist government of Russia, 255
 Communist revolution, 255
 Compromise, 333
 Computer networks, 214
 Computer software, 158, 213
 Computers, 13, 338
 Concentrating photovoltaic systems, 101, 102
 Conductivity of electrolytes, 355
 Conflict and refugees, 265
 Confucius, 303
 Congress Party, 334
 Conservation, 161, 202
 Consider what may be lost, 96
 Conspicuous consumption, 95
 Consume more, 125
 Consumer behaviour, 324
 Consumerism, 171
 Consumption, 271
 Consumption of fossil fuels, 215
 Consumption of goods, 161, 213
 Consumption of meat, 182
 Consumption of plant energy, 182
 Continued extraction of fossil fuels, 53
 Contracting economy, 149, 210
 Contrast of time-scales, 19, 39
 Conventional petroleum, 155
 Conversion, 320
 Cooperation, 272, 281
 Cooperative banks, 216
 Cooperative Movement, 171
 Cooperatives, 276
 COP24, 131, 136
 Copper reserves, 209
 Corporate oligarchs, 193
 Corporate-controlled mass media, 107
 Corporations motivated only by greed, 94
 Corrupt government, 62
 Corrupt governments, 186
 Corrupt politicians, 20, 39
 Cost of photovoltaic cells falling, 101
 Cost of running coal plants, 230
 Cost of war, 255
 Costa Rica, 369
 Cottages were afterward burned, 84
 Council of Canadians, 285
 Countercurrents, 282, 365, 374
 Counterfeit money, 149
 Court-marshalled and shot, 254
 Create transformational action, 140
 Creating hunger, 361
 Creating jobs, 52
 Creativity, 158, 213
 Cretaceous-Paleogene Extinction, 67
 Cries of the women and children, 84
 Crime against human civilization, 300

- Crippled for life, 255
 Crisis, 14
 Crisis of civilization, 14
 Crisis predicted, 150
 Critical moment of history, 374
 Cropland, 152
 Cropland per capita, 148
 Cropland per person, 152
 Cruelty was, of course, the consequence, 85
 Cultural change, 295
 Cultural diversity, 324
 Cultural evolution, 13–15, 309, 340, 373
 Cultural heritage immensely valuable, 339
 Cultural history, 268, 319
 Cultural inertia, 229
 Culturally-driven growth, 150
 Culture, 322, 325
 Culture and human solidarity, 271
 Culture is cooperative, 340
 Culture of Peace, 322–324
 Culture of peace, 280, 317, 372
 Culture of violence, 280, 323, 325
 Currency reform, 216
 Current annual emissions, 55
 Curriculum revisions, 270, 322
 Custodial attitude, 307
 Custodial attitude towards the land, 97
 Cyclical components of phenomena, 217
 Czar Alexander III, 251
 Czech Republic bans fracking, 57

 Daisaku Ikeda's Peace Proposals, 325
 Dalai Lama, 278, 280, 305
 Daly, Herman, 90
 Dangerous feedback loops, 88
 Danish National Pugwash Group, 273
 Danish Peace Academy, 276, 282, 284
 Danish wind industry, 51
 Dark branches of government, 116
 Darkened snow, 70
 Darwinian natural selection, 26
 Dasgupta, Sir Partha, 94, 149
 David Pimental, 181, 185

 Davos Economic Forum, 2019, 137
 Deadly climate conditions, 265
 Deadly heat waves, 265
 Death-machine, 252
 Debt at compound interest, 216
 Debt crisis, 216
 Decade for a Culture of Peace, 317
 Decay of democracy, 86
 Decay of real wealth, 216
 Declaration of war, 251
 Decrease economic inequality, 24, 114
 Decreased rainfall and agriculture, 183
 Deepwater Horizon, 59
 Defamation, 324
 Deforestation, 120, 156, 185, 234
 Deforestation in the US, 156
 Degradation of free energy, 215
 Degradation of topsoil, 185
 Degraded form, 215
 Degraded land, 152
 Demand, 208
 Deme, 18
 Demilitarization, 359
 Demise of the biosphere, 122
 Democracy Now, 194
 Democracy or disaster, 111
 Democracy rather than oligarchy, 24, 114
 Democratic Party, 257
 Democratic Party primary election, 193
 Democratic Republic of the Congo, 169
 Demographic trap, 23, 148
 Demonstrations, 336
 Denmark, 103
 Depletion of natural resources, 107
 Depletion of topsoil, 179
 Depression, 161, 193, 206, 208
 Depression of 1929, 160, 211
 Desertification, 89, 169, 179, 264
 Destruction of forests, 19, 39, 41, 184
 Destruction of habitats, 69
 Destruction of rain forests, 179
 Deterioration in personal form, 85
 Developed countries, 180

- Developed nations, 234
Developing countries, 49, 62
Developing world, 66
Development, 147
Development of paper and printing, 13
Devil's dynamo, 87
Devotion to king, country or cause, 25
Dialogue, 324
DiCaprio, Leonardo, 107, 282
Dictatorships, 62
Dietary changes, 264
Dignity, respect for, 324
Dirzo, Rudolfo, 69
Disappearing mineral resources, 152
Disarmament, 277
Disaster, 110
Discrimination, 324
Disease, 14, 24, 150, 152, 169, 268, 319, 334
Disease and malnutrition, 152
Disease causes poverty, 33
Disease-resistant varieties, 178
Disorder, 214
Dispersal of minerals, 215
Division of labor, 83
DNA, 305
Dogma of economic growth, 90
Donne, John, 340
Doubling time, 91, 232
Draft animals, 152
Drama, 270, 321
Driven to commit suicide, 85
Drought, 66, 173, 179
Drug-resistant tuberculosis, 32
Dry-season water supply, 30, 174
Drying of forests and fires, 74
Dulce et decorum est, 266
Durable goods, 219
Duty to preserve future world, 97
Dylan, Bob, 282
Dysentery, 147
Each religion preserves a culture, 309
Earth Policy Institute, 45, 92
Earth's average temperature, 20, 40
Earthquakes, 57
EAT-Lancet Commission, 175
Eaton, Cyrus, 273
Ecological catastrophe, 152, 186, 332
Ecological conscience, 88, 99, 114
Ecological conscience for economics, 24
Ecological constraints, 95, 107, 153
Ecological footprint, 177
Ecology, 319
Economic and cultural interdependence, 267
Economic chaos, 257
Economic collapse, 95, 171, 221, 339
Economic Consequences of the Peace, 257
Economic development, 163
Economic expansion, 210
Economic growth, 154, 158, 185, 209, 210
Economic hegemony, 33
Economic inequality, 32, 199
Economic interdependence, 271
Economic justice, 277
Economic oppression, 324
Economic problems, 260
Economic progress, 23
Economic recession, 109
Economic reform, 213
Economic reforms, 93, 277
Economic stability, 95, 214
Economic system without growth, 93
Economic tipping point, 49
Economics, 319
Economics of Climate Change, 53
Economics without growth, 158
Economists addicted to growth, 149
Economy as a digestive system, 215
Economy of Brazil, 59
Economy of exclusion, 279
Economy of peace, 361
Economy's circulatory system, 220
Economy's digestive tract, 220
Ecosphere, 220
Ecosystem functioning, 69
EcoWatch, 282

- Education, 161, 212, 271, 281
- Education for peace, 18, 267, 277, 317, 322
- Education for women, 148
- Education of women, 149
- Educational Curricula, 325
- Educational reform, 18
- Egypt, 169
- Ehrlich, Paul R., 69, 163
- Eibel-Eibesfeldt, Irenaüs, 27
- Einstein, Albert, 248, 273, 281, 373
- Eisenhower's Farewell Address, 86
- Eisenhower, Dwight David, 86
- Elderly homeless persons, 279
- Electric cars, 50
- Electric cars have longer lifespans, 239
- Electric vehicle sales, 239
- Electric vehicles, 51, 238, 297
- Electrical networks, 214
- Electrical power, 106
- Electricity generation, 103
- Electrifying transport, 234
- Electrolysis of water, 106
- Electronic media, 281
- Elementary peace education, 269, 321
- Elephant in the room, 115, 116
- Elon Musk, 51
- Elvin, Lionel, 323
- Emissions from agriculture, 234
- Emissions have to stop, 134
- Emotional security, 309
- Emotions, 15, 19, 250
- Emperor Napoleon III, 250
- Emperor's Battle, 255
- Employment, 208
- Employment shared equally, 95
- Empty-world economics, 153, 160, 211
- Empty-world picture, 89
- Enclosure Acts, 84
- End of fossil fuel era, 23, 155, 215
- End of the fossil fuel era, 28, 31, 173, 193, 232, 339
- Endless consumption and growth, 108
- Endless growth impossible, 109
- Endosomatic parts, 215
- Ends and means, 337
- Enemies, 336
- Energy, 67
- Energy conservation, 155
- Energy demand, global, 44
- Energy efficiency, 41, 161, 211
- Energy for transportation, 171
- Energy inputs of agriculture, 29, 173
- Energy payback ratio, 103
- Energy problems, 320
- Energy system world-spanning, 233
- Energy use per capita, 44
- Energy used for cooking, 181
- Energy-dependence of agriculture, 180
- Energy-intensive agriculture, 94, 181
- Engineering students, 269, 321
- Engineers, 321
- Engineers, responsibility of, 269
- England, 251, 252, 332, 333, 337
- Entropic transformation, 218
- Entropy, 215
- Entropy and economics, 213, 217
- Environment's carrying capacity, 89
- Environmental catastrophe, 281
- Environmental changes, 156
- Environmental degradation, 152, 154
- Environmental destruction, 120
- Environmental disaster, 125
- Environmental impact, 158, 212
- Environmental Kuznets curve, 163
- Environmental Protection Agency, 116, 122
- Environmental sustainability, 175
- Enzymes, 105
- Epidemics of plant diseases, 180
- Equal rights for women, 324
- Equilibrium, 208
- Equilibrium economics, 160, 211, 319
- Equilibrium with the environment, 160, 210
- Equity, 135
- Era beyond fossil fuels, 177
- Erosion of topsoil, 185
- Erratic decisiona and lies, 119

- Escalation of conflicts, 332, 337
- Ethical and ecological considerations, 84
- Ethical and ecological dimensions, 86
- Ethical principles, 269, 303, 309, 321
- Ethical responsibility, 269, 321
- Ethics, 15
- Ethics of traditional societies, 97
- Ethiopia, 169
- Ethnic groups, 269, 270, 303, 321
- Ethnic identity, 27
- Eukaryotes, 340
- Europe, 41
- Europe's right-wing parties, 263
- European dependence on natural gas, 56
- European Union, 268, 269, 271, 319, 320
- Evangelii Gaudium, 279
- Evangelicals, 299
- Every government in Poland is coal, 137
- Evolution, 281
- Evolution, control over, 15
- Excess human mortality, 265
- Excessive consumption, 31
- Excessive saving, 208
- Exosomatic parts, 215
- Expansion of the money supply, 216
- Exploitation, 335
- Explosive growth of knowledge, 14, 338
- Explosives, 252
- Exponential growth, 45, 91, 92, 158, 160, 210, 211, 232
- Exponential increase, 216
- Extension of my personality, 296
- Extinction, 154
- Extinction of marine species, 68
- Extinction of species, 156
- Extinction of terrestrial vertebrates, 68
- Extraction costs, 155
- Extravagant gadgetry, 219
- Exxon had the best climate models, 123
- Exxon knew, 123
- Exxon's 1982 internal projections, 123
- Fabian Society, 332
- Factories, 214
- Factory civilization, 335
- Failure of monsoons, 30, 174
- Failure of water supplies, 179
- Falling water tables, 110, 163, 174, 177, 339
- Family planning, 23, 148, 152, 264
- Family planning advice, 33
- Family planning services, 95
- Famine, 23, 24, 28, 31, 88, 94, 112, 148, 150, 152, 163, 169, 173, 178, 180, 183, 186, 277, 339
- Fanaticism, 324
- Far-right movements, 261
- Faraday, Michael, 355
- Farm Security Administration, 194
- Fascism, 120
- Fascism in the 1930's, 260
- Fascism then and now, 250
- Fatal increase in global temperature, 92
- Favelas, 147
- FBI, 271
- FDR's New Deal, 193, 197, 202
- Fear of economic recession, 109
- Federations, 268, 319
- Feedback loop, definition, 70
- Feedback loops, 20, 39, 41, 63, 92–94, 184, 213
- Fellowship of Reconciliation, 285
- Fertile land, 210
- Fertility rates, 169
- Fertilizers, 29, 173, 180
- Feudal landowning class, 252
- Fewer moving parts, 239
- Fielden, John, 85
- Finance and distribution, 180
- Financial institutions, 268, 319
- Financial reforms and regulations, 194
- Finite earth, 149
- Finite food supply, 158, 210
- Finite planet, 91
- Finite supply of fossil fuels, 43
- Fireman, 239
- Fires ignited by lightning, 41

- Fires level entire cities, 195
- First World War, 255
- Fiscal policy, 208
- Fischer, R.A., 26
- Fisher, R.A., 18
- Fixation on growth, 95
- Flogged, fettered and tortured, 85
- Floods, 66, 110
- Florida, Richard, 158, 213
- Flowers, Margaret, 201
- Fly more, 125
- Focus on what needs to be done, 131
- Folly and greed, 97
- Food and Agricultural Organization, 179, 185
- Food and agriculture reform, 175
- Food calories per capita, 182
- Food crisis, 175
- Food insecurity in West Africa, 30, 174
- Food losses and waste, 176
- Food production, 150
- Food security, 265
- Food supply, 153
- Food system is broken, 177
- Force of truth, 337
- Forced marriage, 23
- Forest destruction, 41
- Forest fires, 74, 184
- Forest loss, 184
- Forests, 19, 39, 154
- Forgiveness, 337
- Fortune 500 companies, 234
- Fosen project, 52
- Fossil fuel CEO's, 136
- Fossil fuel corporations, 20, 39, 49, 123
- Fossil fuel industry, 57, 86
- Fossil fuel infrastructure, 230
- Fossil fuel producers, 60
- Fossil fuels, 19, 39, 41, 92, 100, 123, 150, 152–154, 161, 177, 180, 186, 212, 213, 215, 232, 239, 356
- Fossil fuels, continued extraction, 53
- Fossil fuels, rate of use, 44
- Fourteen Points, 256
- Fracking, 57
- Fracking banned by 9 countries, 57
- Fractional reserve banking, 149, 216
- Fractional reserve banking system, 91, 95, 339
- Fragile ecological systems, 214
- Fragility of modern society, 339
- Framework Convention, 66
- France, 250, 251, 256
- France bans fracking, 57
- France bans internal combustion engine, 50
- Frederick Soddy, 215
- Free association, 270, 321
- Free energy, 214, 215
- Free energy and wealth, 215
- Free market, 158
- Free markets, 83
- Free public transport in Luxembourg, 297
- Freedom of expression, 324
- Freedom Party (Austria), 263
- French coal mines, 256
- French Impressionists, 340
- Friends Service Committee, 284
- Friendship, 333
- Fruit, 176
- Fuel cells, 49, 101, 104, 106
- Fuelwood, 152
- Full employment, 271
- Full-world economics, 153, 160, 211, 220
- Full-world picture, 91
- Fully electric cars, 50
- Future dangers, 63
- Future food-production, 178
- Future generations, 93, 99, 100, 140, 319, 324
- Future of human civilization, 63
- Future of megacities, 171
- Future, long-term, 19, 39
- Galtung, Johan, 282
- Game of war, 360
- Gandhi, 332
- Gandhi Inst. of Peace, 284

- Gandhi, Mahatma, 278, 333, 336
 Gandhi, Mohandas, 332
 Gas production, 61
 Gaskell, Dr. Peter, 85
 GE Renewable Energy, 237
 Geisler, Charles, 264
 General economic development, 149
 General glut, 208
 General Theory, 206, 208
 Genes, 18
 Genetic adaptation, 14
 Genetic diversity, 156
 Genetic engineering, 15, 269, 321
 Genetic evolution, 13–15
 Geneva Conventions, 269, 320
 Genius for cooperation, 272
 Genomes, 14
 Geography, 270, 322
 Geological extinction events, 96
 Geothermal energy, 100, 105, 215
 German Kaiser, 255
 German nationalist movement, 250
 German production of coal, 59
 Germany, 239, 256, 268, 319
 Germany bans fracking, 57
 Germany bans internal combustion engine,
 50
 Get rid of fashion, 219
 Giant coal corporations, 122
 Gigawatts (GW), 44
 Girls and women walk lamely, 85
 Glacial epochs, 156
 Glacial melting, 184
 Glaciation, 69
 Glaciers melting, 29
 Glaciers, melting of, 30, 174
 Glickson, Andrew, 122
 Global climate, 122
 Global consciousness, 267, 280
 Global environment, 160, 211
 Global ethic, 24, 267, 280, 317
 Global fertility rates, 169
 Global food crisis, 31
 Global Green New Deal, 201
 Global inequalities, 270, 322
 Global production of coal, 61
 Global Security Institute, 284
 Global temperature, 63
 Global unity not impossible, 19
 Global war, 255
 Global warming, 66, 154, 180, 264, 357
 Global warming and security, 265
 Global Zero, 284
 Globalization, 320
 Glory, 252
 Gold standard, 216
 Golden Dawn party (Greece), 263
 Golden rule, 303
 Good actions, 305
 Good Samaritan, 303
 Goodman, Amy, 194, 282
 Goods, 158, 212
 Goods per capita, 161, 213
 Government intervention, 155
 Governmental expenditure, 204
 Governmental responsibility, 160, 211
 Governments subsidize fossil fuels, 92
 Gradual decrease in population, 219
 Grameen bank, 216
 Grant, James P., 323
 Great Depression, 194, 206
 Great Mystery, 307
 Greatest Challenges of Our Times, 20, 40
 Greed, 84
 Greed and folly, 97
 Greed-based economic system today, 86
 Green New Deal, 193–197
 Green Party, 116
 Green Revolution, 29, 178, 180, 181
 Greenhouse effect, 70, 356
 Greenhouse gas emissions, 264, 265
 Greenhouse gases, 154
 Greenland, 264
 Greenland ice cap, 98, 99
 Greenland ice cores, 75
 Greenland inland ice, 31

- Greenpeace, 284
 Greta Thunberg's Davos speech, 139
 Greta Thunberg's TED talk, 133
 Grey, Sir Edward, 252
 Gross national product, 158, 210
 Grotius, 269, 320
 Groundwater levels, 183
 Groundwater levels falling, 29
 Group selection, 26
 Growing populations, 185
 Growth, 158, 210, 319
 Growth-obsessed economic system, 93
 Growth-oriented economics, 160, 211
 Growth: the religion of economists, 232
 Grundtvig, N.F.S., 275
 Grundtvigian Peoples' Colleges, 275
 Guterres, Antonio, 126
 Guy S. Callendar, 20, 40

 Högbom, Arvid, 357
 Högbom. Arvid, 20, 40
 Hague Conventions, 269, 320
 Haldane, J.B.S., 18, 26
 Hamilton, W.D., 18, 26
 Hanaka, 309
 Hanseatic League, 268, 319
 Hansen, James, 57
 Happy and just society, 86
 Hapsburg Emperors, 250
 Hartman, Thom, 107
 Hartmann, Thom, 99, 282
 Harvard Economic Barometer, 217
 Harvey, Angus, 233
 Hate, 336
 Hate-mongering, 260
 Hatred, 255
 Health, 67
 Healthcare a human right, 193
 Hearst, William Randolph, 372
 Heartrending cruelties, 85
 Heat deaths in India, 55
 Heat engines, maximum efficiency, 106
 Heat waves, 66
 Heat waves in Sweden, 133
 Heating, 234
 Hepatitis, 147
 Herman E. Daly, 219
 Hermod Lannung Foundation, 274, 275
 Heroes, 18
 Hibakushas, 278
 High level of consumption, 271
 High-yield agriculture, 173
 High-yield modern agriculture, 29
 High-yield varieties, 178
 Higher education for women, 23
 Higher loyalty to humanity, 372
 Higher status for women, 23, 94
 Higher status of women, 149
 Highland Clearances, 84
 Highway development, 185
 Himalayas, 30, 174
 Hindu Kush, 30, 174
 Hindu religion, 305
 Hinduism, 276, 332
 Hinge oil, 104
 Hiroshima, 281, 326, 366, 373
 Hiroshima Peace Committee, 278
 Hiroshima Peace Museum, 284
 History, 270, 281, 322
 History of science, 269, 321
 History teaching, 268, 319
 History teaching must be reformed, 272
 History, teaching, 267
 History, teaching of, 317
 Hitler Youth, 25
 Hitler, Adolf, 257, 258, 260, 261, 322, 372
 HIV/AIDS, 32
 Hobson, John A., 207
 Holdren, John P., 163
 Holistic approach to problems, 33
 Holocene Extinction, 69
 Homespun cotton, 334
 Hominids, 14
 Homo Electric, 233
 Hong Kong, 148
 Hoodbhoy, Pervez, 328, 329

- Hoover, Herbert, 257
 Hope for the future, 28
 Hottest years in recorded history, 235
 House of Representatives, 257
 Household items, 216
 Hubbert peak, 155, 209
 Hubbert peaks, 152, 159
 Hubbert, M. King, 155
 HUFUD organization, 359
 Human civilization, 97
 Human Development Index, 169
 Human dignity, 323
 Human economy, 154
 Human emotions, 13
 Human life will have no value, 120
 Human nature, 15, 305, 333
 Human rights, 269, 270, 277, 320, 322, 323
 Human rights in Brazil, 120
 Human society a superorganism, 214
 Human solidarity, 271
 Human suffering, 150
 Humane response to refugees, 264
 Humanism, 325
 Humanitarian crisis, 266
 Humans cause global warming, 66
 Humility, 334
 Hunter-gatherer societies, 150
 Hunter-gatherers, 14, 15
 Hurricanes get bigger, 195
 Huxley, Aldous, 371
 Hybrid cars, 50
 Hydrogen fuel cells, 106
 Hydrogen technology, 33, 49, 101, 104, 106
 Hydrogenation of CO₂, 100
 Hydropower, 100, 155
 Hyperbolic trajectory, 150
 Hyperproject, 233

 I want you to feel fear, 141
 I=PAT, 163
 ICAN, 284, 368
 Idolatry of the Free Market, 277
 Ikeda, Daisaku, 325
 Ikeda, President Daisaku, 326
 Illiteracy, 268, 319
 Imagine what we could do together, 136
 Immediate action required, 266
 Inaction not an option, 112
 Increased severity of hurricanes, 94
 Index standard, 216
 India, 29, 107, 111, 163, 169, 174, 209, 332, 334–337
 India's coal, 63
 India's Energy Crisis, 55
 India's population, historical, 164
 India's Prime Minister Modi, 55
 Indian flag, 334
 Indian home rule, 334, 336
 Indian Minister of Power, 55
 Indian monsoon disruption, 75
 Indigenous faiths, 276
 Indigenous peoples, 137, 201
 Indirect costs of war, 268
 Individual citizens, 270
 Indoctrination in nationalism, 266
 Indonesia, 62, 148, 169
 Industrial activity, 204
 Industrial growth, 107
 Industrial Recovery Act, 194
 Industrial Revolution, 59, 86, 150, 269, 276, 321
 Industrial revolution, 251
 Industrial sector, 158, 212
 Industrial workers, 158, 213
 Industrialization, 333
 Industrialized countries, 62, 152
 Inequality, 32, 33, 268, 279, 319
 Inequality has increased, 86
 Inertia of educational systems, 266
 Inertia of political institutions, 248
 INES, 284
 INF Treaty, 369
 Inflation, 204, 208, 258
 Information and free energy, 214
 Information explosion, 15, 338
 Information technology, 15

- Information-driven cultural evolution, 15
- Information-driven population growth, 150
- Information-driven society, 15
- Information-related work, 158, 213
- Infrared radiation, 356
- Infrastructure, 147, 193, 194, 230, 271, 320
- Inherited part of human nature, 307
- Injustice, 333
- Inner peace, 305
- Inside Climate News, 123
- Inst. for Economics and Peace, 285
- Instability of society, 15
- Installations have grown 57-fold, 236
- Installed photovoltaic capacity, 92
- Instantaneous communications, 373
- Institution of war, 14, 32, 303
- Institutional inertia, 229
- Inter-group aggression, 25, 26
- Interdependence, 277
- Interest rates, 208
- Intermarriage forbidden, 26
- Intermittency, Denmark and Germany, 49
- Intermittency, Denmark and Norway, 49
- Intermittency, problem of, 49
- Internal assessments, 123
- Internal combustion engine ban, 50
- Internal peace, 270, 271
- Internal unity of large countries, 19
- International agreements, 67
- International cooperation, 322
- International Court of Justice, 269, 320, 368
- International Criminal Court, 269, 320
- International law, 62, 269, 281, 320
- International Monetary Fund, 208
- International Peace Bureau, 284
- International understanding, 322
- Internationalism, 271
- Internet, 13, 338
- Interrelated challenges, 33
- Interreligious understanding, 269, 321
- Intolerable economic inequality, 32, 33
- Intra-group altruism, 26
- Inuit culture, 307
- Inundation of coastal cities, 66
- Invasion of Belgium, 252
- Invasion of Iraq, 114, 372
- Invention of writing, 13
- Investment, 208
- Investment in renewable energy, 236
- Investment in solar energy, 52
- Investment opportunity, 50, 107
- Investments, 210
- IPCC, 22, 40, 66, 139, 180
- IPCC report from Incheon, 2018, 125
- IPCC reports, 99
- IPPNW, 284
- Iran, 62
- Iraq, 62
- Irish Potato Famine, 180
- Irish potato famine, 155
- Irreversible biodiversity loss, 66
- Irreversible climate change, 20, 39
- Irreversible warming, 123
- Irrigation, 173, 180
- Irrigation of arid lands, 179
- Isaiah 45 = 45th President, 299
- ISIS, 360
- ISIS runs on oil, 114
- Islam, 303
- Israel's nation state law, 261
- Italy, 250, 256
- IUCN, 69
- Jackson, Tim, 91
- Jainists, 276
- Jamail, Dahr, 99
- James Hansen, 57
- Japan, 148
- Jatropha, 104
- Jewish tradition, 303
- Jewish Voice for Peace, 284
- Job security, 161, 212
- Jobbic party (Hungary), 263
- Jobs from renewables, 52
- Joseph Schumpeter, 218
- Jungle burned for agriculture, 156

- Kahr, Dr. Gustav von, 258
Kaiser Wilhelm I, 250
Kaiser Wilhelm II, 250, 254
Kapp Putsch, 257
Karma, 305, 337
Keep that oil in the ground, 136
Keynes, John Maynard, 160, 202, 204, 257
Keynesian economics, 204
Keystone XL, 137
Kiel Canal, 256
Killing them, 120
Kilowatts (KW), 44
King, Rev. Martin Luther, 278
Klare, Michael, 33, 109
Klein, Naomi, 199
Known resources, 41
Koestler, Arthur, 15
Koestler, Arthur, 25
Krieger, David, 365, 370
Kristallnacht, 261
Kristensen, Thorkil, 154, 159
Kuwait, 62
Kuznets curve, 163
Kyoto Protocol, 22, 40
- László Szombatfalvy, 20, 40
Labor, 153
Labor must be moved, 95
Labor was viewed as a commodity, 85
Labor-intensive activities, 33
Lack of action, 66
Lack of safe drinking water, 32
Lakota, 305
Lancet report on food reform, 175
Land of the Spotted Eagle, 97
Land Use Policy, 264
Lang, Tim, 175
Laozi, 303
Lapham, Robert J., 148
Large countries and global unity, 19
Large nations, 270
Large-scale famine, 173
Large-scale global famine, 112
Large-scale species extinction, 94
Last Hours, 99
Late Devonian Extinction, 67
Late marriage, 24, 163
Laterization, 185
Latest observations, 98
Law of the Sea, 269, 320
Laws binding on individuals, 270
Lawyers' Committee on Nuc. Pol., 284
League of Nations, 256, 257
Leave fossil fuels in the ground, 114
Lenton, Timothy Michael, 75
Leonardo DiCaprio Foundation, 213
Less animal products, 175
Lester Brown, 183
Lethal heat events, 265
Level playing field, 115
Liberalism, 333
Libya, 62
Lifestyle change, 108
Lifestyles, 41
Lightning strikes, 184
Lignocellulostic ethanol, 105
Limiting global warming to 1.5°C, 125
Limits to growth, 32, 33, 159
Limits to growth and climate change, 89
Line in the sand, 125
Liquid fuels, 155
Lithium ion storage batteries, 51
Lithium ion storage cells, 49
Lithium-ion battery, 239
Living standards, 63, 161, 212
Lobbys, 281
Local currencies, 171
Local self-sufficiency, 171
Location of wind parks, 103
Long trips in a car, 296
Long-term future, 19, 39, 95, 98, 107, 109, 112, 171
Long-term survival of civilization, 88
Long-term future, 232
Lorraine, 250
Loss of cropland, 179

- Love, 336, 337
 Lower instincts, 260
 Loyalty, 18
 Loyalty to humanity, 280
 Lucky Dragon, 273
 Ludendorff, General, 255, 257, 258, 260
 Luther Standing Bear, 97
 Luxembourg bans fracking, 57
 Luxuries of the few, 133

 M.S. Swaminathan, 178
 Machine gun, 254
 Machinery, 335
 Machines, 335
 Madness, 367
 Mahatma Gandhi, 332, 334
 Mahayana Buddhists, 276
 Mahler, Halfdan, 147
 Main grain types, 183
 Major coal producers, 61
 Major extinction event, 69
 Major fossil fuel producers, 60
 Major oil producers, 60
 Makiguchi, Tsunisaburo, 325
 Malaria, 32, 320
 Malice, 367
 Malnutrition, 66, 268, 319
 Malthus, T.R., 13, 23, 207, 210
 Malthus, Thomas Robert, 152, 158
 Malthusian forces, 150, 169
 Manifesto 2000, 324
 Manipulation, 367
 Manufactured goods, 251
 Marginal land, 152, 185, 210
 Marine energy, 100
 Mario Giampietro, 181
 Market forces, 161, 212
 Market mechanisms, 161, 202, 335
 Marriage, 18
 Marshall Islands, 367
 Marshall Plan, 206
 Mass media, 13, 18, 32, 107, 108, 112, 115,
 116, 134, 139, 267, 280, 297, 303,
 317, 338, 372, 373
 Mass migration, 265
 Massive retaliation, 278
 Material structures, 215
 Mathiew, Binu, 375
 Mature ethical system, 114
 Mature forests, 184
 Maudlin, W. Parker, 148
 Maximizing productivity, 83
 Mayor of Hiroshima, 274
 Mayor, Federico, 323
 Mayors for Peace, 284
 McKibben, Bill, 199
 Means, 337
 Meat consumption, 182
 Mechanisms of the brain, 15
 Medicine, 156
 Meditation, 295
 Mega-cities, 171
 Megacities, 171
 Megalomania, 250
 Megawatts (MW), 44
 Mein Kampf, 260
 Melted asphalt, 55, 112
 Melting glaciers, 94, 107, 173, 339
 Melting of Arctic ice, 30, 174
 Melting of glaciers, 30, 174, 177
 Melting of polar icecaps, 90
 Merkel, Angela, 263
 Metabolic throughput, 220
 Metal ore reserves, 209
 Metals, 209, 271
 Methane, 104
 Methane gas, 139
 Methane hydrate feedback loop, 20, 39, 63,
 68, 73, 75, 96, 98, 100, 213, 232
 Methane, 10,000 gigatons, 73
 Methane-hydrate feedback loop, 88, 92, 94
 Mexico, 62, 156, 169
 Middle East, 53, 250, 277
 Middle Powers Initiative, 285
 Might makes right, 33
 Migration into Europe, 266

- Migration to cities, 147
 Migration, political reactions, 261
 Militarism, 272, 325, 359
 Militarization of governments, 62
 Military budgets, 32, 268, 320
 Military lobbies, 325
 Military trade, 360
 Military use of oil, 62
 Military-industrial complex, 32, 86, 87, 115, 281, 369
 Mill, James, 208
 Mineral resources, 186
 Minerals, 153
 Minimum wage laws, 207
 Mining ancient groundwater, 30, 174, 183, 184
 Minister of Education, 274
 Miscalculation, 367
 Miscanthus, 104
 Mistake, 367
 MIT Technology Review, 55
 Mitigation, 67
 Mobilization, 251
 Modern agriculture, 150, 180
 Modern arms, 277
 Modern languages, 322
 Modern warfare and oil, 62
 Modern weapons, 271
 Modi, Narendra, 111
 Moment of crisis, 18
 Monarchists, 258
 Monetary policy, 208
 Monetizing underground “assets”, 123
 Money and growth our main concerns, 140
 Money and war, 361
 Money and wealth, 215
 Money driving decisions, 57
 Money supply, 149, 207
 Money used to control governments, 86
 Money wasted on war, 114
 Money wasted on wars, 95
 Money-controlled newspapers, 372
 Monocultures, 155, 180
 Monsoon, 29, 174
 Monsoon disruption, 75
 Monsoon failures, 30, 174
 Montessori, Maria, 323
 Moral restraint, 24
 More than hope, we need action, 136
 Most dangerous organization in history, 300
 Much of the world uninhabitable, 94
 Muhammad Yunus, 216
 Muhith, Abdul, 266
 Multicellular organisms, 340
 Multiethnic societies, 28
 Multinationals, 320
 Munich, 258
 Muniruzzaman, Maj. Gen, 266
 Murky depths of stupidity, 115
 Musk, Elon, 51
 Mussolini, Benito, 260, 261
 Mutual understanding and dialogue, 328
 N. Georgescu-Roegen, 217
 Nagasaki, 281, 366, 373
 Naomi Klein, 213
 Napoleon Bonaparte, 250
 Nation-state, 280
 Nation-states, 271
 National Academy of Sciences, 69
 National armies, 271
 National Climate Assessment, 136
 National debt crisis, 149
 National Front party, 263
 National Renewable Energy Laboratory, 236
 National Socialist German Workers Party, 257
 Nationalism, 256, 267, 272, 280, 317
 Nationalism a dangerous anachronism, 267
 Nationalism taught in schools, 266
 Nationalist teaching, 322
 Nationalists, 258
 Nationalization of banks, 216
 Native American ethics, 97
 Natural capital, 154
 Natural gas, 29, 31, 155, 180

- Natural gas production, 61
 Natural habitat destruction, 69
 Natural resources, 67, 153
 Nature: Climate Change, 265
 Naval power, 251
 Navigant Research, 52
 Nazi Party, 257, 258, 260, 261
 Need for human solidarity, 339
 Negative entropy, 214
 Negative peace, 270, 321
 Nehru, Jawaharlal, 323
 Neocolonialism, 268, 319
 Neofascism, 120
 Neofascism worldwide, 261
 Neofascist leaders, 261
 Neolithic ancestors, 13
 Nerve gas, 13
 Net carbon sink, 176
 Net primary product, 154
 Netherlands bans petrol driven cars, 51
 New Deal, 208
 New economic system, 32
 New ethical rules, 309
 New global agricultural revolution, 175
 Newspapers, 280
 Newspapers and war, 372
 Newton, Isaac, 340
 Nichiren Buddhism, 325
 Nigeria, 169
 Nineteen Eighty-Four, 371
 No Fossil Fuel Money Pledge, 195
 No one ever talked about it, 134
 Nobel Peace Prize, 368
 Nobel Prize in Chemistry, 355
 Nobel Prize in Literature, 282
 Nobel Women's Initiative, 285
 Nobody likes wars, 360
 Non-anthropocentric ethics, 305
 Non-discrimination, 325
 Non-renewable resources, 95, 155, 158, 210, 215, 271
 Non-violence, 278, 324, 333–335, 337
 Non-violent protest, 333, 336
 None of this is inevitable, 235
 Nonrenewable resources, 319, 320
 Nonviolent tradition, 340
 Nonvoters, 119
 Normalization of China-Japan relations, 326
 Norman Borlaug, 178
 North America, 41
 North Atlantic Anomaly, 30, 174
 North Sea oil, 60
 Northern Ireland bans fracking, 57
 Norway bans petrol driven cars, 51
 Norwegian North Sea oil, 60
 Not truly human, 27
 NSA, 116
 Nuclear Abolition Forum, 284
 Nuclear Age Peace Foundation, 284, 365, 367
 Nuclear Ban Treaty, 368
 Nuclear catastrophe, 332
 Nuclear famine, 367
 Nuclear terrorism, 32
 Nuclear war, 32
 Nuclear weapons, 13, 14, 269, 320, 321
 Nuclear weapons an absolute evil, 325
 Nuclear-armed countries, 368
 Nuclear-weapon-free world, 326
 Nuremberg Principles, 269, 320
 Nuts, 176
 Obama, Barack, 201, 264
 Obscenely enormous military budget, 116, 194
 Ocasio-Cortez, Alexandria, 193, 194, 197, 199, 201
 Ocean current changes, 30, 174
 Offshore wind turbines, 237
 Offshore winds, 103
 Ogallala aquifer, 30, 110, 175, 179, 184
 Oil, 29, 31, 155, 180
 Oil and gas executives and lobbyists, 195
 Oil producers, 60
 Oil reserves in OPEC countries, 53
 Oil sands in Canada, 56
 One child policy enforcement, 164

- OPEC countries, 53
 Open Access Movement, 340
 Open world economics, 319
 Optimum global population, 152
 Ordovician-Silurian Extinction, 67
 Ores, 209
 Organic agriculture, 219
 Orinoco River, 57
 Orthodox Christians, 276
 Orwell, George, 371
 Our house is on fire, 141
 Output per hectare, 152
 Overcoming cultural inertia, 33
 Overcoming institutional inertia, 33
 Overdrawn aquifers, 177
 Overgrazing, 154, 179
 Overpopulation, 14
 Overpopulation and poverty, 94
 Overpopulation causes poverty, 33
 Overshoot and crash, 15, 150
 Oxfam, 86
 Oxford Institute of Economic Policy, 29
 Ozone layer, 367

 Pakistan, 29, 169, 174
 Palm oil production, 19, 39
 Pan-Serbia, 250
 Pan-Slavic movement, 251
 Paraguay, 148
 Paranoia, 250
 Paranoid times, 300
 Paris Agreement, 22, 40, 116, 122, 135, 139, 176
 Paris Climate Conference, 283
 Paris, India and coal, 111
 Parliamentary democracy, 337
 Participation of women, 324
 Party for Freedom, 263
 Passionate about automobiles, 297
 Passionate attachment to one's group, 26
 Passions of mankind, 13
 Pastoral societies, 150
 Pasturage, 152

 Patagonia, 264
 Pax Christi, 284
 Peace, 271, 325
 Peace Education, 317
 Peace education, 267, 274, 277
 Peace is possible, 362
 Peace movement, 280, 365
 Peace Pledge Union, 285
 Peace Research Inst., Oslo, 284
 Peace without victory, 256
 Pecci, Aurelio, 90, 159
 Pelosi, Nancy, 194, 201
 Pentagon's budget, 116
 People without electricity, 48
 People's Climate March, 107
 People's Party-Our Slovakia, 263
 Per capita energy use, 41, 101
 Permafrost melting, 75, 264
 Permian extinction, 66
 Permian-Triassic Extinction, 63, 67, 96, 99, 233
 Permian-Triassic extinction, 92
 Perovskite, 236
 Perpetual growth impossible, 232
 Personality/Status, 296
 Pesticides, 29, 173, 180
 Petrobras, 59
 Petrodollar, 109
 Petroleum production in Russia, 56
 Petroleum, conventional, 155
 Petroleum-based agriculture, 181
 Petroleum-derived fibers, 152
 Petroleum-driven tractors, 152
 Phillipines, 169
 Phoenix Farm, 333
 Photosynthesis, 154, 183, 340
 Photovoltaic cells, 101
 Photovoltaic panels, 101
 Photovoltaics, 155
 Photovoltaics, rate of growth, 45
 Physical chemistry, 355, 356
 Physical constraints, 210
 Physicians for Soc. Respons., 285

- Plant disease, 156
- Plant-based foods, 175
- Playing fields of Eton, 266
- Pledges remain unmet, 66
- Plosti oil fields, 218
- PNND, 284
- Poison gas, 254
- Poisoning of water supplies, 57
- Polish production of coal, 59
- Political inactivity, 281
- Political instability, 265
- Political irresponsibility, 261
- Political justice, 277
- Political oppression, 324
- Political will, 20, 39, 41, 125
- Politicians, next election, 63
- Politics of global warming, 123
- Pollination of corn, 183
- Pollination of rice, 183
- Pollution, 14, 155
- Polotocal puppets, 136
- Poor and most vulnerable, 67
- Pope Francis I, 114, 279, 309
- Pope John Paul II, 278, 279
- Pope John XXIII, 279
- Population, 158, 161, 210, 213, 320
- Population and fossil fuel use, 150
- Population explosion, 14, 15, 269, 321
- Population extinction pulse, 69
- Population genetics, 18
- Population growth, 28, 31, 152, 178, 185, 268, 319
- Population growth and poverty, 147
- Population headed for a crash?, 150
- Population losses and declines, 69
- Population of 9 billion, 186
- Population of China, 163
- Population of India, 163
- Population oscillations, 154
- Population pressure, 153
- Population projections in Africa, 169
- Population stabilization, 147, 161, 173, 211
- Population stabilization today, 147
- Population/cropland ratio, 152
- Populations displaced by war, 265
- Populations of animals, 154
- Populism in the US, 263
- Portugheis, Alfredo, 359, 362
- Positive checks, 152
- Positive feedback loops, 70
- Positive peace, 270, 321
- Post-fossil-fuel era, 150, 181
- Post-petroleum economy, 109
- Postman, Niel, 371
- Potato blight, 155
- Potsdam Institute, 67
- Poverty, 33, 152, 160, 177, 211, 268, 277, 319, 334
- Poverty alleviation, 67
- Poverty causes disease, 33
- Poverty causes overpopulation, 33
- Poverty causes war, 33
- Poverty-related deaths, 32
- Power unbalance, 271
- Power-worshiping culture, 323
- Powers of government, 161, 212
- Prakash, Varshini, 194
- Prayer for World Peace, 284
- Pre-industrial Europe, 84
- Predictions of the Stern Review, 29
- Preindustrial societies, 97, 307
- Prejudice, 324
- Presalt oil, 59
- Preserving ethical principles, 309
- Pressure on land, 210
- Preventive checks, 152
- Price of solar energy, 239
- Priceless values sacrificed for money, 137
- Primary energy, 41
- Primary health care, 33
- Primary health care for all, 23
- Prince Max of Baden, 256
- Prison, 336
- Private banks, 216
- Producer, 207
- Production of natural gas, 61

- Profits, 158, 209
Progress, 15
Progress of science, 271
Progressive values, 193
Prohibition of weapons production, 219
Project to destroy the Amazon, 120
Prokaryotes, 340
Prolonged childhood, 14
Promoting peace, 322
Propaganda, 280
Prosperity gospel preacher, 300
Prosperity Without Growth, 91
Protestants, 276
Protesting at the Swedish parliament, 131
Provision of health services, 149
Prussia, 250
Prussian military caste, 256
Pseudospeciation, 27
Public health, 148
Public health work, 33
Public transport, 95, 297
Public transportation, 161, 212
Public work projects, 194
Pugwash Conferences, 273, 284
Pull the emergency brake, 131
Pulses, 176
Purchasing power, 208
Purely economic laws, 84, 86
Pursuit of pleasure, 371
Pyush Goyal, 55
- Quakers, 277, 278
Quantum theory, 13, 15
Quantum Theory Explained, 328
Quick action, 41
Quick change, 19, 39
Quick change is needed, 309
- Racism, 193, 199, 260, 332
Radiation fallout, 367
Radio station for demilitarization, 361
Radioactive contamination, 87
Radioactive decay, 105
Radioactive fallout, 273
Railroads, 252
Rainforests, 154
Rainforests destroyed, 89
Ramadan, 309
Rape, 120
Rapid change is required, 135
Rapid population growth, 179
Rate of change, 14
Rate of fossil fuel use, 44
Rate of species loss, 69
Rates of use, 42
Raychandbhai, 333
Re-balance use of time, 219
Reaction kinetics, 356
Real needs, 160, 210
Real power belongs to the people, 133
Recession, 207, 208
Reciprocity, 303, 337
Reconciliation, 332, 337
Recycling, 209
Recycling resources, 161, 211
Red meat, 176
Reduced consumption of meat, 264
Reducing use of luxury goods, 95
Reforestation, 33, 95, 161, 211
Reform, 333
Reform Jews, 276
Reformed economic system, 213
Refugee crisis, 264, 265
Refugees, 120
Refugees from rising temperatures, 265
Regional agreements, 67
Reichstag fire, 260
Rejection of violence, 324
Relatedness of all life, 305
Relativity, 13, 15
Relativity explained, 329
Religion, 18, 270, 280, 322
Religion and tribal marking, 28
Religious belief in growth, 232
Religious ethics, 269, 303, 321

- Renewable energy, 63, 95, 106, 108, 152, 161, 186, 193, 211, 213, 215, 239
- Renewable energy infrastructure, 33, 110, 194, 197, 271
- Renewable energy policy network, 115
- Renewable energy sources, 152, 155
- Renewable substitutes, 186
- Renewables cheaper than fossil fuels, 45, 49, 233
- Rents, agricultural, 210
- Reparations, 256, 258
- Republican Party, 122, 257, 300
- Republican presidential candidates, 115
- Reserve indices of metals, 31, 209
- Reserves of metals, 209
- Resistance to change, 307
- Resource curse, 62
- Resource Wars, 33
- Resource-extracting firms, 62
- Resources, 215, 320
- Resources needed to manufacture cars, 297
- Resources per capita, 177
- Respect for life, 323, 324
- Returning good for evil, 305
- Revenge and counter-revenge, 303
- Reverse transition, 152
- Rhineland, occupation of, 256
- Ricardo, David, 210
- Right Livelihood Award, 367
- Rights of animals, 307
- Rights of individuals, 323
- Rights of Mother Earth, 97
- Ring of Fire, 105
- Rising ocean levels, 94, 177
- Risk management, 67
- Rite of passage into adulthood, 295
- Rituals, 307
- River deltas threatened, 264
- RNA, 305
- Rockström, Johan, 175, 235
- Roman Catholics, 276
- Roman Empire, 266
- Romanian National Peasant Party, 218
- Rome Treaty, 269, 320
- Rooftop solar installations, 48
- Roosevelt, Franklin D., 160, 161, 193, 202, 203, 208
- Rough beast of fascism, 261
- Roumania bans fracking, 57
- Round Table Conference, 336
- Ruhr, occupation by France, 258
- Rule of international law, 33
- Rule of law, 322
- Rules have to be changed, 136
- Runaway climate change, 107
- Rural economy, 335
- Ruskin, John, 333
- Russell Peace Foundation, 284
- Russell, Lord Bertrand, 273
- Russell-Einstein Manifesto, 273
- Russia, 250, 251
- Russia's reserves of oil and gas, 56
- Russian Arctic oil production, 56
- Russian Czar, 255
- Russian Czars, 250
- Russian petroleum industry, 56
- Sabotaging renewable energy, 122
- Safe drinking water, 33
- Sahel, 179
- Saint Francis, 305
- Sale of African land, 169
- Salination, 179
- Salt march, 336
- Salt tax, 336
- Salvado, Miguel, 359
- Sanders Institute, 199
- Sanders, Senator Bernie, 116, 119, 193, 261
- Sane Nuclear Policy, 285
- Saturation pressure, 70
- Satyagraha, 333
- Saudi Arabia, 62
- Saudi Arabia and photovoltaics, 48
- Saving the future, 136, 229, 309
- Say's Law, 207
- Say, Jean-Baptiste, 207

- Scandinavia, 373
Scandinavian countries, 116
Schlieffen Plan, 254
Schwartz, Aaron, 340
Schweitzer, Albert, 305
Science, 322
Science education, 269, 321
Science is cooperative, 338
Science means nothing to politicians, 136
Scientific community's duty to warn, 96
Scientific evidence, 66
Scientific revolution, 150
Scientists, responsibility of, 269
Sea ice loss, 70
Sea level rise, 29, 31, 66, 75, 90, 98, 154, 173, 264, 339
Sea levels were 40 meters higher, 93
Second law of thermodynamics, 215
Secret land purchases, 186
Secret societies, 257
Secure jobs, 161, 212
Security, 277
Security threats, 266
Seeds of Peace, 285
Select Committee on Climate Crisis, 195
Self-interest, 83, 86
Self-reliance, 335
Self-sufficiency, 336
Self-sufficient economy, 171
Selfishness and greed exalted, 88
Selfishness exalted as the mainspring, 86
Semiconducting materials, 101
Semipermeable membranes, 106
Senate, 257
September 11 attacks, 325
Sequestered carbon, 184
Serbian nationalism, 251
Serbian nationalists, 250
Sermon on the Mount, 303
Service sector, 158, 212
SGI, 325
Sharing science and technology, 338
Sharing time and resources, 324
Sharing was part of their lifestyle, 88
Shaw, Pamela, 161, 211
She's a fantastic money sink, 297
Shell and Exxon knew, 123
Shift to 100% renewable energy, 100
Shiite Muslims, 276
Shintos, 276
Shortened food chain, 264
Siberia, 264
Siberian Traps, 68, 96
Sikhs, 276
Simiens, 51
Singapore, 148
SIPRI, 284
Sixth mass extinction, 69, 135
Slave-like media, 109
Slouching towards Bethlehem, 261
Slums, 147
Small hydro, 215
Smaller families, 155
Smallholders, 105
Smith's invisible hand at our throats, 83
Smith, Adam, 158, 160, 208–211
Smuts, General Jan, 257
Social competition, 24
Social conscience, 88, 99, 114
Social conscience for economics, 24
Social games, 134
Social goals, 335
Social impact of science, 269, 321
Social inequality, 180
Social insects, 214
Social reform, 332
Social Security Administration, 194
Social security for old people, 94
Social services, 149
Social tensions, 15
Socialism, 116
Soil and water conservation, 95
Soil conservation, 33, 161, 211
Soil erosion, 179, 185
Soka Gakkai, 325, 326
Soka Gakkai International, 284

- Soka Univ. of America, 283
 Soka University Japan, 283
 Solar designs for architecture, 101
 Solar energy, 100, 154, 215
 Solar Foundation, 52
 Solar Jobs Census, 52
 Solar panel prices, 48
 Solar panels on new houses, 48
 Solar systems for heating water, 101
 Solar thermal power, 155
 Solar thermal power plants, 101
 Solidarity, 323, 324
 Soma, 371
 Somme, Battle of, 254
 Soot particles, 70
 Sources and sinks, 220
 South Africa, 155, 332, 333, 336
 Southeast Asia's food supply, 30, 174
 Spain bans fracking, 57
 Special theory of relativity, 329
 Species driven to extinction, 89
 Species loss, 69
 Spinning and weaving machines, 84
 Spinning wheel, 334
 Spiritless and dejected, 85
 Stability, 18
 Stabilization of population, 153, 264
 Stabilize global population, 24
 Stabilize population, 114
 Stabilizing global population, 94
 Stalemate, 254
 Standard of living, 152
 Stars and stripes, 300
 Starvation, 152, 180
 Starved to the bone, 85
 State and corporate power, 260
 State Militia, 271
 State-provided care of elderly, 149
 Stationary economy, 210
 Statistical probability, 214
 Steady-state economic system, 24, 33, 114
 Steady-state economics, 32, 158, 210, 219
 Steady-state economy, 91, 161
 Steam engine, 84
 Steel, 251
 Steel, concrete and plastic, 234
 Stein, Jill, 116, 201
 Stern Report, 183, 184
 Stern Review, 53, 174
 Stock market, 210
 Stockholm, 158, 213
 Stockholm Resilience Center, 175, 235
 Stone, Oliver, 282
 Stop emissions of greenhouse gases, 140
 Stop fossil fuel extraction, 24
 Stop subsidizing fossil fuels, 115
 Stricter vehicle standards, 238
 Stronger social safety net, 201
 Student climate strike in Belgium, 137
 Student peace prizes, 274
 Stupidity, 254
 Submarginal land, 179
 Subprime mortgage crisis, 95
 Subsidies, 115, 116
 Subsidies to fossil fuels, 114
 Summer water supplies, 31, 107, 177, 184
 Sunday drives, 295
 Sunni Muslims, 276
 Sunrise Movement, 194, 197
 Supercomputers, 13
 Superorganisms, 214, 340
 Supply, 208
 Survival, 18
 Survival of the fittest, 279
 Sustainability, 86, 89, 91, 154, 158, 160, 161, 171, 210, 211, 319
 Sustainability crisis, 134
 Sustainability, 95
 Sustainable Development Commission, 91
 Sustainable economic system, 273
 Sustainable goals, 155
 Sustainable limit, 150, 152
 Svante Arrhenius, 20, 40
 Swadeshi movement, 334
 Swanston's Law, 237
 Swastika, 260

- Sweden, 131
 Sweden Democrats party, 263
 Switzerland, 268, 319
 Switzerland bans fracking, 57
 Synthetic fertilizers, 152
 System change not climate change, 112
 Szent-Györgyi, Albert, 248
 Szombatfalvy, László, 20, 40

 Tanks, 255
 Tax of 70% on ultra-wealthy, 194
 Tax structure, 155
 Taxation, 155, 161, 212
 Taxation, power of, 270
 Teacher's training colleges, 269, 321
 Team spirit, 18
 Tear gas, 112
 Technical change, 14
 Technical or human failure, 366
 Technology, 15, 152, 252, 279
 Technology, transfer of, 147
 Tectonic plates, 105
 Telegraph, 252
 Television, 280
 Tell it like it is, 131
 Temperature and agriculture, 183
 Temperatures, 239
 Terawatt, definition, 155
 Terawatts (TW), 44
 Terp, Holger, 276
 Territorial integrity, 256
 Terrorism, 260, 277, 360
 Textbooks, 322, 325
 TFF, 282, 284
 Thawing Arctic permafrost, 139
 The 2016 US presidential election, 115
 The case for economic reform, 93
 The Curse of the Factory System, 85
 The Elders, 285
 The Great Transition, 92
 The Guardian, 69, 175, 193
 The threat of global famine, 94
 The Wealth of Nations, 83

 Theme days, 270, 321
 Theology studies, 269, 321
 Theory of rents, 210
 Theosophists, 332
 There is still time, 140
 Thermal expansion of oceans, 154
 Thermal expansion of the oceans, 90
 Thermohaline circulation, 75
 Thermonuclear catastrophe, 281
 Thermonuclear war, 87, 92, 112, 115, 232, 261, 271, 339, 366
 Thermonuclear weapons, 278
 This car goes FAST, 296
 Thom Hartmann, 213
 Thou shalt not kill, 279
 Threat of economic collapse, 95
 Threat of global famine, 23
 Threat of nuclear war, 32
 Threats to the environment, 31
 Thunberg, Greta, 22, 131, 133, 137, 139, 141, 229, 355
 Tidal energy, 215
 Tim Jackson, 214
 Time of crisis, 114
 Time-scales, 19, 39
 Tipping point, 63, 92, 99, 100, 126, 213
 Tipping points, 20, 39, 41, 139
 Tipping points and feedback, 74
 Tipping points, definition, 74
 Tipping point, 111
 Toda Declaration, 325
 Toda Institute of Peace, 283
 Toda, Josei, 325, 326
 Tolerance, 324, 325
 Tolstoy Farm, 333
 Tolstoy, Leo, 333
 Tony deBrun, 367
 Too holy to be seen, 116
 Top Gear, 125, 297
 Tornados, 94
 Torture, 120
 Totnes, Devon, England, 171
 Towards a Non-violent Society, 276

- TPNW, 368
 Trade unions, 207
 Traditional agriculture, 181
 Traditional rain patterns, 265
 Traditions were forgotten, 84
 Traitors to life, 303
 Transcend International, 284
 Transition to 100% renewable energy, 42, 43, 92
 Transition to 100%renewables, 49
 Transition Towns, 171
 Transmission infrastructure, 48
 Transport, 234
 Transportation links, 214
 Transportation of grain, 180
 Trench warfare, 254
 Trevada Buddhists, 276
 Triassic-Jurassic Extinction, 67
 Tribal emotions and nationalism, 24
 Tribal marking through language, 27
 Tribal markings, 27
 Tribalism, 15, 18, 260, 280
 Tribe, nation, church or ideology, 25
 Tribe-like groups, 25
 Trickle-down theories, 279
 Trillian-dollar elephant, 116
 Triple Entente, 251
 Tropical cyclones, 66
 Tropical rain forests, 69, 156, 210
 Tropical regions uninhabitable, 88
 Trump of the Tropics, 120
 Trump sent by God to be King, 299
 Trump's COP24 coal convention, 136
 Trump, Donald, 116, 122, 126, 193, 260, 261, 263, 299, 300, 369
 Truth, 333, 334, 337
 Truth is drowned in distractions, 371
 Truthout, 282
 Tuberculosis, 320
 Tunes blasting, 295
 Turkish Sultan, 255
 TV intrinsically superficial, 371
 Two billion malnourished, 177
 Tyndall, John, 356
 Typhoid fever, 147
 Uexküll, Jakob von, 283
 Ultraviolet radiation, 367
 UN climate scientists, 195
 UN Framework Convention, 22, 40, 66
 UN General Assembly, 325
 UN High Commission for Refugees, 280
 UN Peacebuilding Office, 285
 UN Secretary-General, 126
 Unconstitutional state of emergency, 261
 Undemocratic government, 62
 Underground "assets", 20, 39
 Unemployment, 33, 107, 110, 147, 160, 161, 193, 194, 202, 211, 271
 UNEP, 185
 UNESCO, 280, 322, 323, 325
 UNESCO Courier, 323
 UNICEF, 323
 Unidirectional transformation, 218
 Uniforms, 252
 Unilateral acts of kindness, 332
 Unique historical moment, 309
 United Nations, 281
 United Nations Charter, 269, 320, 322
 United Nations Climate Summit, 107
 United Nations Day, 274
 United Nations Environmental Program, 201
 United Nations reform, 33
 United States, 169, 268, 319
 United States drifting towards fascism, 260
 Uniting for a Green New Deal, 201
 Universal demilitarization, 359
 Universal human brotherhood, 269, 303, 321
 Universal primary health care, 94
 University for Peace, 282
 University peace education, 283
 Unlimited economic growth, 91
 Unlimited growth, 277
 Unlimited material needs, 277
 Unprecedented challenges, 99
 Unprecedented heat waves, 66

- Unprecedented investment opportunity, 50
- Unsustainable human behavior, 297
- Unsustainable lifestyles in media, 125
- Unsustainable use of groundwater, 183
- Unto This Last, 333
- Urban growth, 185
- Urban sprawl, 264
- Urbanization, 147, 179
- Urgency of Green New Deal, 199
- Urgency of our situation, 126
- Urgent need for renewable energy, 99
- US Department of Energy, 57
- US Evangelicals, 299
- US Federal Government, 271
- User-owned banks, 216
- Utopian communities, 333
- Utter absence of domestic privacy, 86

- Value-Creating Education, 325
- Vanishing resources, 31
- Vanity, 254
- Vapor pressure, 70
- Vegetables, 176
- Vegetarians, 332
- Venezuela, 62
- Venezuela's Belt of Tar, 57
- Verdun, Battle of, 254
- Versailles, 250
- Versailles Treaty, 206
- Versailles, Treaty of, 257
- Vestas, 51, 237
- Veterans Against War, 285
- Viceroy Lord Irwin, 336
- Vicious circle, 93
- Vietnam, 366
- Village life, 334
- Village solar installations, 49
- Village wind turbines, 49
- Violence, 324
- Violence, rejection of, 324
- Violently driven from their homes, 84
- Vitousek et. al., 154
- Volcanic eruptions in Siberia, 68
- Volcanic regions, 105
- Volvo bans petroleum driven cars, 50
- Vulnerability of modern society, 277

- Wages fell to starvation levels, 85
- Wake Up, 365
- War, 15, 18, 24, 150, 152, 163, 169, 204, 260, 268, 278, 300, 319, 359, 372
- war causes poverty, 33
- War criminals, 256
- War guilt, 256, 257
- War in Syria, 114, 266
- War is now prohibitively dangerous, 267
- War Resisters International, 284
- War-addicted economic system, 86, 93
- War-free world, 19, 270, 272, 322
- Warlike traditions, 252
- Warning from the World Bank, 66
- Wasdell, David, 99
- Wassely Leontief, 218
- Waste products, 215
- Wastefulness, 268, 319
- Water scarcity, 66
- Water shortages, 110
- Water supplies, 214
- Water supplies near to dwellings, 94, 149
- Water tables, 179
- Water tables falling, 31, 163
- Water vapor a greenhouse gas, 70
- Watts, 44
- Wave energy, 215
- Wave power, 155
- We are all specialists, 339
- We are not doing anything, 137
- We have the facts and solutions, 136
- We have to change, 134
- We have to speak clearly, 133
- We love our cars, 297
- We must act now, 125
- We must change almost everything, 140
- We must speak clearly, 140
- Wealth, Virtual Wealth and Debt, 216
- Weimar Republic, 257, 258

- Welfare, 67
- Wells, H.G., 340
- West African monsoon failure, 169
- West African monsoon loss, 30, 75, 174
- Western Front, 254
- Western Sioux, 305
- Whipped half-starved child workers, 86
- Wholesale deforestation, 122
- Why do we have wars, 360
- Why wasn't it made illegal?, 134
- Why we love cars, 295
- Why were there no restrictions?, 134
- Wild vegetation, 185
- Wildfires, 94, 369
- Wildfires in Sweden, 133
- Wilkinson, Ellen, 322
- Will a disaster wake us up?, 110
- Willing to die (and kill) for cars, 297
- Wilson, E.O., 26, 69, 156
- Wilson, President Woodrow, 256, 257
- Win-win diet, 176
- Wind energy, 48, 103, 215
- Wind energy, rate of growth, 45
- Wind farm's footprint, 48
- Wind park location, 103
- Wind power, 100, 155, 237
- Wind turbine cooperatives, 52
- Wind turbines, 103, 237
- Windmill construction, 33
- Winter heating of homes, 56
- With hands on our hearts, 266
- Women's International League, 284
- Women, education for, 148
- Women, higher status for, 148
- Women, participation of, 324
- Workaholic habits, 219
- Working conditions deteriorated, 85
- World Bank, 63, 66, 208
- World Bank Group, 67
- World Bank warning, 66
- World Bank's warning, 92, 232
- World Beyond War, 284
- World citizenship, 267, 317
- World Conference of Religions for Peace, 276, 278
- World Development Report, 66
- World federal authority, 271
- World Federalists, 284
- World food supply, 185
- World Future Council, 283, 365
- World government, 270
- World Health Organization, 280
- World population projections, 164
- World War I, 204
- World War II, 208, 325, 326, 360
- World without war, 93
- World's oil reserves, 57
- Worldwatch Institute, 161, 183, 211
- Worldwide exchange of ideas, 338
- Worship of the free market, 88
- Wounded, 255
- Xenophobia, 281
- y Gasset,, Ortega, 15
- Years remaining, 42
- Young population, 148
- Yugoslavia, 250
- Zaragoza, Federico Mayor, 317, 323
- Zeese, Kevin, 201
- Zoroastrians, 276