Manifesto For A Sustainable Planet

Transforming Global Emergency to Opportunity and Action

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Foreword by President
Tarja Halonen

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Foreword

Sustainability is neither a doctrine nor a trend. It is a basic condition within which human beings now have to learn to live, work and consume if the planet is to remain habitable. It marks a break from the old concepts of boundless growth and human domination over the environment. It argues for a new paradigm that recognizes human economic and social activity as being subservient to the environment. In short, no sustainable environment, no economy, no viable society.

Sustainable development meets present needs without compromising the needs of future generations. Intergenerational equity in the resource-constrained world we have now entered requires that social and environmental issues are given equal weight alongside the economic development.

In sustainability, long-term and holistic thinking is essential rather than the short-termism which currently dominates. Methodological rigor and strategic, comprehensive planning should correspondingly increase when the horizon is long-term. But there is a tendency for organizations to defend their existing and often very narrow commitments. This is particularly true for ministries, such as defense, energy and transportation, where large sums must be committed over long budget periods. The same problem exists in industry, particularly if the cluster model is used by the innovation system, but this is also true in universities and research institutes where studies and research reports are often not directly relevant to decision-making.

In order to create a sustainable future for all of us what we should do is to embed risk management into our strategic planning and build analytical teams that can look forward with holistic insight into the interconnected future.

In this new paradigm of sustainability it is not enough to generate more and better scientific data, massive amount of research and analysis on limited observations, or to develop more sophisticated models to capture the fields of only one or two separate areas of inquiry. **We need rather a much deeper, clearer, analytical understanding of the interrelated developments of the world and the relationships among their components.** This comprehensive approach leads to a complex, dynamic but realistic understanding of our society interacting with nature and facing the limitations of the resources of the planet.

From this new comprehension of the world as it is with its all complicated feedbacks comes wisdom that leads to effective action. Therefore it is not enough to define the problem. We also need **to show the implications of policies** so that policy makers can find **actionable solutions** taking the holistic and synergistic implications of their policies into account.

For the above reasons the Helsinki Sustainability Center was established in 2012 and for the first two years I had an honor to serve as its Chairperson. I warmly welcome factual reports that can take us beyond the existing consensus. This Manifesto is one of those.

This Manifesto defines the fundamental interrelated issues - facts of climate, resources, economy and energy - that our global society has to take into account to reach long-term sustainability. Secondly, it proposes actions that should be taken to prevent worst-case scenarios and open up new sustainable opportunities. The results presented here – a scary scenario of catastrophic climate change but also proposals for necessary measures humankind has to take to avoid it, and to prosper - are the fruits of a multidisciplinary cooperation between a world-renowned energy and climate policy expert, Ian Dunlop, a long-time UN policy planner, Tapio Kanninen, and one of the new leaders in strategic thinking and research, Mika Aaltonen. The bios of Ian, Tapio and Mika are at the end of the book – their combined knowledge and expertise provides a solid foundation for the Manifesto.

One might not like or understand on the first reading all pieces of information contained in this important document but its holistic, comprehensive data and logic of argumentation is both penetrating and innovative and puts us in a thinking mode. I hope that the Manifesto will lead to a lot of discussion, and reflection among national and international policy-makers, media, civil society actors and scholars – as well as citizens at large – and I will actively participate in that discussion which is long overdue. The destiny of our civilization is at stake and it is high time for action.

Helsinki Spring 2015

Tarja Halonen
Former President of Finland
Co-Chair of the High-Level Panel on Global Sustainability set up by UN Secretary-General Ban Ki-moon

Executive Summary

This Manifesto tells us that the planet and human race face a global emergency. This emergency is not yet widely recognized, less understood, as its main characteristics are still largely hidden. They consist of interconnected trends in climate change, energy use, population, economy and technology, which are gradualy revealing themselves, as recent evidence demonstrates. The Manifesto aims at explaining briefly these trends, interconnections between them and to propose a way forward.

Climate Change

CHAPTER 1 tells in stark terms how global temperatures, carbon dioxide emissions, the rate of natural catastrophes and melting of the Arctic and the Antarctica have tremendously increased during the last decades and years.

One of the greatest concerns of the combined impact of these trends is the increase in sea level rise. The Intergovernmental Panel on Climate Change (IPCC) is still giving cautious and conservative estimates of the sea level rise in this century, of a 1–2 metres rise. But new scientific evidence gives reasons for much more pessimistic figures, even 5 metres rise within 100 years, if present CO2 emission trends continue unchanged. Ice has been melting considerably quicker than earlier predicted. Major coastal cities like New York, London, Shanghai and Helsinki would be wiped out in their current form if present trends continue as before.

Another great concern is the potential reduction in global population. We now have some 7 billion inhabitants in the world, expected to rise to 9 billion. But if the present greenhouse emission trends continue scientists have estimated that the carrying capacity of the earth in the so called "4^0 Celsius world" – where current policies are heading - is less than 1 billion, a scary reduction of the global population as the full effects of climate change take effect.

Global Resources, Energy and Prospects for Continued Global Economic Growth

CHAPTERS 2 AND 3 discuss global resources, energy use and prospects for continued economic global growth. Chapter 2 tells us that national accounts and Gross Domestic Product (GDP) are already outdated systems in measuring the threats we face in terms of over consuming our planet's resources. Using a more recent measuring system, "global footprint accounting", we are already using 1.5 worth of planets resources, a trend expected to worsen. This is a global Ponzi scheme in the short, medium and certainly longer term. But there are other more specific threats related to our energy use that undermine prospects for continued global economic growth and fundamentals of our global prosperity, poverty reduction and welfare.

Our economic progress over the decades has been based on cheap energy, particularly oil. While the price of oil has clearly come down in 2014, it is still high in historic standards. If the global economic growth remains to be moderate, the oil price could stay relatively low but if the global growth picks up, in a few years we probably face a major shortage of oil. The difficulties of filling the shortfall with alternative energies will hamper prospects for continuing global economic growth for the following reasons:

- The cost of producing energy is rising inexorably as cheaper sources are exhausted and more expensive and less accessible sources have to be developed. In particular the ratio of the energy available to society compared to the energy needed to produce it, is dropping markedly. This leaves less energy available to run society as we know it.

- The necessity to meet international climate change targets makes it mandatory that the global economy transitions rapidly away from polluting fossil fuels toward renewable sources of energy. But this rapid transformation will not be easy as renewables at present, whilst improving rapidly in efficiency with reduced costs, are a very small proportion of global energy supply.

- Less than 20% of existing proven fossil-fuel reserves can be consumed from now on if the world is to stay below the climate change target, leading to the risk of a so called "carbon bubble" with assets of fossil fuel companies becoming stranded if investment in fossil fuels continues When world markets start to accept the full implications of this dilemma, it is likely to negatively affect the value of these companies and financial markets generally.

- New technologies, whilst undoubtedly a part of the solution, cannot be deployed with either the speed or to the extent necessary to meet climate change emission reduction requirements.

Climate Change Talks

CHAPTER 4 discusses first the role of international climate change negotiations which have so far failed in their most important task: namely reducing greenhouse emissions. In fact global carbon dioxide emissions, the worst greenhouse gas component, have just intensified during these negotiations. Climate change talks in Paris in December 2015 could and should be a major event turning the tide but the negotiations are very complicated. The results should help in changing the world markets to facilitate the rapid transfer to a carbon-free world. Turning the world economy in right direction is impossible if governmental subsidies to fossil fuels, mainly responsible for CO2 emission, continue to be 4-5 times of the money flows going into zero or much less-polluting renewables. This is one of the most critical issue for the future of humanity that Paris talks should address and solve.

Conclusions: We Are in a Global Emergency

CHAPTER 5 concludes that we are in an unprecedented global emergency, which must be recognized, and proper actions should follow, immediately. The role of major corporations, governments and civil society are key in this major transformation, but corporations and governments in particular have become dominated by short-term thinking. This has to change to ensure that long-term solutions to our climate and energy dilemma are adopted.

Overview

Globally, leaders of states and governments as well as mainstream politics, business and bureaucracy are all united in the view that their primary objective must be to re-invigorate economic growth following the 2008 financial crisis. What escapes them is that conventional economic growth in the developed world, and to a lesser extent in the developing world, is slowing down and gradually grinding to a halt, probably permanently, whether we like it or not.

The causes are not the traditional villains of boom and bust in the business cycle, inappropriate tinkering with financial levers or corrupt conduct by banks, but the emergence of real global biophysical limits brought about by the combined exponential increase in population and consumption. These limits are the underlying causes that have prevented the US and Europe from shaking off fully the recession since 2008, and are in many ways behind current crises in Egypt, Syria, and elsewhere.

In essence we have 20th century leaders trying to re-activate the growth model on which we have relied since World War II. But now this effort is taking place in a 21st century world subject to fundamentally different biophysical constraints.

Humanity is now the dominant global force. What was workable in a relatively empty world of 2 billion people in post-World War II is not workable in today's full world of 7 billion, let alone the 9 or 10 billion to come as later discussed in this Manifesto. Humanity today requires on average the biophysical capacity of 1.5 planets to survive. If everyone lived at US levels, we would require 5 planets, at European levels around 3 planets. This is clearly unsustainable, as we are fast destroying the global commons of clean air, water and the fertile soil and oceans on which we depend for our food supply and life support. Our ideological preoccupation with a market economy, based on political expediency and short-term profit maximization, is rapidly leading toward an unstoppable path that, at its worst, means an uninhabitable planet.

The immediate pressure points are the inter-related issues of energy, water and food security, but particularly climate change and the peaking of global oil supply. As a result, progressive leaders around the world are beginning to acknowledge that current business models cannot continue. The World Economic Forum (WEF) has, for years, identified climate change as one of the major risks to business viability. Others urge business to move away from the short-termism which dominates business thinking, refocusing on the long term and incorporating a wider range of social and environmental considerations in decision-making. These efforts, whilst laudable, unfortunately have not yet had any substantial impact and time is running short to move away from mankind's current unsustainable path.

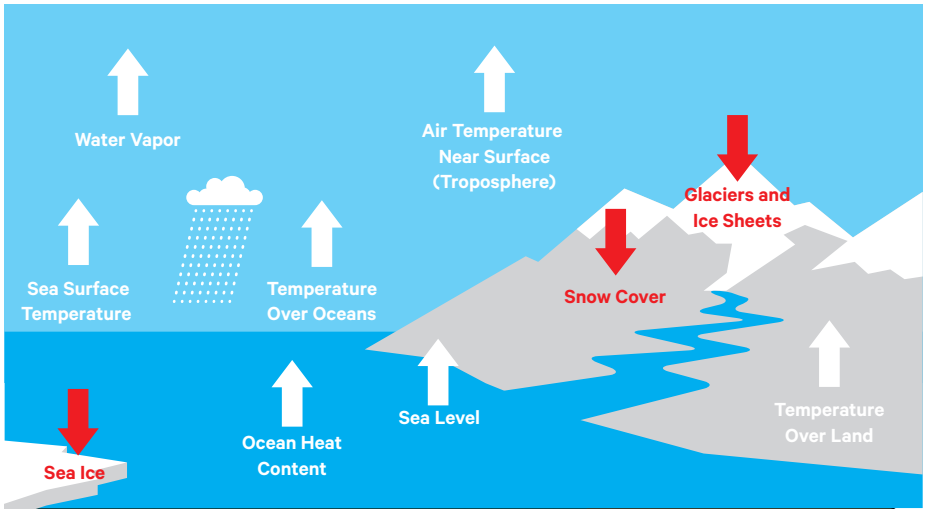
What we are not facing up to is that the only realistic way now to avoid catastrophic climate change is to immediately halt any new high-carbon development and to initiate emergency action by placing economies on a "war-footing", to rapidly implement low-carbon re-structuring. Pressure is already mounting, particularly from the major supranational organizations such as the UN, the World Bank, OECD, IEA and the IMF. As Christine Lagarde, Head of the IMF, bluntly put it at the 2013 WEF Davos meeting: *"Unless we take action on climate change, future generations will be roasted, toasted, fried and grilled"*. The Heads of the UN, the World Bank, OECD and IEA have been equally outspoken. But for the most part the world leaders - whether in public or private domain - are not listening.

The challenge humanity faces today is unprecedented. However, we have the potential to genuinely prosper in a low-carbon world, provided we have the vision to accept the challenge and to recognize the opportunities within our grasp.

This Manifesto sets out the rationale behind these concerns and proposes a way forward.

1. Status of Our Planet in Peril

Graph 1. Ten Indicators of a Warming World.



Climate change is the most urgent and pervasive of the threats our planet is facing. The warming it has been generating for decades can be seen in many different ways:

Graph 1. Ten Indicators of a Warming World[9]
This chapter provides evidence of the rapid and dangerous changes humanity is already experiencing in face of escalating global warming, and the risks to which we will be increasingly exposed.

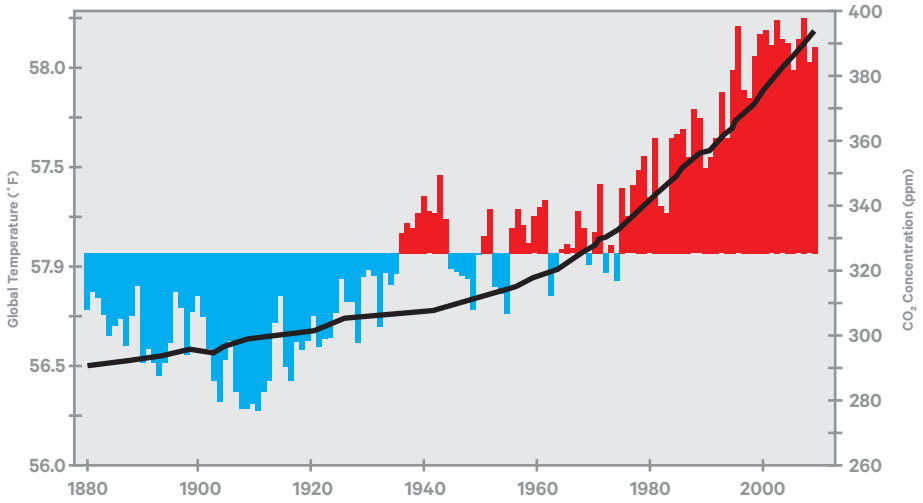
Increasing Global Temperatures
The increase in average atmospheric temperature has been dramatic in recent decades, as carbon dioxide levels have increased, as seen in graph 2. The list of warmest years on record is dominated by years from this millennium. Each of the 12 years between 2001 and 2012 were among the 14 warmest on record.

Graph 2: Global Average Temperature and Carbon Dioxide[1]
Some climate sceptics claim that the world has not warmed since the anomalously hot year of 1998, and hence the anthropogenic (man-made) global warming thesis can be discounted. This argument is not born out by the facts. Whilst the increase in average global surface temperatures has slowed, much as expected after a record hot year in 1998 and subsequent La Nina events, the heat content of the oceans, where most of the accumulating net energy is stored, has continued to increase rapidly.

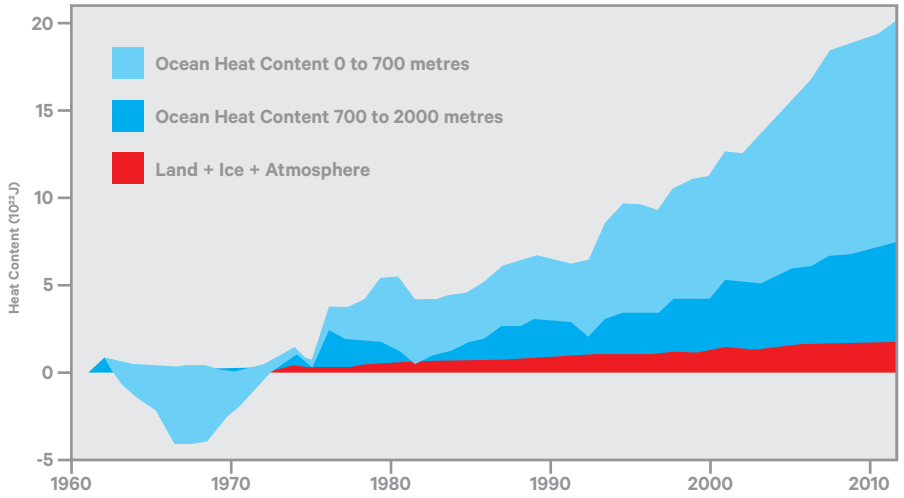
Graph 3: increasing Heat Content of Oceans and Land[3]
The 5th Assessment Report of the International Panel on Climate Change (IPCC AR5)[4] estimates that around 90% of the increase in energy stored in the climate system in recent time has accumulated in the oceans.

Increasing Frequency of Extreme Weather Events
The occurrence of extreme weather events - events which are statistically outside the normal range of historical experience - is accelerating around the world as recent analysis by Munich Re, a major global insurance company, demonstrates in the graph below.

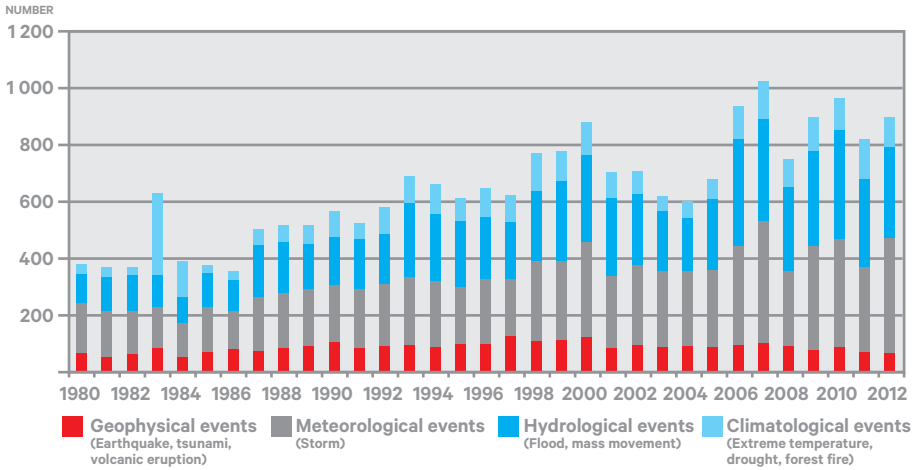
Graph 2. Global Average Temperature and Carbon Dioxide.



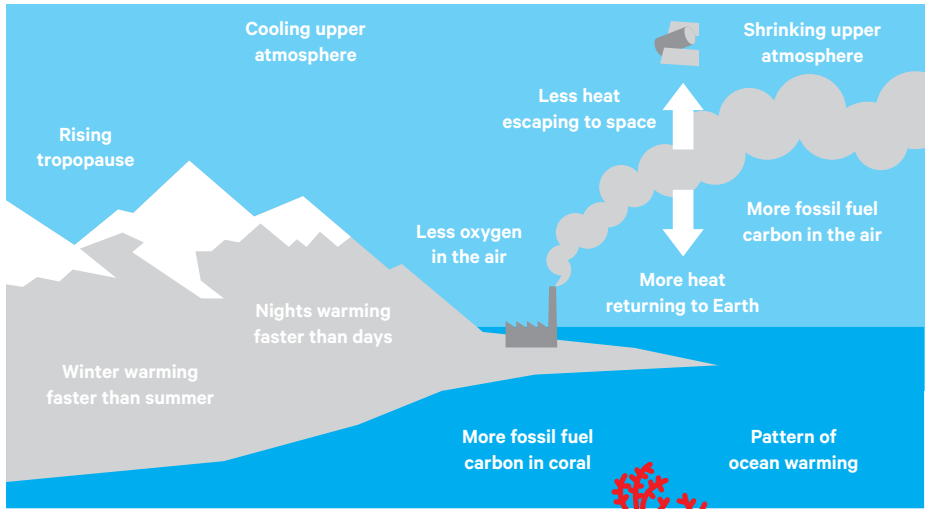
Graph 3. Increasing Heat Content of Oceans and Land.



Graph 4. Natural Catastrophes 1980 – 2012.



Graph 5. Human Fingerprints on Climate Change.



Graph 4: Natural Catastrophes 1980 – 2012[5]

The question is frequently asked: "*Is a particular extreme event caused by climate change*". The answer is that all events now have both a natural variability and a climate change component. The latter is due to the fact that the environment in which they occur is now warmer and more moist than it used to be. As warming increases, the climate change component will also increase[6].

Are Humans the Cause of Global Warming?

Sceptics of the anthropogenic global warming thesis will often agree that the planet is warming, but attribute it to natural causes, arguing that such changes have occurred previously in geological history. They may also take the view that the degree of warming is of no great consequence and certainly not a reason to fundamentally change our lifestyles away from "*business-as-usual*".

That view is not born out by the vast majority of informed science around the world, as the 5th Assessment Report of the Intergovernmental Panel on Climate change (IPCC AR5) makes clear:

> "*Warming of the climate system is unequivocal, and since the 1950's, many of the observed changes are unprecedented over decades to millennia. ------- It is extremely likely that human influence has been the dominant cause of the observed warming since the mid-20th Century*".[7]

This is further reinforced by the US National Climate Assessment (NCA) released in May 2014:

> "*Taken together, this evidence tells an unambiguous story: the planet is warming, and over the last half century, this warming has been driven primarily by human activity . ------ The burning of coal, oil and gas, and the clearing of forests have increased the concentration of carbon dioxide in the atmosphere by more than 40% since the Industrial Revolution, and it has been known for almost two centuries that this carbon dioxide traps heat. Methane and nitrous oxide emissions from agriculture and other human activities add to the atmospheric burden of heat-trapping gases. Data shows that natural factors like the sun and volcanoes cannot have caused the warming over the past 50 years*".[8]

Scientists look for multiple lines of independent evidence to confirm human activity as the primary cause of global warming, some of which are indicated in this graph:

Graph 5. Human Fingerprints on Climate Change[9]

Each fingerprint is backed up by extensive scientific, peer-reviewed analysis which seek to contest or confirm the thesis.

Further evidence, as shown in Graph 6, is provided by modelling analysis comparing actual observations of global temperature change with the change which would have occurred, first with natural forces alone, then with natural plus human forces (including the sun and volcanic activity). As the graph shows, the actual observed temperature changes over the last 50 years can only be explained by the inclusion of human forces.

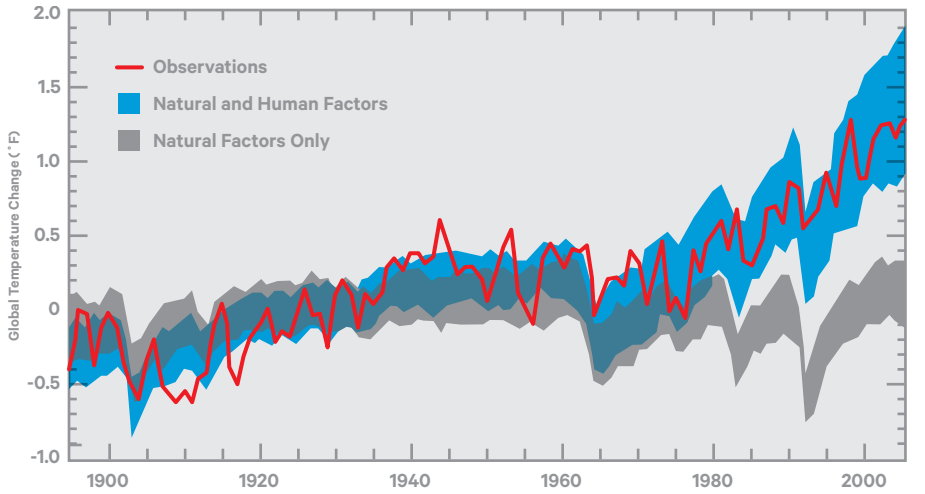
Graph 6. Separating Human and Natural Influences on Climate[10]

The science on an issue this complex is never "settled" and knowledge will continue to improve, but informed opinion is clear – the planet is warming, and there is an extremely high probability that human activity, particularly the consumption of fossil fuels, is a large part of the cause.

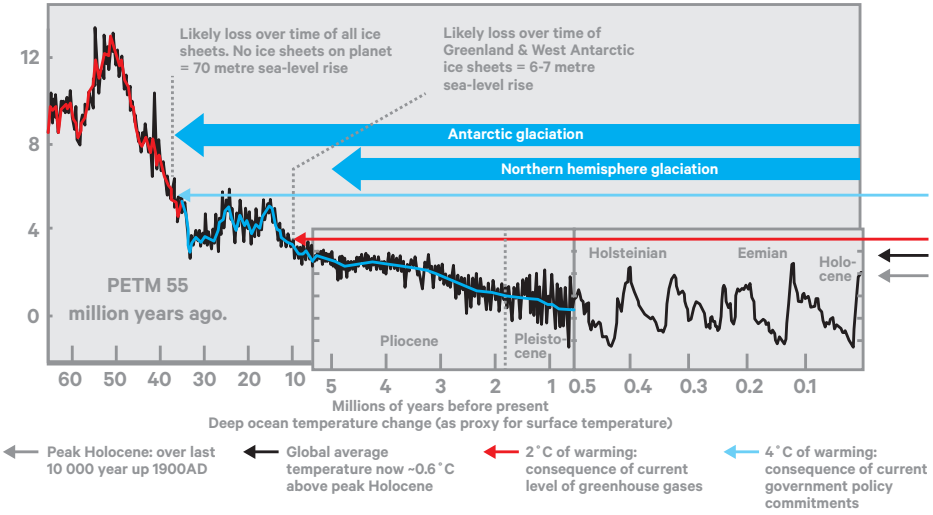
Climate Change as Global Risk Management

Addressing climate change is essentially risk management at a global level. Despite uncertainties around the science, for some time we have known enough to understand that we face potentially catastrophic risks, risks that are with us now, not one or two decades hence. We ignore them at our peril - which is exactly what governments and corporations around the world are currently doing.

Graph 6. Separating Human and Natural Influences on Climate.



Graph 7. Paleoclimate History and Sea Level Rise.



The basic science is well understood, and has been for decades. The uncertainties relate far more to the speed and extent of climate change impact. On that score, the newest empirical evidence demonstrates that we have badly underestimated both speed and extent.

The recent analyses of the Intergovernmental Panel on Climate Change (IPCC AR5) and the US National Climate Assessment (NCA) are understandably conservative, and do not include many of the more serious risks, such as rapid sea level rise from accelerating Arctic and Antarctic ice sheet melt and abrupt methane release from melting permafrost, as we currently have insufficient information to be definitive on their impact. However, given their potentially catastrophic nature, sensible risk management dictates that we must use the available information now to take precautionary action.

This is particularly so given the lag between emitting greenhouse gases and their impact being manifested. Such impacts may be irreversible, so by the time scientific knowledge has improved, it may be too late to prevent catastrophic outcomes. Indeed, in these circumstances **where uncertainty is high and the possible impact is severe, there is a strong case for taking even greater precautions than if we had better knowledge.**

Climate change is an unprecedented risk management challenge, for the survival of much of humanity is at stake. It requires catastrophic risk management techniques far different to those to which business and government are accustomed, whether in commercial operations, financial markets or even high-risk ventures such as deepwater oil exploration.

"*Politically realistic*" incremental change from "*business-as-usual*", which epitomises current policy, is no longer tenable. This must be replaced with normative policy where the targets required to avoid catastrophic consequences are defined based on the latest science. Action is then determined by the imperative to achieve the target, not by art-of-the-possible, incremental change. This will involve both mitigation – *avoiding the unmanageable,* and adaptation – *managing what is now unavoidable.*

Some examples of the risks of the global emergency we are facing are explained below.

Paleoclimate Analysis and Sea Level Rise

Recent advances in science and climate observations provide a better understanding of the ancient history of our planet's climate. Some of the results are summarized in graph 7.

Graph 7. Paleoclimate History and Sea Level Rise[11]

An explanation is as follows:

The graph 7 shows global average temperature over the last 65 million years, commencing from left with a peak at the Paleocene Eocene Thermal Maximum (PETM) 55 million years ago when there was no ice on the planet, subsequently cooling (blue lines) toward the present day at your right.

- As the planet cooled from the PETM, Antarctic glaciation began 37 million years ago, followed by Arctic glaciation 4.7 million years ago.
- Humanity as we know it only developed over the last 10,000 years to 1900AD, during the so called Holocene geological era (at the extreme right of the graph). During this period, temperature was relatively stable.
- Global average temperature today is about 0.6 °C above the peak Holocene temperature (black line).
- The objective of current negotiations is to prevent temperatures rising more than 2°C above pre-industrial levels (red line). This would take global temperature back to a point prior to the beginning of Arctic glaciation when – as you can see in the graph 7 – sea level rise was 6-7 metres higher than today.
- Current policies to address climate change agreed by governments around the world are far from achieving this objective. They are likely to result

in temperature increase of around 4°C above peak Holocene (light blue line). This would take global temperature back to a point prior to the beginning of Antarctic glaciation when sea level was some 70 metres higher than today.

The facts in graph 7 are rarely discussed in the public domain or in current negotiations, maybe as the implications are too stark. If any of us were diagnosed with early stages of cancer most would take immediate and drastic action. Mankind, by contrast, is behaving quite differently and unfortunately moving in the wrong direction. Science has informed us now for some decades about these stark facts but only minimal action has been taken and, for the most part, negative trends have just intensified.

Therefore, the "official" objective, of limiting warming to 2°C above pre-industrial levels, is likely to produce 6–7 metres sea level rise over time, wiping out cities like London, New York, Shanghai, Singapore, Tokyo and Helsinki in their current form. If rapid world-wide action is not taken to limit CO2 emissions in the next few years, sea level rise of this or higher magnitude may well become irreversible - we could not stop it any more even if we belatedly develop the political will to start an emergency action some decades from now.

But current policies of governments all over the world, if implemented without change, are likely to result in temperature increase above 4°C and produce sea level rise of 70 metres over time, with catastrophic impact on humanity, given the large proportion of the global population living in low-lying areas in close proximity to coastlines.

This is not just a concern for small island states and low-lying countries like Bangladesh. Large swathes of China, Europe and the USA would be affected by even a 6–7 metres sea level rise let alone any higher figures.

Speed of Sea Level Rise

The speed with which the polar regions are warming heightens concern over the potential for more rapid sea level rise than acknowledged officially. The Arctic and Antarctic contain both floating sea ice, and ice sheets on land. The sea ice, as it melts, does not contribute greatly to sea level rise other than a minor amount as a result of thermal expansion, albeit its reduction is an important indicator of the speed of warming. The land-based ice sheets will be the major source of sea level rise.

Graph 8: Rapid warming of Arctic and West Antarctica[11]

Graph 8 shows decadal average temperature increases over the last 5 decades and the first few years of this decade. The rapid warming at both poles, evidenced by the darker colours on the graph - 2-3 times the global average – should be of great concern to all of us.

Graph 9: Ice in Arctic is thinning[12]

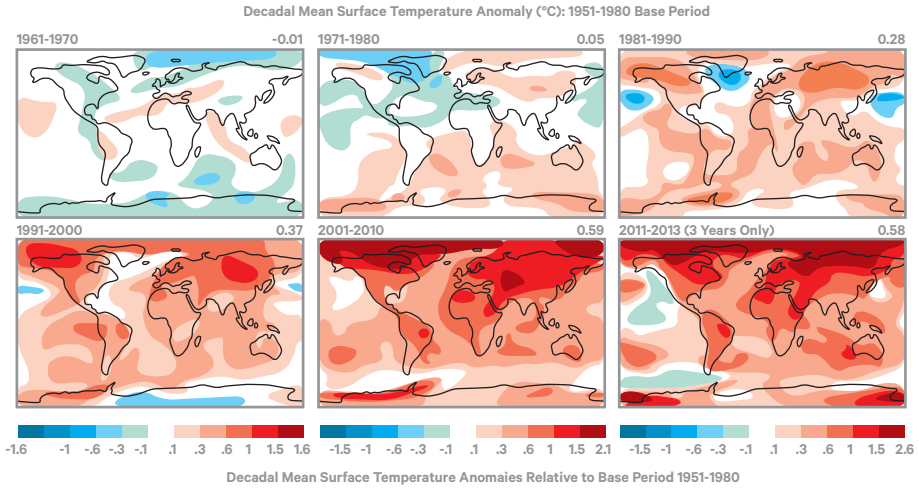
The result of this warming in the Arctic can be seen in Graph 9, which gives the actual sea ice volumes by month since 1979, with trend lines fitted to the data. It shows that, on present trends the Arctic, might be sea-ice free in summer by 2015 -18, something that was not previously predicted to occur until late in the 21st Century.

As the graph 9 shows, the annual minimum Arctic sea ice volume, which occurs in September each year, has reduced by 80% since 1979 and 40% in the last 7 years. This rate of melt is far faster than predicted by the IPCC in their Assessment Reports, as can be seen in Graph 10, which compares the areal extent, that is the area as opposed to the volume, of Arctic sea ice in September each year since 1900.

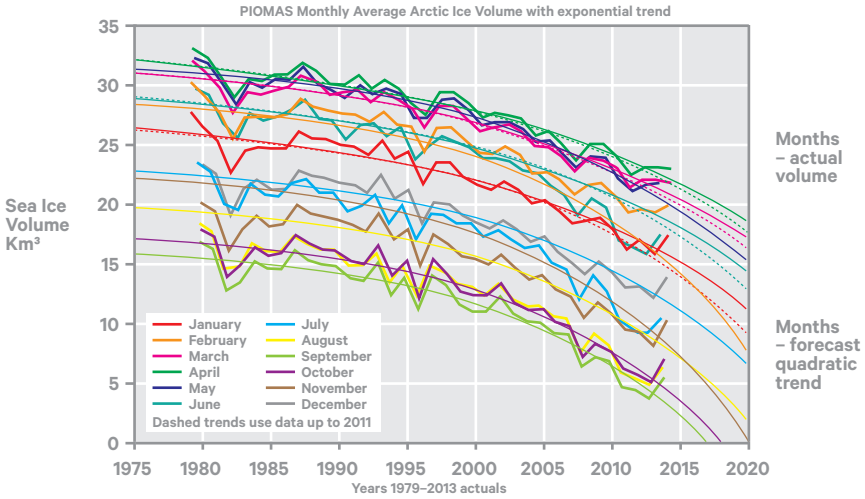
Graph 10: Arctic Sea Ice Extent: IPCC Projections Compared to Actual Observations[13]

At the opposite pole, West Antarctica is warming twice as much as previously thought, almost faster than anywhere else on the planet. Warmer waters in the Southern Ocean now appear to be undercutting the ice sheets, which rest on rock at the sea water interface, pushing back the grounding line and leading to disintegration of the glaciers, as shown below.

Graph 8. Rapid Warming of Arctic and West Antarctica.

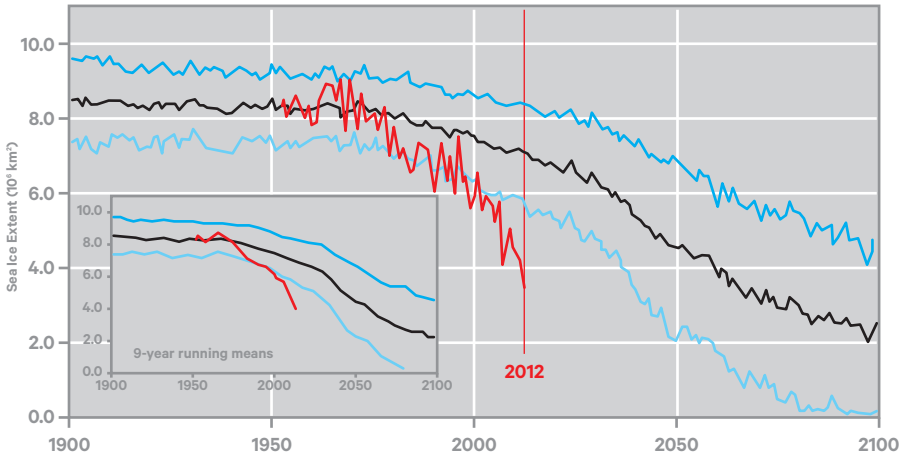


Graph 9. Ice in Arctic is Thinning.

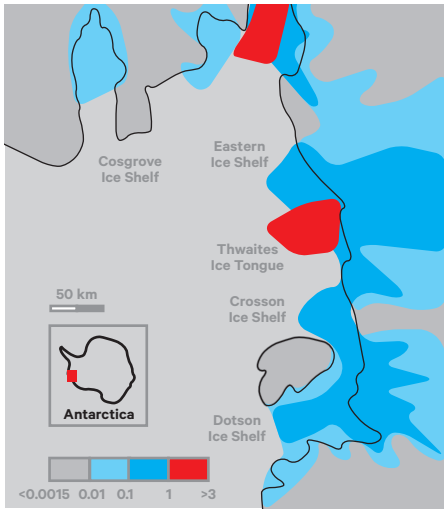


Graph 10. Arctic Sea Ice Extent: IPCC Projections Compared to Actual Observations.

Actuals (red line) vs IPCC forecasts (black line) & confidence limits (blue lines) for September Minimums.



Graph 11. West Antarctica Warming.



Graph 11. West Antarctica Warming. [14]

The official view of sea level rise, for example from the IPCC and the US National Climate Assessment (NCA), is that the upper bound might be around 1-2 metres by 2100, with most opinion focused just over 1 metre.

However, Dr. James Hansen, the prominent US climate scientist, former long-time Director of NASA's Goddard Center for Space Studies and now at Columbia University's Earth Center, in analyzing latest evidence of the Greenland Ice Sheet mass loss, has raised the possibility that melt rates are increasingly exponential, which would result in far more rapid sea level rise than previously expected. There is, as yet, insufficient data over a long enough period to confirm this view, but if current trends continue, depending on the doubling time, they would result in considerably faster sea level rise than being assumed officially. For example, as shown in graph 12:

- 10 year doubling time (gray line) would lead to 1 metre sea level rise by 2067 & 5 metres by 2090
- 5 year doubling time (red line) would lead to 1 metre sea level rise by 2045 and 5 metres by 2057 – **this 5 metres sea level rise is only some 40 years ahead of us in this worst case scenario!**

Graph 12: Accelerating Melt of Greenland ice Sheet and Sea Level Rise implications[15]

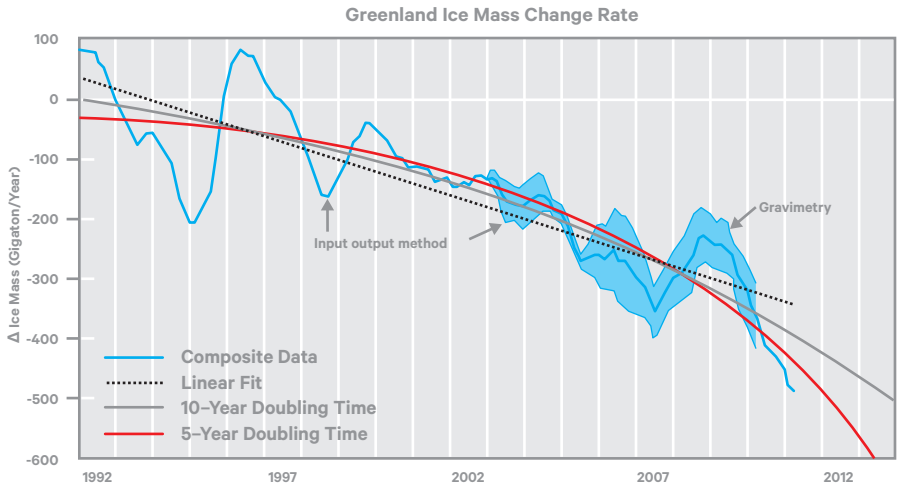
A 5 metres sea level increase early in the second half of the 21st Century is a fundamentally different prospect to anything being contemplated officially, and will have devastating consequences unless its risks are carefully managed. It highlights the increasing concerns, which have developed over recent years over the concept of tipping points as ice has been melting considerably quicker than earlier predicted.

An example of our future – if nothing fundamental is done in a matter of a few years before critical tipping points are crossed – is shown in picture 1:

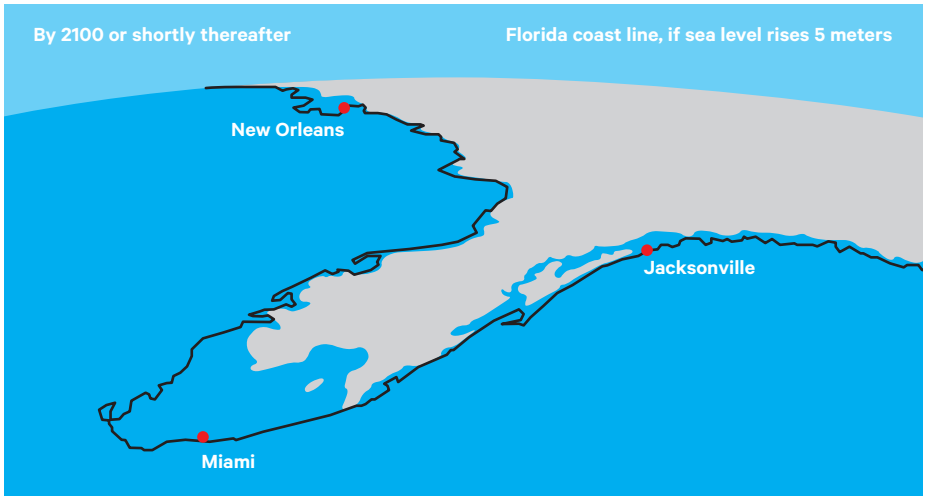
Tipping Points

It is often assumed that the impact of climate change will manifest itself in a predictable, gradual manner as global temperature increases. Unfortunately this is unlikely to be the case due to the "tipping point"

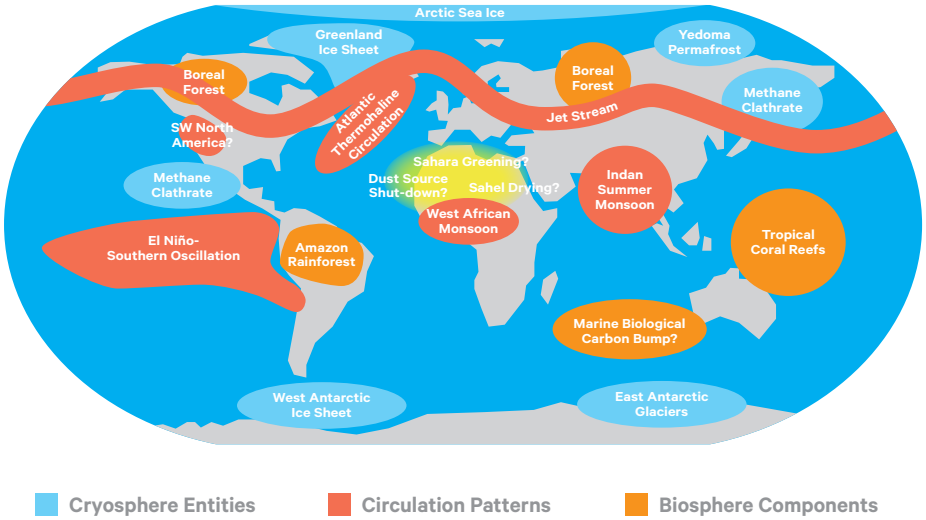
Graph 12. Accelerating Melt of Greenland ice Sheet and Sea Level Rise implications.



Picture 1. Florida Coast Line, if Sea Level Rises 5 Metres (Hansen 2012).



Graph 13. Tipping Points in the Global Climate System.



phenomenon. A tipping point occurs when the global, or regional, climate jumps rapidly from one relatively stable state to another which may be far less conducive to human development, or indeed survival. The jump would typically occur because of positive feedbacks in the climate system, where one small change triggers a far bigger change in the system overall.

The Arctic sea ice melt is a classic example. As accelerating warming in the Arctic melts the ice, its so called "albedo effect", whereby the white ice reflects much of the incoming solar radiation back into space, diminishes. The surface area changes from reflective white ice to grey/green sea which absorbs more radiation, thereby speeding up warming. In turn the warmer water accelerates ice melt, as can be seen in the graphs above.

It also has other impacts. The Arctic contains extensive areas of permafrost, holding overall twice as much carbon as the global atmosphere. Accelerating Arctic warming also melts the permafrost, releasing further carbon into the atmosphere, much in the form of methane, which in the short term has a far greater warming impact than carbon dioxide, - eighty times stronger over a 20-year timeframe - further compounding the positive feedback.

A major concern with tipping points is that they become irreversible – once triggered, they cannot be stopped even if human carbon emissions were to reduce dramatically. This is particularly the case with Arctic warming as the evidence suggests we may already be close to, or possibly past, some tipping points of that massive geographical area.

Major potential tipping points in the global climate system are shown in graph 13.

Graph 13: Tipping Points in the Global Climate System[16]

The Arctic sea ice and permafrost tipping point has been explained above. Other examples are as follows:

- **Permafrost Methane Outburst**: in addition to gradual release of methane to atmosphere with permafrost melt, there might also be a risk of a large abrupt release of methane – an outburst – at some level of temperature increase.

- **Greenland Ice Sheet Melt**: acceleration will create major sea level rise, as indicated above.

- **West Antarctic Ice Sheet Melt**: this would also have a major impact on sea level rise as discussed before.

- **Amazon Rainforest:** if recent droughts continue, dieback of the rainforest may result in the Amazon changing permanently from a major carbon sink, absorbing carbon and therefore reducing its amount in the atmosphere, to a carbon source, emitting carbon to the atmosphere. This would be a major reversal of the role of the Amazon in the global climate system, taking into account the huge land area it occupies.

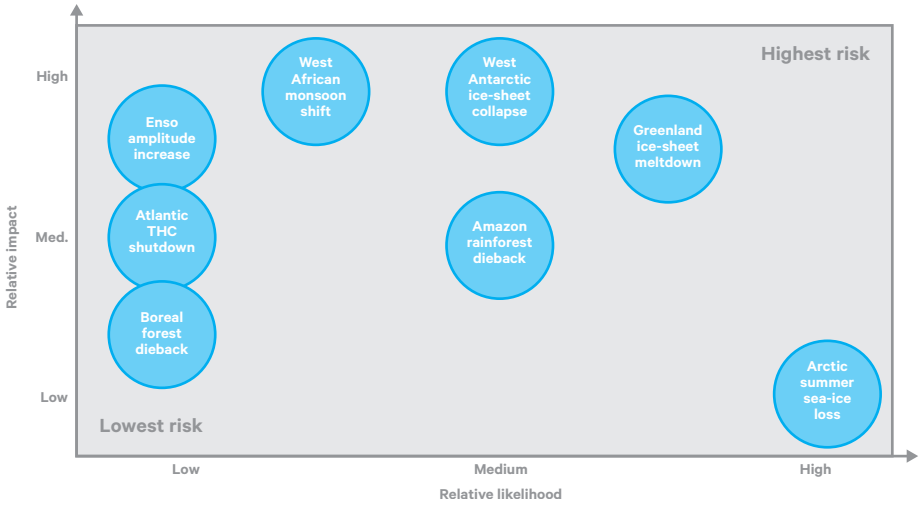
- **Indian Monsoon:** a collapse of the monsoon could result in further drying of already drought-devastated areas, adding to existing social and economic disasters in major countries in the area, and possibly triggering wider climatic change.

- **Ocean Acidification:** accelerating acidification of world oceans as a result of CO_2 absorption from atmosphere, is already having an extremely damaging effect on marine life, and thus on the food chain.

As climate change knowledge improves, scientists are still researching how each of these tipping points might be triggered, when, and what kind of cumulative impact they will have on our global climate. Some indication of current thinking on their ranking is given in graph 14. Whilst this can only be a preliminary assessment, it is essential that the possibility of such occurrences should be incorporated into our risk management of climate change. At the moment such incorporation does

"In a 4°C world, the limits for human adaptation are likely to be exceeded in many parts of the world, while the limits for adaptation for natural systems would largely be exceeded throughout the world."

Graph 14. Tipping Point Impact and Likelihood.



not take place and IPCC assessment reports have not quantified the impact of tippings point, due to lack of sufficient scientific knowledge.

Graph 14. Tipping Point Impact and Likelihood[17]

Note: ENSO is the El Nino Southern Oscillation in the Pacific Ocean.

Note: Atlantic THC is the Altantic Thermohaline Conveyor which warms the European Continent.

Why Mainstream Sea Level Rise Projections Are Much Less Alarming?

The projections of IPCC have so far projected much smaller sea water rise towards the end of this century – only some 1 - 2 metres - and the public and decision-makers still expect these figures to be close to reality. But we have given much higher estimates in this publication. What could be reasons for this discrepancy? The reasons could be found in a couple of areas:

1. As discussed the cumulative impact of tipping points is not included at all or not to sufficient degree in IPCC projections (as it is scientifically difficult to estimate this very complex phenomenon).

2. The insights of the paleoclimate analysis has not yet been included, or not to a sufficient degree, in IPCC projections.

3. Common denominator approach in making IPCC projections might err on the side of cautious estimates; governments' involvement might also have an impact tempering down the conclusions.

4. The long time period between publications of IPCC projections (6-7 years) and careful and time consuming checking of data might mean that projections are already dated when they come out.

A novelty of the issues of tipping points and paleoclimate analysis for scientists, politicians and public at large might be a major reason as well. Not much of their dynamics – how tipping points interact with each other and other events and trends in a shorter time or in a very long time period – is known for sure as it is a highly complicated scientific area. IPCC is a very conservative institution as it is a scientific body with governmental input and it prefers to err on the side of caution and mainstream views. But because any misreading or delay in understanding the potential and accelerating role of tipping points could be catastrophic for the future of humankind this discussion should be started among politicians and public at large as scientific certainty might never be reached in this complicated field – or only when it is too late to do anything meaningful any more.

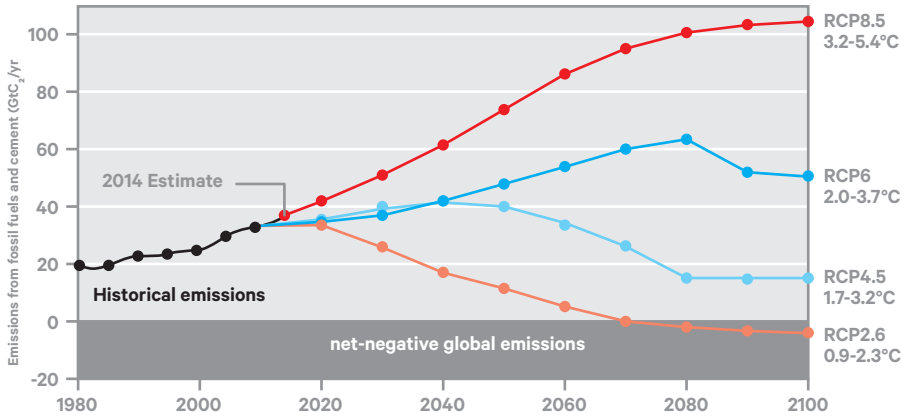
A 4°C World – One Billion People Or Less – A World to Be Avoided at All Cost

As already mentioned, international climate change negotiations agreed some time ago that an acceptable target to avoid dangerous climate change as per the Charter of the UN Framework Convention on Climate Change (UNFCCC Charter) would be to limit global average temperature increase to no more than *2°C* relative to pre-industrial conditions. There was no scientific validity to this target, rather it was thought to be "politically realistic", as well as being roughly aligned to the scientific view at that time (10-20 years ago) of what constituted "dangerous". However, as the analysis above indicates, current knowledge suggests that 2°C is far too high given the speed with which climate change is already occurring. Indeed, 2°C now represents the boundary between dangerous and extremely dangerous climate change.

Despite international agreement and the mounting evidence, over the last two decades negotiators have been unable to agree on the means of achieving even the 2°C target. On the contrary, global emissions of greenhouse gases continue to accelerate above the IPCC's worst-case scenario, as graph 15 indicates. The coloured lines show the IPCC Representative Concentration Pathways

When asked at the Melbourne 4 Degree Conference in July 2011 to explain the difference between a 2°C and a 4°C world, Hans Joachim Schellnhuber, Angela Merkel's climate change advisor and Director of the Potsdam Institute for Climate Impact Research replied simply: "human civilisation".[21]

Graph 15. Global Emissions Following a Worst-Case Path.



(RCPs), which are scenarios of various pathways of emission reduction. The upper red line is more-or-less business-as-usual. The lower orange line is the pathway to stay below the 2°C target. The other lines are intermediate emission scenarios. The black dotted line shows actual emissions to date, continuing on the worst-case business-as-usual pathway.

Graph 15. Global Emissions Following a Worst-Case Path[18]

If nothing continues to be done to change the current global emissions trajectory, the world is heading toward a 3.2 – 5.4°C temperature increase this century, say on average 4°C, rather than the official 2°C objective.

Given the lack of global action, it is now almost inevitable that temperature cannot be constrained below 2°C. Rather than face up to the urgent need for change, political and business leaders glibly talk about adapting to a 4°C world with little idea of what it really means - which is a world of 1 billion people or less, not the present 7 billion as scientists have estimated a major drop in the carrying capacity of the planet to feed and nurture humans at these high temperatures.[19]

As the UK Royal Society put it January 2011, *"In such a 4°C world, the limits for human adaptation are likely to be exceeded in many parts of the world, while the limits for adaptation for natural systems would largely be exceeded throughout the world".*[20]

When asked at the Melbourne 4 Degree Conference in July 2011 to explain the difference between a 2°C and a 4°C world, Hans Joachim Schellnhuber, Angela Merkel's climate change advisor and Director of the Potsdam Institute for Climate Impact Research replied simply: *"human civilisation"*.[21]

Kevin Anderson, Deputy Director of the UK Tyndall Centre for Climate Change Research summarises the dilemma as follows:

> *"For humanity it's a matter of life or death. We will not make all human beings extinct as a few people with the right sort of resources may put themselves in the right parts of the world and survive. But I think it's extremely unlikely that we wouldn't have mass death at 4°C. If you have got a population of nine billion by 2050 and you hit 4°C, 5°C or 6°C, you might have half a billion people surviving."*[22]

> *"It is fair to say, based on many discussions with climate change colleagues, that there is a widespread view that a 4°C future is incompatible with any reasonable characterisation of an organised, equitable and civilised global community. A 4°C future is also beyond what many people think we can reasonably adapt to. Besides the global society, such a future will also be devastating for many if not the majority of ecosystems."*[23]

Large parts of the world would be subject to extreme drought, with severe impact on food and water supply and human health, whilst other parts experience intense rainfall and flooding, sometimes both in short order.[24] [25]

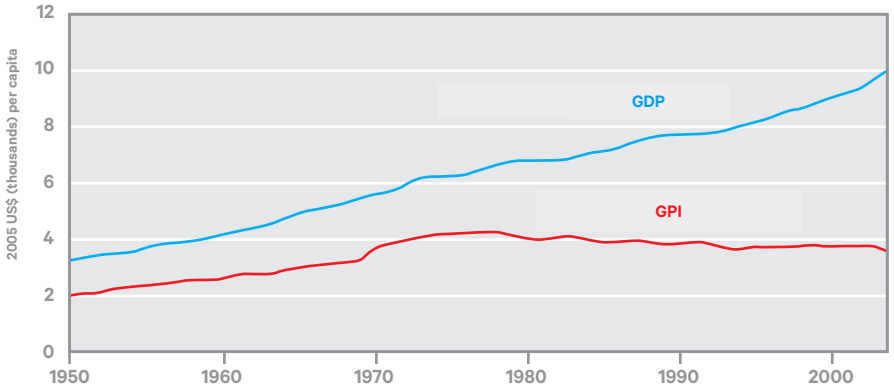
An analogy with human physiology is appropriate. Normal body temperature is 37°C. Add 2°C and you have high fever. Add 4°C and you are probably dead. Just so with the climate.

In short, as the World Bank emphasises[26], if we have any sense of responsibility to current and future generations, a 4°C world is to be avoided at all costs.

2. Global Resources and Energy Use

"At the moment we are seriously overusing our critical natural resources, producing and consuming energy in a way that is severely polluting our living environment and atmosphere."

Graph 16. GDP versus GPI.



Our global resources and energy are what the industry, agriculture and service sectors need to operate and what we also need as human beings to continue our daily activities at work, at home, and in various institutions, organizations and groups we are engaged with. However, the resources and energy are not endless on our planet, or at least in the way we use them now, and their use should be in balance with nature's possibilities and limits. But at the moment we are seriously overusing our critical natural resources and producing and consuming energy in a way that is severely polluting our living environment and atmosphere.

Measuring Economic Activities and the Use of Global Resources

Economic activity is traditionally measured by using the so-called *national accounts system* developed by Prof. Richard Stone who was awarded a Nobel Prize in Economics in 1984 for that work. The concept of Gross Domestic Product (GDP), used in measuring global and national economic growth, is derived from that accounting system but its problems are well known. For instance, traffic jams increase GDP by increased use of gasoline but evidently not quality of life and protection of our air from pollution and emissions of green house gases. But still nations and international organizations use GDP as the definite and only measure of solving major problems in society and the world – in fact as a measurement of progress in general – without addressing the negative consequences caused to our environment and global sustainability – in particular the misallocation of resources which is destroying our quality of life.

Other measurement systems than national accounts have been developed to take into account the sustainability or negative aspects of economic growth, but as yet are not widely used. One example is the GPI (Genuine Progress Indicator) which, as graph 16 demonstrates, suggests that human progress plateaued in the early 1970s and has since gradually declined.

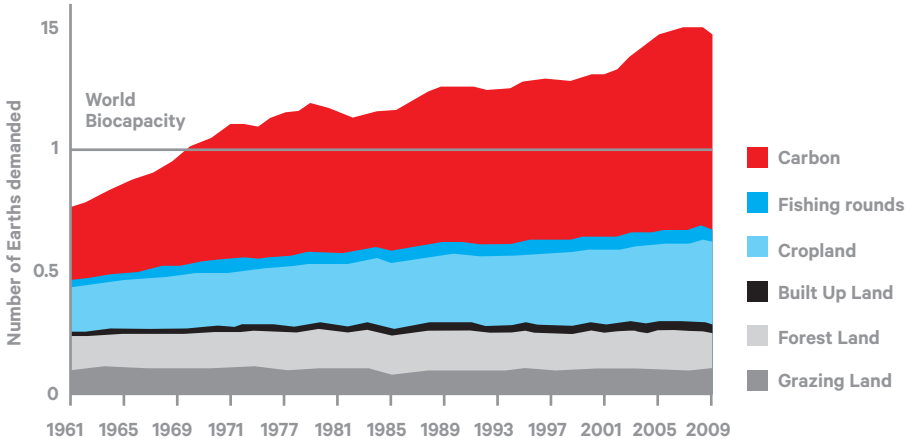
Graph 16. GDP versus GPI.[27]

Another measurement system of human activity that is more accurate than national accounts in measuring human progress, its sustainability and the limits to that progress, is *global ecological footprint* accounting. It answers a very different question from national accounts which measure economic growth. The Global Ecological Footprint Network (GFN) makes an annual evaluation of world's ecosystem sustainability. "Ecological footprint" is a resource accounting tool and its accounts are like bank statements documenting whether we are living within our ecological budget or consuming nature's resources faster than the planet can renew them. In other words, is our global economic and financial system based on a kind of Ponzi scheme which will collapse at some point, and indeed are we are living dangerously beyond our means?

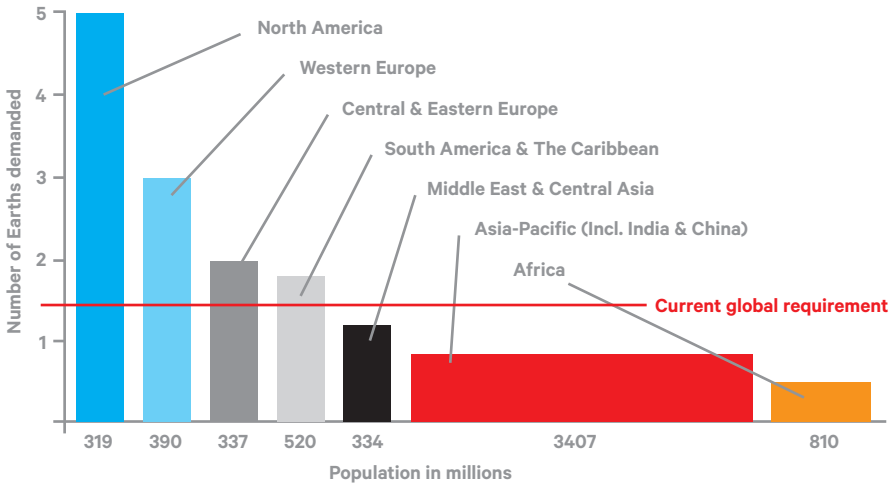
Human Race is Living Way Beyond its Means

Recent GFN analysis shows that humanity is currently using resources 50 percent faster than nature can sustain. Thus at present it takes 18 months to produce the food, fiber, and timber used, and to absorb the carbon emitted in one year. In other words, we would need 1.5 planets to continue this lifestyle. Historically this has been due to the developed world's massive consumption of the planet's resources, but increasingly developing countries such as China and India are having an impact. The result is unprecedented pressure on our natural systems, but most countries are still increasing their biocapacity deficits. This is only possible by importing resources, depleting their own stocks or filling the atmosphere and ocean with their carbon emissions. This process has been worsening ever since humanity first exceeded the world's biocapacity limit in the early 1970's as shown in graph 17.

Graph 17. Historical Trend of World Ecological Footprint.



Graph 18. Regional Use of Global Biocapacity.



Graph 17. Historical Trend of World Ecological Footprint[28]

A Global Dilemma: How to Make Ecological Footprint More Equal?

Looking at the Global Ecological Footprint from a regional viewpoint, Graph 18 shows that if the world population all lived at North American standards, it would require 5 globes' worth of resources, at West European standards 3 globes but Asia only 2/3 of the globe and Africa only 1/3. Africa and Asia are therefore within their ecological quotas in relation to their population but will be suffering from the gross over-consumption that has been and will be taking place elsewhere. The world consumption of our resources is therefore is very unequal and unfair. But how can China, India and other Asian and Latin American countries as well Africa increase their economic growth, get out from poverty, **without** increasing their ecological footprint over the upper limits of their quota. This kind of increase would be fair and just. But this is a big dilemma for mankind. The answer is: they clearly cannot unless the global North – North and South America and Europe - reduces its own ecological footprint, its gross overconsumption. If this does not happen there will be at some point global and regional collapses where all continents will suffer, and greatly so.

Graph 18. Regional Use of Global Biocapacity[29]

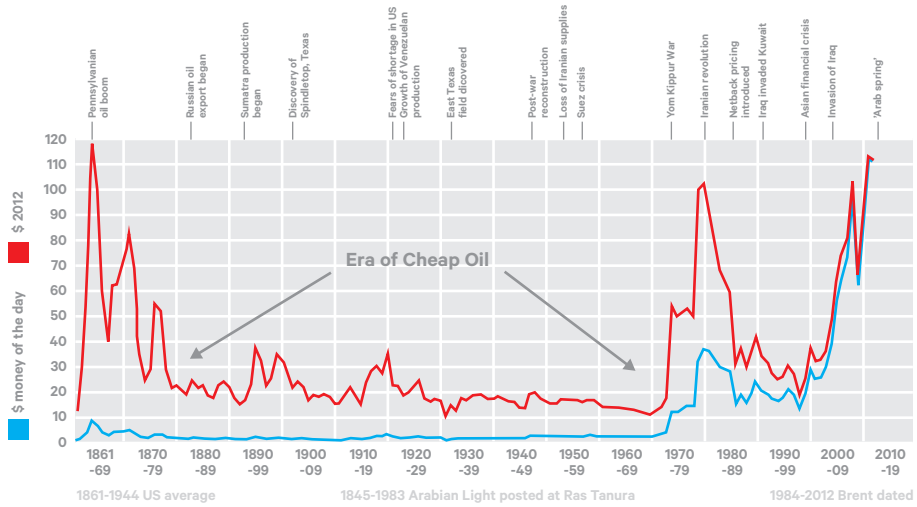
Availability of energy has been, and remains, crucial to maintenance our living standards and to global sustainability. Energy use is also essential to the alleviation of poverty, particularly in the global South. In the West and North our economic growth and increased prosperity have been based on cheap oil in the period of 1900-1970. The following chart shows this graphically.

Graph 19. Long Term Oil Prices[30]

But the era of cheap oil and energy has ended as the graph shows. This problem has three main causes:

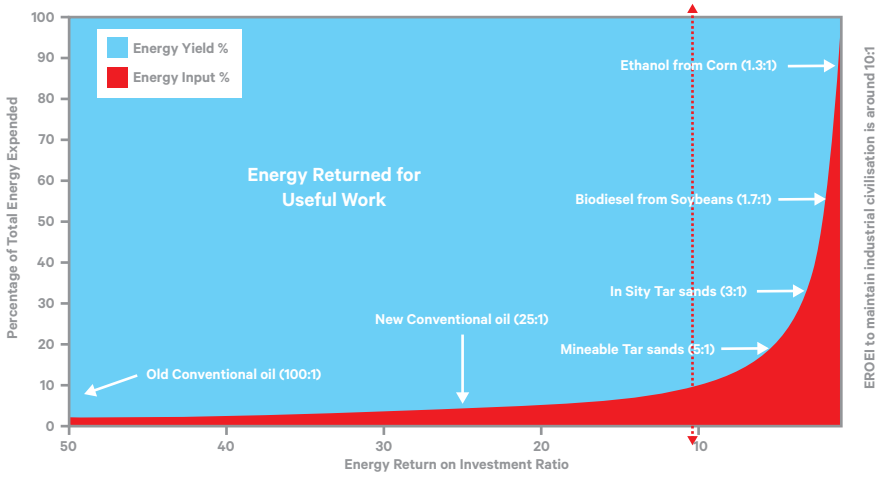
- increasing cost/benefit ratio for the oil industry
- the concept of peak oil and
- the high cost/benefit ratio of alternatives for crude oil such as renewable sources of energy.

Graph 19. Long Term Oil Prices 1861 – 2013.



"Historically, "Energy Return on Energy Investment" (EROEI) ratio was 100:1 or more. As the easily accessible oil and other fossil fuels have been used up, the ratio has declined to a global average of around 20:1 today as exploration and production has moved into more difficult territory such as deep offshore waters. For many of the new sources such as tar sands, the ratio is below 5:1 and may fall below 1:1 when the true environmental impact is internalized."

Graph 20. Energy Return on Energy Investment.



Energy Return on Energy Invested (EROEI): A Major Challenge for Global Economy

The implications of the problems facing the mankind in the near future can be understood by using the concept of "Energy Return on Energy Investment" (EROEI). The concept indicates how many energy units are produced for the energy invested in producing it. For instance, **to get oil from the ground also needs some oil or other energy source for drilling, transportation and other necessary activities to keep the oil industry going. Therefore, if one energy unit (e.g. one gallon of oil) invested to produce energy for our collective use brings us 10 units (e.g equivalent of 10 gallons of oil) the ratio is 10:1.**

Graph 20. Energy Return on Energy Investment[31]

EROEI is rarely discussed in mainstream economic literature, yet it is arguably the most important issue the world will face in the next few decades. Historically, from an energy production perspective, this ratio was 100:1 or more, for example for large onshore oilfields in the hey-day of the Middle East pre World War II. As the easily accessible oil and other fossil fuels have been used up, that ratio has declined to a global average of around 20:1 today as exploration and production has moved into more difficult territory such as deep offshore waters. For many of the new sources such as tar sands, the ratio is below 5:1 and may fall below 1:1 when the true environmental impact is internalized. In comparison, shale gas in Pennsylvania is around 20:1. EROEIs are very source specific. There is little point in continuing operations – from the view of environmental impact and economic profitability - when EROEI ratios fall much below 3:1.[32 33 34]

The red area in the graph represents the energy invested in producing energy, for example in building drilling rigs, pipelines and tankers to access the oil and move it to market. The blue area is the surplus available to run our society, for example transport systems, urban services power generation etc. As the ratio has reduced, moving from left to right across the graph, over time the blue proportion has been dropping and the red proportion increasing. Overall, to maintain an industrial society as we know it requires an EROEI of around 10:1, as indicated in the graph.

But what about alternatives to fossil fuels? Could they offer better solutions in terms of better EROEI? Not really.

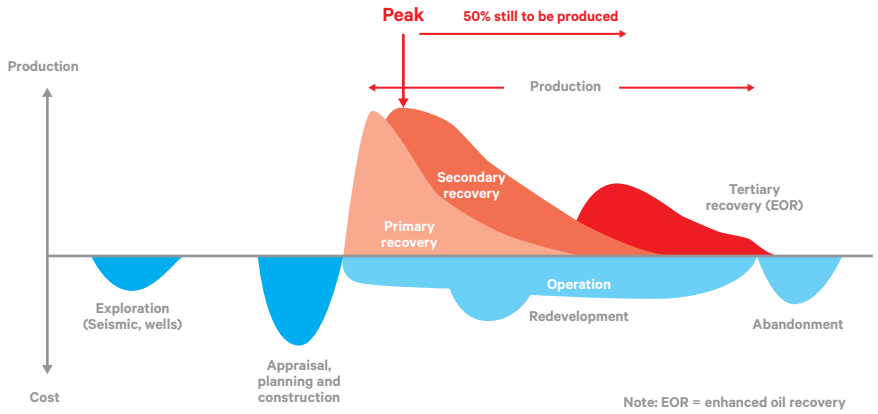
The alternatives to fossil fuels encompass:

- demand reduction via efficiency & conservation
- hydro
- wind
- solar PV
- concentrating solar thermal
- passive solar
- geothermal
- wave
- tidal
- new generation nuclear
- biomass
- biofuels (albeit these may be excluded on low EROEI grounds)
- the unknown unknowns ?

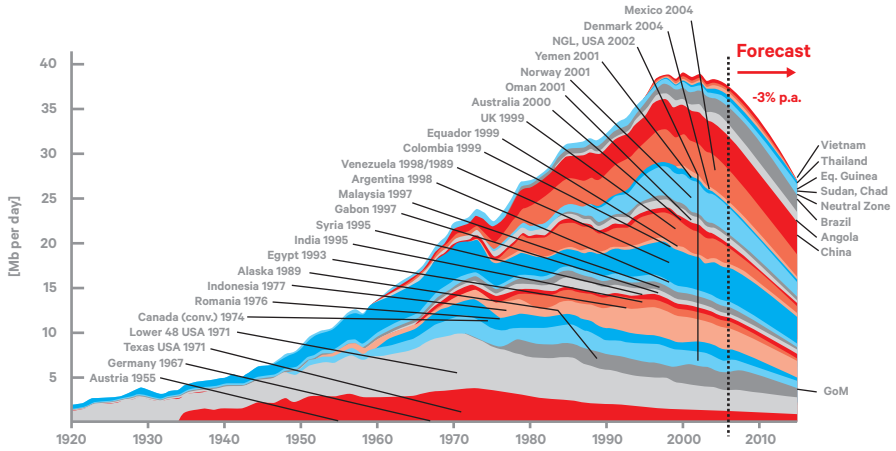
Each alternative currently contributes a minor amount to global supply relative to fossil fuels, albeit some are growing rapidly. With the exception of nuclear, they also have far greater spatial requirements than fossil fuels, raising issues of potentially conflicting land use. They have relatively low EROEIs which will improve as their efficiencies and related technologies improve, but they will never have the power density of coal, oil or gas. To become more effective, these intermittent sources also require major innovations in, storage and transmission, which is now happening. However their great advantage is that they do not emit carbon

At present, EROEIs of alternative energy sources are around or lower than 10:1, so until these ratios improve, there will not be sufficient energy to sustain conventional economic growth unless we make fundamental changes to our lifestyles by consuming less via increased energy efficiency and conservation.

Graph 21. Production Profile of a Typical Oilfield.



Graph 22. Global Oil Production Peak.



This was already evident when high energy prices from the 2008 Global Financial Crisis right until 2014 dampened economic activity in developed economies.

Whether other forms of cheap energy will emerge, or energy will remain expensive, is unclear, but there is little doubt that energy prices in the medium term will be volatile as the new order unfolds.

We return in the next chapter to the crucial issue how global economic growth is dependent on energy use and its availability as well on climate change and available technology.

History has demonstrated that major innovations in the energy arena can take at least 30 years to reach "materiality", based on conventional commercialization processes[35]. This only serves to underline the enormity of the transition ahead, and the fact that we cannot rely on historic transformation processes if we are serious about avoiding dangerous climate change.

Further, it is rarely acknowledged is that decisions made today about energy systems, urban design, housing and infrastructure generally, lock in patterns of consumption and emissions which last for decades to come, which is why those decisions must be taken with a clear understanding of their long term implications, and not based on short-term political expediency.

Peak Oil – Diminishing Resources of Oil Supply

A related problem to the declining rate of EROEI is the depletion of global oil reserves, so-called peak oil. Oil is still the most important energy resource for our societies and will remain so for some time even if the alternatives forms of energy like renewables rapidly take a larger market share. The two charts, 21-22, explain the basic nature of this problem.

Peak oil is in essence a geophysical problem, determined by the structure of oil reservoirs. Graph 21 shows the production profile of a typical oil field. After exploration and development, production initially increases as drilling is carried out to reach a maximum level, or initial peak. Beyond this, various secondary and tertiary recovery processes can be used to extend the production life, but the peak production is rarely exceeded. Production then declines as the natural pressure in the reservoir declines.

Broadly, the production profile follows a bell-shaped curve. At the peak we have not run out of oil, as roughly 50% of all the recoverable oil in the reservoir remains to be produced. The critical point is that the production level cannot be increased, not because of any economic or price considerations, but because of the physical attributes of the reservoir.

Graph 21: Production Profile of a Typical Oilfield[36]

If this approach is applied to all oil fields worldwide, at some point we would expect to reach a global peak of oil supply, unless decline in existing reservoirs is more than offset by new discoveries.

Graph 22: Global Oil Production Peak[37]

Graph 22 shows how this is now playing out globally as more and more countries pass their individual peaks. New discoveries have not been keeping up with existing reservoir decline. Graph 23 shows the growing gap between global oil discoveries and conventional oil production. It raises the question how this growing gap might be filled in the future, as there are many problems in trying to do this:

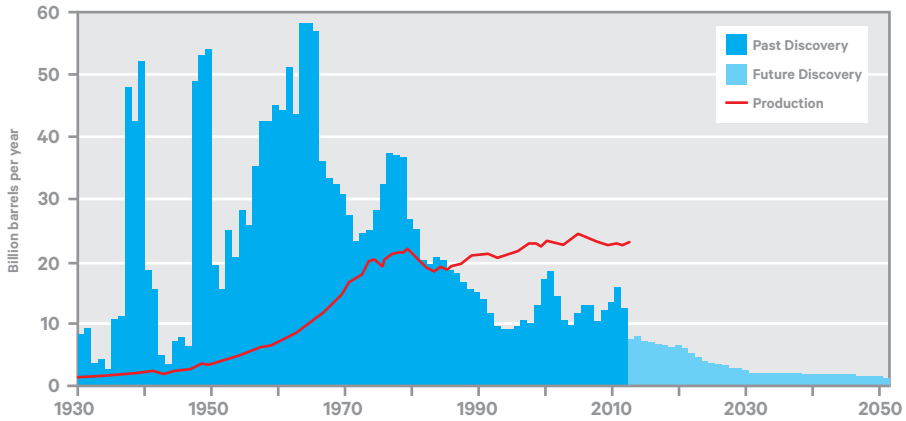
- Not discovering new oil fields quickly enough.
- Data on existing oil reserves is suspect.
- Many established oil provinces are in decline.
- Unconventional resources are proving difficult to develop.
- Oil producing nations are using more oil domestically and exporting less.

Graph 23: Growing Gap Between Discovery and Production of Conventional Oil[38]

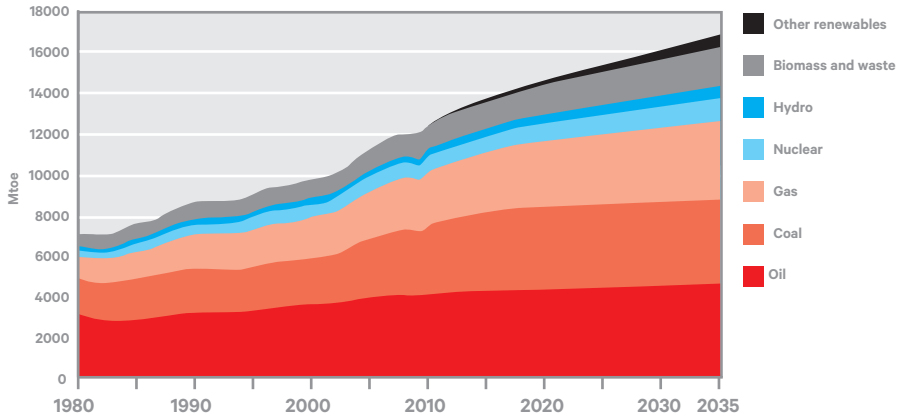
Peak oil becomes very important as the new emerging markets, particularly the BRICS countries (Brazil, Russia, India, China and South Africa), endeavour to rid themselves of poverty, seeking high rates of economic growth, surpassing the growth rates of the global North and West.

But where would the energy come from to make these kind of economic

Graph 23. Growing Gap Between Discovery and Production of Conventional Oil.



Graph 24. World Primary Energy Demand to 2035.



growth rates possible for BRICS countries?

The International Energy Agency (IEA) has the following view of energy supply under their "New Policies scenario", which is more or less "business-as-usual" with some adjustment for policies which governments have committed to but not yet implemented.

Graph 24: World Primary Energy Demand to 2035[39]

Within this overall energy picture, conventional oil supply peaked in 2005. Demand has since been met by expansion of unconventional oil supply(such as shale oil or gas, see exhibit on p.19), but by 2035 substantial additional supply has to be found out equivalent to around 4 new Saudi Arabias, currently the world's largest oil producer. It is highly unlikely that this gap can be filled from unconventional sources, so a supply/demand imbalance is likely to develop, with major negative implications for global economic growth.

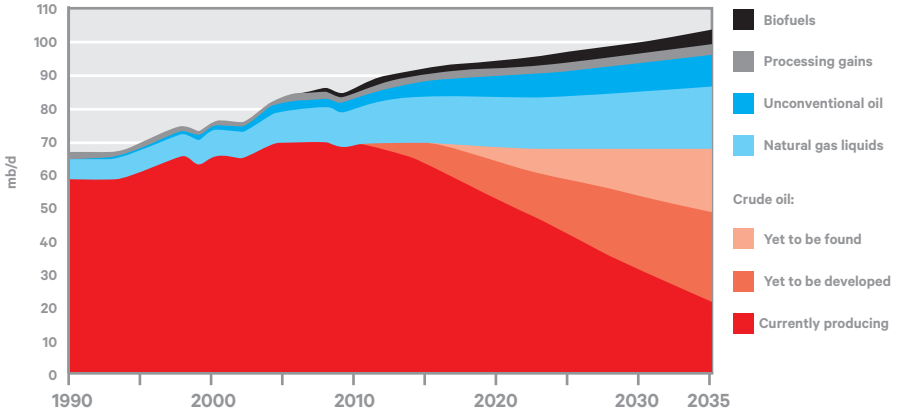
Graph 25: World Oil Production[40]

This intensifying major imbalance between oil supply and demand poses a major dilemma for global energy supply. However matters are further complicated by the climate change implications of the "New Policies" scenario above. The IEA does not "forecast" that energy supply will expand as outlined in the "New Policies" picture above, as many fossil-fuel producers regularly claim. Scenarios are not forecasts – rather they indicate what would happen if, in this case, "business-as-usual " with some minor variation was to be maintained. In fact the IEA argue strongly that if this were to happen, the outcome in climate change terms would be disastrous. As Fatih Birol, the IEA Chief Economist put it in 2012:

> *"The world is currently following a trajectory which will increase temperature by 6°C relative to today, for which the energy sector is largely responsible. If that is allowed to happen, we are all in trouble"*

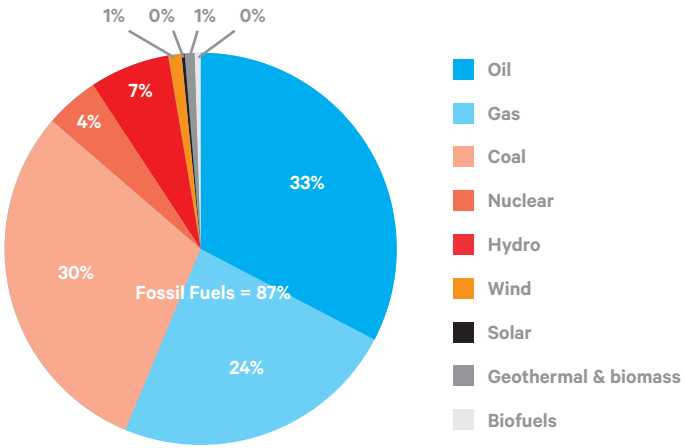
The IEA also have a scenario, the 450 scenario, aimed at containing temperature increase below the official 2°C temperature increase. This requires far more extensive emission reductions than the New Policies scenario above.

Graph 25. World Oil Production.



"By 2035 substantial additional supply of oil has to be found out equivalent to around 4 new Saudi Arabias."

Graph 26. Global Energy Consumption.



Renewables Are Rapidly Becoming Competitive, But From a Very Low Base

The renewable energy alternatives outlined on the left have seen remarkable reductions in cost over recent years, and strong take-up in countries such as Germany, and now China, who have been prepared to provide appropriate incentives to companies to hasten their market penetration. Rapid technological development is greatly improving renewables competitive position relative to fossil-fuels, albeit the playing field is still not level as the price of fossil-fuels excludes so-called externalities such as the cost of carbon pollution and health impacts, in other words it does not reflect their true cost to society. Recent analysis by the International Monetary Fund suggests that the price of coal, for example, should be raised by 60% or more to reflect these externalities[41]. This means that the fossil-fuel industries continue to enjoy the enormous subsidy they have benefited from since the Industrial Revolution. The subsidies given to the renewable industries are small in comparison. We return to the highly important question of subsidies in the chapter 4. The challenge for the world is that renewables, despite great strides in recent years, still only represent a very small proportion of total global energy consumption, as shown below:

Graph 26: Global Energy Consumption[42]

Around 7% of global energy consumption in 2013 came from hydropower, with a further 2% from new renewables such as solar, wind, geothermal, biomass and waste. Allowing a further 6% for traditional biomass (wood) gives a total 15% of global consumption from renewables – a very low figure.

Clearly if carbon emissions have to be reduced rapidly to meet climate change targets, there is an enormous task ahead, which is not going to be solved by conventional change processes. Hence the need for emergency action.

Are Unconventional Fossil-Fuels A Solution?

Unconventional fossil-fuels have attracted much attention in recent years. Unconventionals includes the following:

OIL:

- **Oil Shale**, also known as Kerogen Shale, refers to any sedimentary rock which contains kerogen from which oil may be produced by heating the kerogen.
- **Oil Sands** contain a dense and viscous form of petroleum, virtually bitumen.
- **Light Tight Oil** refers to light crude oil trapped in low permeability, low porosity shale, limestone or sandstone formations.
- **CTL & GTL** refer to Coal-to-Liquids and Gas-to-Liquids technologies where oil is produced from coal or gas respectively.

GAS:

- **Tight Gas** is natural gas trapped in extremely low permeability and low porosity rock, sandstone or limestone formations.
- **Shale Gas** is natural gas contained in organic-rich strata dominated by shale – in effect a sub-category of tight gas.
- **Coal Bed Methane (CBM) or Coal Seam Gas (CSG)** is methane adsorbed on to the surface of coal in coal seams.
- **Methane Hydrates** are methane molecules trapped in a solid lattice of water molecules, kept in solid state by low temperature and high pressure (e.g. in deep water or in the Arctic seas).

Global oil resources for example are significantly increased by unconventionals, as indicated below:

Graph 27: Global Oil Resources[43]

Horizontal axis is oil resources technically recoverable, but at increasing cost going from left to right. The negative segment means the amount already produced. In short, we have a great amount of resources in theory, but little of it is environmentally and economically viable.

But resources are not the real concern. What matters is the ability to extract those resources and to create a flow to the market in an economically and environmentally acceptable manner. As the graph shows, there are difficulties on both counts. Production costs rise rapidly for unconventionals and they are also worse in terms of their environmental impact than conventional fossil-fuels. Overall, these factors reflect the declining EROEI for fossil-fuel supply.

Much attention has been focused recently on "**fracking**", or more accurately hydraulic fracturing. This is the process of opening up fractures in tight subterranean geological formations by the use of high-pressure fluid injection, to improve the flow of fluids residing in those formations to the surface. It particularly applies to extracting tight oil and tight gas.

Fracking was initially developed by the oil and gas industry in the late 1940s to improve the flow of hydrocarbons from conventional reservoirs, and has since been widely applied[44]. Today over 50% of conventional oil and gas wells around the world are fracked as part of standard oilfield practice. Most of these reservoirs are at considerable depth below the surface, and relatively localized, where fracking does not interfere with other critical activities, such as agriculture or water acquifers. Conventional oilfield fracking practice has not generally been a concern.

However, more recently fracking has gained notoriety as it has been applied increasingly to the production of oil and gas from unconventional resources in shale beds and coal seams. These are closer to the surface and have the potential to fundamentally interfere with agricultural activity and water availability, create geological disturbance such as minor earthquakes, with substantial pollution and health risks.

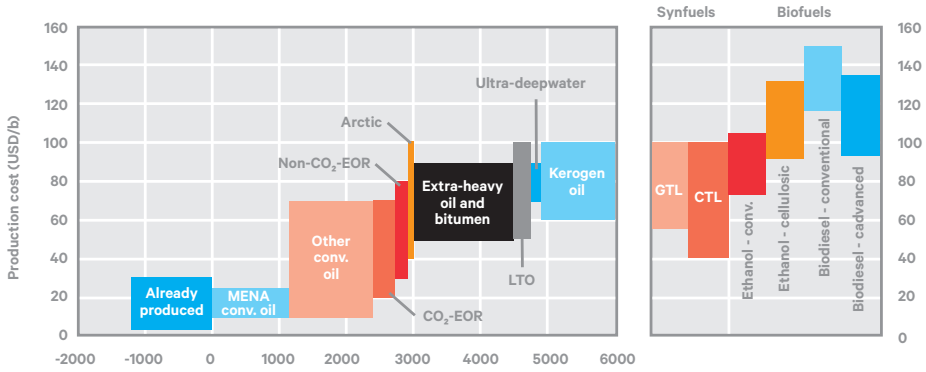
Fracking technology has progressed enormously in recent time, driven by higher oil and gas prices. Techniques such as sophisticated directional drilling now enable extensive areas of shale beds and coal seams to be accessed in ways never previously possible. In the USA, this has led to a significant increase in unconventional oil and gas production, to the point where proponents argue the country could become "*energy independent*" in a matter of years[45].

Whilst this jump in US production has had short-term benefits, the downside effects of fracking are now starting to emerge, with questions raised over the viability of unconventional production from both the economic and environmental perspectives[46][47][48].

This shale oil and gas revolution has in addition a major downside as environmental and climate impact of fracking is a real concern. In particular, shale gas has damaging implications for climate change as methane leakage to atmosphere during its production may result in a higher warming potential than using coal. Also the removal of aerosols in the atmosphere when gas replaces coal may accelerate warming. As Nobuo Tanaka, former Executive Director of the IEA put it in 2011: "*Whilst natural gas is the cleanest fossil fuel, it is still a fossil fuel. --------- An expansion of gas alone is no panacea for climate change*"[49].

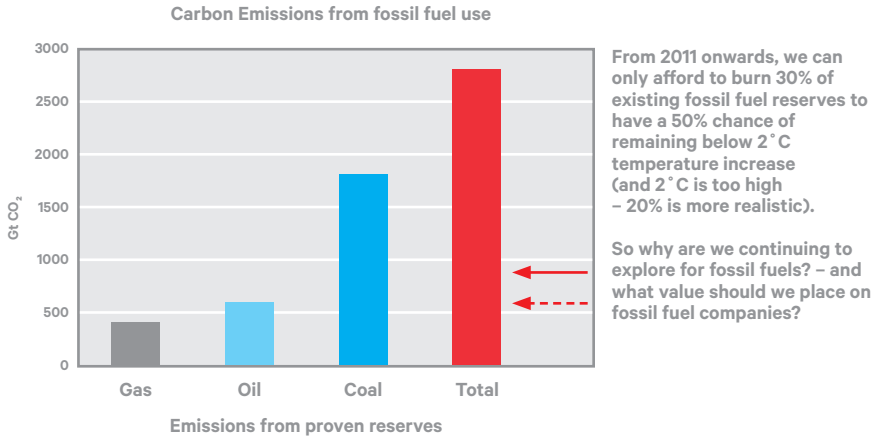
The recent fall in global crude oil prices, from above $100 per barrel to around $60 per barrel in January 2015, reflects the convergence of the factors outlined here. The consistently high oil price since the Global Financial Crisis in 2008 has been a significant factor in stalling economic growth, despite strenuous government efforts to counteract this by increasing money supply via so-called "quantitative easing". The result has been a drop in global demand just at the time the US has substantially expanded high-priced oil supply from shale fracking investments, many of which will be uneconomic at current prices. Demand is also being negatively affected by the beginnings of the transition to the low-carbon economy. Conventional

Graph 27. Global Oil Resources.

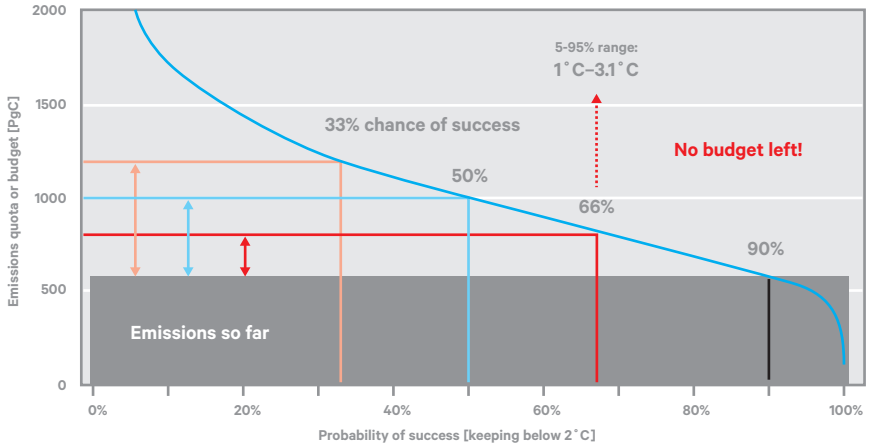


EOR = Enhanced Oil Recovery
MENA = Middle East & North Africa
GTL = Gas to Liquids
CTL = Coal to Liquids

Graph 28. Climate and Energy Dilemma.



Graph 29. The Real Carbon Budget Challenge.



oil producers in OPEC have decided not to reduce supply, hence putting further pressure on the high-cost newcomers. As the transition to the low-carbon economy gathers pace, continuing volatility in energy prices in general is inevitable as the old fossil fuel sources struggle to maintain their position in the face of the new disruptive technologies and pressure to curb carbon emissions. **We need to move away from fossil-fuels in toto – a global rush into fracking will certainly not meet this objective, and will waste substantial funds which would be far better spent on low-carbon alternatives.**

The Climate and Energy Dilemma

Climate and energy are inextricably linked, and integrated solutions are essential if we are serious about sustaining our society whilst avoiding catastrophic climatic outcomes. They cannot be isolated in separate silos as in most current policy-making.

Climate science indicates that if the world is to have a reasonable, say two in three, chance of constraining temperature below the "official" 2ºC increase, albeit 2ºC is too high, from now on only about 20 per cent of current proven fossil-fuel reserves, as opposed to resources, can be burnt. The remaining 80 per cent must be left in the ground.

Graph 28: Climate and Energy Dilemma[50]

This raises fundamental questions: why then continue to explore for fossil-fuels and what value should be placed on resource companies whose future depends on being able to exploit those reserves?

However, the dilemma is even greater. Graph 28 assumes a 50 – 66% chance of keeping temperatures below 2ºC – not very good odds for the survival of much of humanity. A more realistic chance of not exceeding the 2ºC limit, whilst still not ideal, would be, say 90%.

Graph 29: The Real Carbon Budget Challenge[51]

The blue line in Graph 29 is the carbon budget probability distribution for varying chances of staying below a 2ºC temperature increase. The grey box indicates total global carbon emissions from the Industrial Revolution to date. For a 33% chance of success in staying below 2ºC, the orange arrow indicates the world could emit, in future, an amount roughly equal to the amount already emitted to date. For 50% and 66%, as the chance of success increases the budget reduces. However, at 90%, there is no remaining budget.

The "official" solutions to this dilemma encompass a range of technologies, **particularly carbon capture and storage** (CCS) which aims to capture CO_2 at the point of emission, compress it and sequester it underground in geological traps such as depleted oil and gas reservoirs or other secure structures such as acquifers or salt domes. This is well-established technology in conventional oil and gas operations, but extending it to sequester the enormous volumes now being generated from fossil-fuel combustion far exceeds the capacity of depleted oil and gas reservoirs. **CCS may be a partial solution in due course, but it cannot be relied upon to be the "silver bullet" as it is so often portrayed.**

Other clean-coal technologies, whilst partially reducing emissions from coal burning, similarily are unlikely to provide the extent of emissions reduction now required.

Our refusal to confront these facts has triggered serious discussion in scientific circles **on geo-engineering;** altering the atmospheric system to prevent warming occurring by, for example, putting sulphates into the atmosphere, thereby replicating emissions from volcanoes.

This is a dangerous development given that the implications are poorly understood. Geo-engineering is a last resort which should not be used while other options are available. However the inaction of current leaders means that those options are rapidly being cut off.

In short, the world should move as fast as possible to low-carbon energy supply. Obviously that is not going to happen overnight, but it emphasizes the need to transform current policy negotiations from a focus on incremental change to an emergency response.

3. Interconnections Between Climate Change, Energy Use, Technology and Economic Growth

A fact often ignored in policy discussions is how critical areas of decision-making – on economic growth, climate change, energy availability and solutions – interact and how this interaction makes certain policy results impossible even though they are vigorously pursued in present-day politics. Here we pose some key questions, which highlight these profound linkages.

We first analyse our options for keeping temperature rise at or below 2°C – the official target discussed in our section on climate change - from the perspective of the availability of energy resources in the face of continuous global economic growth. We pose three questions:

Question 1: Connection Between Economic Growth, Energy Use and Climate Change

1. Can global economic growth continue as before - with growth rates higher in BRICS-countries (Brazil, Russia, India, China and South Africa) and somewhat or clearly lower in North America, Europe and developed Asia - while we are simultaneously and successfully limiting global temperature increase to 2°C by 2100?

The answer is clearly no. As we discussed in previous section the non-availability of cheap energy sources for world economy may well itself slow economic growth quite separately from efforts to limit global warming. But here we are interested in the interconnections between global economic growth and achieving climate change targets.

It is clear in looking at global energy resources that we are not running out of either oil, coal, or gas as we have plentiful supplies of such energy resources. But the critical issue is how to convert these resources into energy flows to the global markets that growing economies need in an environmentally and economically efficient, cheap and thus politically acceptable manner in face of accelerating demand especially from BRICS-countries. And here comes the question that has to be answered by all economic policy-makers if we are serious about the well-being of future generations:

How do you achieve climate change goal of 2°C by 2100 with present use of fossil fuels in a world economy that grows steadily although unevenly?

The biggest challenge for policy-makers in this connection is that, as mentioned before, according to the most recent estimates only 20 percent of current proven fossil-fuel reserves can be burnt to have a reasonable chance of remaining at or below the 2°C target[52]. This means in practice that we, as a global community, have to reduce drastically our reliance on fossil fuels at the same time as:

- BRICS-countries and some other emerging economies will have clearly increased energy demands ; and
- Environmentally acceptable energy resources – and in particularly the cheap ones – are clearly diminishing as discussed in the previous section.

Acceptance of these facts would result in fundamental change in present global economic and energy policies. **We are still far from realizing the fact that most oil, coal and gas reserves are unburnable which brings us to the brink of another big calamity, a major new financial crisis.** The Guardian reported on 18 April 2013 on this **"carbon bubble":**

"The world could be heading for a major economic crisis as stock markets inflate an investment bubble in fossil fuels to the tune of trillions of dollars, according to leading economists. "The financial crisis has shown what happens when risks accumulate unnoticed," said Lord Stern, a professor at the London School of Economics. He said the risk was "very big indeed" and that almost all investors and regulators were failing to address it. The so-called "carbon bubble" is the result of an over-valuation of oil, coal and gas reserves held by fossil fuel companies. … these reserves will be in effect unburnable and so worthless – leading to massive market losses. But the stock markets are betting on countries' inaction on climate change. The stark report is by Stern and think tank Carbon Tracker. Their warning is supported by organizations

"The key here is to move quickly from the use of fossil fuels as a basis of our economic growth, poverty reduction and prosperity."

Options for mankind:

Option A. Current Situation.

Current economic growth continues as before → Current use of fossil fuels continues as before → 4-6 °C world by 2100 or so → Extreme suffering by our grand children and their children

including HSBC, Citi, Standard and Poor's and the International Energy Agency. The Bank of England has also recognized that a collapse in the value of oil, gas and coal assets as nations tackle global warming is a potential systemic risk to the economy, with London being particularly at risk owing to its huge listings of coal." [53]

Our Remaining Two Questions Are:

Question 2: Connection Between New Technology, Economic Growth and Climate Change

2. Can technology help us move quickly to make the use of fossil fuels less polluting so that our global economic growth model can continue and we will stay below the 2°C target by 2100?

The answer is also a clear no. New technology will undoubtedly be a major contributor to solving the climate and energy dilemma, and may allow the continued use of some fossil fuels. However it is unlikely to be available in the time, or to the extent, required to allow for widespread fossil fuel use if we are serious about taking action on climate change.

Question 3: Connection Between Alternative Energy Sources, Economic Growth and Climate Change

3. Can our global economic growth model continue if we quickly move to the alternative energy sources - such as renewables and nuclear – in an emergency programme to remain below the 2° C target by 2100?

Here also the answer is a clear no. The present alternatives—primarily solar, wind, and nuclear—contribute only a small proportion of global energy supplies relative to fossil fuels (see graph 26). Thus their replacement of fossil fuels while maintaining global economic growth is highly unlikely in the short term (5-20 years). But they may provide a longer term solution for mankind and a steady-state economy. These technologies are improving extremely rapidly and their costs are decreasing.

The conclusion is that unless we, as a community of nations, have the courage to address climate change seriously, we will enter a period of escalating economic and social crises. The only solution is for global economies to be rebooted towards genuinely sustainable modes of operation. This represents a true dilemma for governmental decision-makers as will be discussed in the next section.

Options for the Mankind

To address the interconnections between climate change, energy availability and economic growth is not an easy task for world decision-makers. The next chapter of the Manifesto will briefly discuss the fact that time is running out, and that the longer we leave it, the fewer options we have to turn the tide. The key here is to move quickly from the use of fossil fuels as a basis of our economic growth, poverty reduction and prosperity. Other measures are also important – such as to improve the sustainability of our buildings, forestation and stopping deforestation just to take a couple of examples – but nothing else compares to the role of fossil fuels in accelerating climate change through its massive contribution to the increase in carbon dioxide emissions in recent decades.

But here lies the big problem for mankind. Moving from fossil fuels to alternative sources of energy – renewables and nuclear – takes time and the process is bound to affect in fundamental ways economic growth rates in the countries of North, South, West and East. Would the politicians and political leaders have courage to address this problem, honestly?

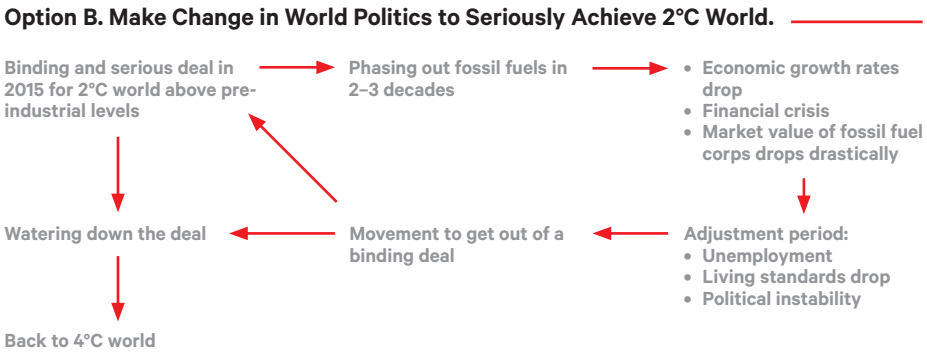
OPTION A. Current Situation:

The following two charts illustrate the problems we are facing right now. Option A describes the current policies of the countries on the globe with "business as usual" economic and energy policies - as starting point for future world economy. This will bring about a world of 4-6 C° which no one wants but at the moment the political decision-making system throughout the world is set up to continue as before.

But if world leaders finally realize that we cannot go like this anymore – as it is morally and ethically wrong to burden future generations with an unsolvable climate change crisis - we have to make a big change in our economic and energy policies

"A massive transition to a new economy centred around renewables, nuclear, energy efficiency and conservation should start immediately, and it would bring about a lot of disruptions to the world economy."

Options for mankind:



to stay below 2°C by 2100. Then the prospects for decision-making do not look easy as illustrated in Option B. As will be discussed in the next section the intergovernmental climate change negotiations are set up to try to reach a major deal in 2015 on a binding climate change agreement which should ideally keep temperature increase below 2°C, even though 2°C is too high. This is the basis in the chart in describing the political realities governments have to face in reaching this deal.

OPTION B. 2°C World:

Option B describes what would be needed to achieve this goal from the point of key variables and argumentation discussed in this section, namely that the use of fossil fuels should be phased out in 2-3 decades, and a massive transition to a new economy centred around renewables, nuclear, energy efficiency and conservation should start immediately. But, realistically, this would bring about a lot of disruptions to the world economy so there would be huge pressure not to reach a binding deal in 2015 but rather a face-saving postponement - with marginal agreements on some secondary or preliminary measures - as has happened before many times over. This sad result would not mean much in terms of changing the future of the mankind.

Another aspect of the politics of climate change is that both science and the role of fossil fuels in climate change, as described here, will be down-played by those private and public vested interests who benefit from the present situation. So the box "Movement to get out from a binding deal" will be fueled by special interests that have a lot of financial resources to spend for a campaign to water down the deal. And so far they have always been successful together with overall ignorance of governments of the seriousness of the global dilemma as described above. Could this be changed?

4. A Way Forward

A. Urgency of Action

The Doomsday Clock was moved 1 minute closer to midnight on 10th of December 2012. The famous clock is kept by the Bulletin of Atomic Scientists (BAS) at the University of Chicago. Its board of directors decides its movement in consultation with the sponsors, currently including 18 Nobel laureates. In December the justification to move the clock closer to midnight was taken because of both the increasing dangers of nuclear proliferation and inaction in climate talks. Allison Macfarlane, the chair of BAS' Science and Security Board, argued for the decision as follows:

> *"The global community may be near a point of no return in efforts to prevent catastrophe from changes in Earth's atmosphere. The International Energy Agency projects that, unless societies begin building alternatives to carbon-emitting energy technologies over the next five years, the world is doomed to a warmer climate, harsher weather, droughts, famine, water scarcity, rising sea levels, loss of island nations, and increasing ocean acidification."* [55]

> *"Since fossil-fuel burning power plants and infrastructure built in 2012-2020 will produce energy—and emissions—for 40 to 50 years, the actions taken in the next few years will set us on a path that will be impossible to redirect. Even if policy leaders decide in the future to reduce reliance on carbon-emitting technologies, it will be too late."*

From 1940s to 2007 the Doomsday Clock indicated that nuclear holocaust was the biggest danger to the survival of mankind. Recently, climate change has been acknowledged as an important possibility by top scientists as well. And fact remains we are moving closer to the midnight with present trends—unless policies, institutions, and individual action drastically change.

B. Failing Intergovernmental Negotiations

A lot of efforts have been made by the international community to correct the prospects of catastrophic climate change that we have discussed in this Manifesto. But even after over 20 years of intensive negotiations on climate change - both at the technical and political level - **CO2 emissions have just grown.** Therefore there is something fundamentally wrong in our global governance system, and so far nothing drastic has been seriously proposed to change the present system of negotiations.

Here we list some major events and conferences related to climate change and sustainable development. The number of participants, both heads of state and NGOs, has tremendously grown and some structural improvements have been made and international agreements have been reached but in a key issue – reducing greenhouse emissions - the talks have been a total failure:

- 1962 Silent Spring book by Rachel Carson,
- 1968 Establishment of the Club of Rome and Spaceship Earth concept launched,
- 1972 The Limits of Growth Report and the UN Conference on Human Environment in Stockholm,
- 1974 Bruntland Commission on Sustainable Development,
- 1992 Rio de Janeiro, UN Framework Convention on Climate Change (UNFCCC) signed,
- 1997 Kyoto Protocol,
- 2002 World Summit on Sustainable Development in Johannesburg,
- 2009 Copenhagen Summit and "accord",
- 2012 UN Conference on Sustainable Development in Rio de Janeiro, Rio plus 20, and
- 2014 UN Climate Summit, New York.

The next critical milestone in climate talks will take place in Paris 2015, an event which we now turn to.

Towards 2015 Paris UNFCCC Climate Meeting

A crucial issue for the future will be the 2015 climate change talks in Paris. A binding deal should be established there although it is, based on earlier

Graph 30. Political Forces Needed for Change in UN Climate Talks.



agreements, supposed only to come in force in 2020 which is too late. Is it possible to change the dynamics of the negotiations from national short-term interests to global interests and sustainable well-being of future generations? It is a possibility but the international negotiators need a lot of pressure both from the above – from global private economic actors, from biggest companies of the world – and from the bottom, from the citizens of the world. We will shortly discuss why governments left alone might be unable to turn the tide. The following graph illustrated the needed change:

Graph. 30. Political Forces Needed for Change in UN Climate Talks

The role of biggest companies in the world is important as many chief executives – who are well informed about the facts in this Manifesto – have concluded that conducting business is not possible in a radically warming planet and the present emission rate is catastrophic. They could and should act as a major pressure group to force the governments to agree for a binding deal in 2015 and forcing the implementation of the deal to start immediately, not only in 2020.

A Market-based System to Transform Economies Towards a Carbon-free World?

The role of responsible major corporations in the world would be ideally to advise and pressure governments on the ways to use the present world's market-based system to transform economies into a carbon-free model. Determining an ecologically sustainable price for carbon and setting up a global cap-and-trade system (a system where a limited amount of emissions permits are traded in a worldwide scheme) would be one set of solutions although its implementation in an ideal form is a major challenge as discussed below.

Ideally, we should use the current wealth created by " the oil economy" to drive transition into clean energy. The most rational way would **be to calculate how much CO2 we could still emit into atmosphere, divide that by next 50 years by a down hill curve, split annual emissions as carbon credits and let scarcity in the markets take care the reduction.** This kind of cap-and-trade-mechanism was used when acid rain, sulphur dioxide (SO2) problem was solved in North America 1993-2003 with excellent results.

For clean investments**, carbon price should be ten times the current price level it is for instance in Europe.** There is a large consensus that this alone would attract investments switching away from coal. Instead of subsidizing oil, countries could start to create new mechanisms to increase renewable solutions like solar panels. This would be especially helpful in developing countries.

In order to get a binding international agreement on these issues major efforts should be focused on the UN climate meeting in Paris in 2015. In addition to a global cap-and-trade system we also need to rapidly remove the governmental subsidies to fossil fuels versus renewable energy sources, another topic for an agreement that could be foreseen in Paris.

Our oil companies are investing annually some 600-700 billion USD to find new reserves and governments give fossil fuel subsidies annually over 500 billion USD. Renewable investments were last year only on the level 250 billion USD and subsidies 88 billion USD. This means that the money flow into fossil energy is about 3-4 times bigger than into renewables. If we cannot change this flow in coming years we are not able to develop clean energy fast enough and we could have a major economic collapse, if (or when) some climate change related "Pearl Harbor event" will hit us and we will have a panic exit from investments into fossil companies and use of fossil energy. This could then cause many countries, and eventually the world economy, to collapse.

But What is the Reality in UN Negotiations?

The signs of reaching a UN agreement for instance on changing the subsidy flows from fossils to renewables are not promising at the moment. An example highlights this dilemma. A High-level Panel

"This is the dilemma of reaching UN agreements, and often also a problem in governmental schemes regulating markets to a more sustainable business practices. Agreements become so watered down and complicated through negotiations that they loose their impact."

on Post-Development Agenda was created by the UN Secretary-General in 2012 and headed by Presidents of Indonesia, Liberia and Prime Minister of the UK. It made a reasonable and simple recommendation in 2013 in its final report, under a sustainable development goal "Secure Sustainable Energy", as it was an expert body without governmental negotiators:

> *"Phase out inefficient fossil fuel subsidies that encourage wasteful consumption"*[56]

This recommendation could have been made even sharper and targeted more to the problem of massive governmental subsidies to fossil industry vs. renewables as discussed above. However, when the General Assembly Open Working Group on Sustainable Development Goals, with all UN Member States participating, directly or indirectly, started its work on this recommendation it was moved out from the energy section of the outcome document and then watered down with caveats – as happens traditionally in UN talks - so that all countries and country groups could live with it. In its final form as it was agreed in July 2014 in the Working Group's Outcome Document it reads as follows:

> *"…rationalize inefficient fossil fuel subsidies that encourage wasteful consumption by removing market distortions, in accordance with national circumstances, including by restructuring taxation and phasing out those harmful subsidies, where they exist, to reflect their environmental impacts, taking fully into account the specific needs and conditions of developing countries and minimizing the possible adverse impacts on their development in a manner that protects the poor and the affected communities."*
> [57]

This is the dilemma of reaching UN agreements, and often also a problem in governmental schemes regulating markets to a more sustainable business practices. Agreements become so watered down and complicated through negotiations with various interest groups that they lose their initial goal or impact – as has happened for instance in the European cap and trade system. And they also can become subject of powerful counter-lobbying as happened to the Australian cap and trade system in summer of 2014 bringing down the whole system negotiated over a long period of time.

As governments might be unable to rectify this dilemma, outside forces – corporations and civil society - should step in as we already discussed in the beginning of this section and will discuss more in our concluding chapter.

C. Reforming the UN and Other World Governance Structures

Secretary-General Ban Ki-moon has been active in climate change issues but should also start to act more together with heads of IMF, the World Bank and some other heads of major organizations. UN reports should also become sharper putting out a global emergency message as discussed in this report even if some Member States would object. Also organizationally, the UN should establish a truly multidisciplinary policy planning capacity and global emergency unit in the Office of the Secretary-General to deal with the interrelated emergency issues related to climate change, a trend surely to intensify in the future.

But there should also be a longer-term goal of changing fundamentally the UN and global governance system. In longer term, a second conference of the UN Charter, foreseen in its article 109, could be called for as one idea for a really big reform corresponding to a global emergency described in this Manifesto. A collective decision to do so is important in order to start a democratic process with all countries and other stakeholders involved to first fully understand all aspects the crisis, and, secondly, jointly to seek organizational innovations and processes needed to solve it.

But it will take a long time to produce results in this kind of major effort as in fact the outcome

"At the same time as new governance structures and a new paradigm for sustainability should be pursued, some very practical measures should be taken in changing the codes for buildings and infrastructure to engage the localities for a more sustainable future."

would be a new governance structure for the world. Therefore, it would be wise to complement it with other initiatives — to be taken separately or jointly by governments, academia, corporations and civil society. When creating new institutions and initiatives it would be important secure the maintenance of major achievements to the twentieth century in the area of democracy and human rights.

D. New Guidelines for Buildings, Localities and Insfrastructure

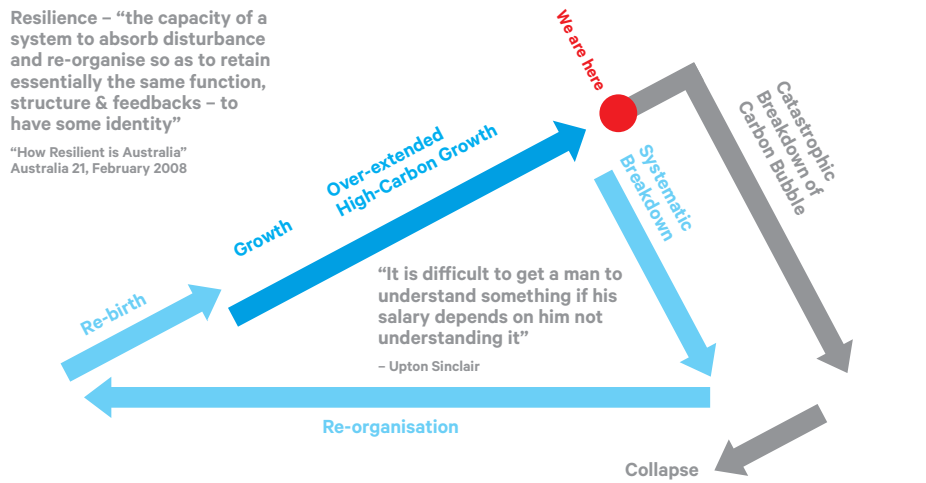
At the same time as new governance structures and a new paradigm for sustainability should be pursued some very paractical measures should be taken in changing the codes for buildings and infrastructure to fully commit the localities for a more sustainable future. Some international initiatives or organizations like C40 Cities — 40 Cities Leadership Group for cleaner cities movement and Local Governments for Sustainabilityy (ICLEI) already do important work in this are but much more of the same is needed.

Here are some necessary goals for the future that have been often mentioned in this connection:

- Urban re-design (e.g. using high-density sustainability principles integrated with efficient public transport, de-centralising work centers).
- Rail to become major transport mode both for passangers and freight.
- Electricity from clean energy to become dominant energy supply.
- Air travel will reduce.
- Localised food production.
- Major IT innovations to reduce ecological footprint.
- Enhanced resource productivity.

5. Conclusions

Graph 31. Risk of Catastrophic Collapse.



A. The Policy Response Needed

Clearly, we are not being honest about the problem the world now faces, described in previous pages as catastrophic climate change with its interconnections to energy use and economic growth. We prefer not to *"scare the horses"* but talk around the problem without clearly defining it for reasons of short-term political expediency or self-interest. Problem definition typically provides 80 per cent of the solution, so honesty is essential if you are genuine in your endeavours. It needs to be done carefully, setting out both the problem and a solution, but it must be done. Otherwise the result is totally inadequate policies that become impossible to change given the political capital invested in creating them, which is exactly what has happened with successive international negotiations since the original Rio meeting in 1992.

Overall, there is a lack of systems-based thinking in joining the dots of the climate and energy dilemma to form sensible integrated solutions. The result is that the resilience of the global economy, and society, to respond to this threat is badly weakened.

Our market economy in latter half of the 20th century worked remarkably well. Organisations were born, grew, reached limitations, systemically broke-down, reorganised and were reborn. That was fine provided there was honesty about the challenges being faced and in developing sensible solutions.

However, once denial of those challenges, and of the real solutions, sets in, the resilience of the system to become self-correcting fails, as growth becomes over-extended to the point where the system cannot recover. That is now happening with our high-carbon economies as successive leaders in both politics and business, fail to heed the climate and energy warning signs. Much of this failure stems from the short-termism created by excessive bonus remuneration systems in both business and politics.

Graph 31: Risk of Catastrophic Collapse.[54]

This may well end up in catastrophic breakdown, for example, as a result of the bursting of the carbon bubble we are creating on the assumption that the 20th Century high-carbon world will continue. Business and investors are still rushing into unconventional high-carbon resources, developing projects which are fundamentally unsound on both economic and environmental grounds. The impending collapse will be difficult to recover from, as substantial funds will become stranded assets, rather than having been invested in the low-carbon opportunities which represent our future.

B. The Real Challenge – An Emergency Response

Avoiding a 4ºC world means emissions in the developed world have to peak within 3-4 years, then decline rapidly, by about 9% per annum — an unprecedented task which requires nothing less than an emergency response.

It is clear that the existing political, corporate and market economy processes will not deliver — either the level of change we need technologically, or in the time that we require it. So we need a circuit breaker to disrupt conventional thinking.

As Kevin Anderson, Deputy Director of the UK Tyndall Centre for Climate Change Research, put it recently: *"Today, in 2013, we face an unavoidably radical future. We either continue with rising emissions and reap the radical repercussions of severe climate change, or we acknowledge we have a choice and pursue radical emission reductions. No longer is there a non-radical option. Moreover, low-carbon supply technologies cannot deliver the necessary rate of emission reductions – they need to be complemented with rapid, deep and early reductions in energy consumption."*[58]

Thus the context of the debate has to change quickly, and we have to be brutally honest about the problem. Whereupon the cry will inevitably go out: *"The government must do something"*! But the governments are not necessarily going to do anything. Experience over the last 20 years tells us that adversarial politics, in Western democracies at least, is incapable of handling an issue this complex without serious outside pressure.

Therefore, we have to build coalitions of cham-

"This time we have to succeed in doing what is necessary".

pions, from progressive thinkers who are prepared to speak out from whatever segment of society. For example, community groups, progressive corporates, the military, academia and levels of government who are prepared to honestly face the facts. Also,the supernational organisations; virtually every major supernational organisation, including the UN, OECD, IEA, World Bank, IMF, and the WEF - are talking in similar terms about the global emergency we face and they cannot continue to be ignored. These coalitions need to go public, articulating both challenge and solutions, bypassing conventional politics.

We should also create mass movements to spread awareness of the risks of runaway climate change and urgency of action to stop it before it is too late. That could include mobilizing rock and movie stars, film directors, painters and other artists, sport idols as well as statesmen and -women **who are independent from daily politics,** to speak about a global emergency. Arranging climate change concerts, sport events and documentaries could be a vehicle for achieving more awareness. The above has been done to some extent, but a critical mass has not yet been created as things go as before in terms of CO2 emissions.

Eventually the combination of top down pressure from progressive thinkers and bottom up pressure from communities may force governments to respond. As a French politician in the 1800s, Alexandre Auguste Ledru-Rollin, said: *"There go the people I must follow, for I am their leader".*

We must also mandate the critical policy outcomes. We have to define where we are today, where the science tells us we have to get to, and then commit to the path between the two without further procrastination.

It will not be easy, but we know the solutions; we now need the will to implement them. We believe the process must be initiate largely outside conventional politics because it will not be successful if it becomes embroiled in that system with day-to-day short-term political decision-making dominating. This certainly poses issues for democracy, but there are precedents in such emergency situations. For instance, after the Pearl Harbor the US car industry was completely changed to support the war efforts in a matter of months. Governments can change, and quite fundamentally, when they eventually face reality as it is.

The current situation has major implications for population, as global carrying capacity is going to be severely constrained by natural events as described in this Manifesto, even if we do take emergency action on climate change.

Above all, we must have proactive business leadership, because corporations in the end have to design and implement the solutions. They are well aware of the science; if they're not, they should be. Local and national corporations have to start thinking and acting globally, understanding also the broader picture laid out for instance in this Manifesto. Business claim to be experts in risk management, but global-regional-local interconnectivity is a new risk they have never previously experienced, requiring very different strategy and management techniques.

In a 4ºC world, conventional business and politics are not possible and it is in everybody's interests to prevent that world happening. We have solutions, but our options are being cut off by inaction and time is extremely short. We need informal groups of progressive leaders to initiate a completely different conversation, building coalitions to trigger genuine emergency action.

This will require the sort of initiatives that were taken in the lead up to World War II, as economies were completely re-orientated in six to 12 months to meet a totally different purpose. That is the challenge that really confronts us. The stakes for humanity are high, we are at a watershed.

As Winston Churchill put it:

"*It is no use saying 'We are doing our best'. Sometimes you have to succeed in doing what is necessary*".

Author Bios

Ian Dunlop has wide experience in energy resources, infrastructure, and international business, for 30 years on the international staff of Royal Dutch Shell. He has worked at senior level in oil, gas and coal exploration and production, in scenario and long-term energy planning, competition reform and privatization.

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An engineer from the University of Cambridge (UK), MA Mechanical Sciences, he is a Fellow of the Australian Institute of Company Directors, the Australasian Institute of Mining and Metallurgy and the Energy Institute (UK), and a Member of the Society of Petroleum Engineers of AIME (USA).

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