Because It's Not a Drill:

Technologies for Deep Adaptation to Climate Chaos.

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Abstract

The climate emergency calls on us to explore what we can do, individually and collectively, to adapt to climate-induced disruption. Such adaptation must go beyond mere adjustments to our existing economic system and infrastructure, in order to prepare us for the breakdown or collapse of normal societal functions. A framework for exploring this issue, called Deep Adaptation, is summarised. Technologies will be important for helping us develop not only resilience but also collapse-readiness. Five areas of technology are outlined in order to illustrate the kinds of ideas that can emerge from applying a Deep Adaptation approach to our predicament. In outlining technological possibilities, it is emphasised that any technology should be assessed on a case-by-case basis, rather than from a general perspective on whether technology is helpful or not. In addition, the focus on technology in this paper and its associated discussions is not intended to distract from the political and psychological challenge of our climate emergency. Therefore, a transformative economic agenda is retained as a context for how we imagine policies to harness technologies for Deep Adaptation. Brief recommendations are offered for the European Commission.

Introduction

DG Connect, the Directorate General of the European Commission that focuses on information technology, has requested ideas about technologies that might enable Deep Adaptation to climate chaos. In order to understand the reasoning behind such an invitation, it is important to summarise some of the latest climate science and how it is leading more people to conclude that we are now in a climate emergency, which will increasingly disrupt our way of life. I summarise some of this science below, with my conclusion that a societal collapse is now inevitable within the lifetimes of readers of this paper, due to the cascading effects of widespread and repeated harvest failures. I outline some areas for technologies to be deployed for urgent adaptation to climate change, in order to illustrate the kinds of ideas we now need to discuss. I then introduce the concept of Deep Adaptation as a framework for further discussion on technologies that might help us develop collapse-readiness in both collective and personal ways.

The topic of our climate emergency engenders a wide range of difficult emotions (Clayton, et al 2017). One of those emotions is fear, which is not conducive to our ability to consider ideas which do not fit with our existing worldview or sense of self (Woodbury, 2019). Some of the ideas in this paper may trigger strong emotions, perhaps in relation to the perspective offered on collapse, on economics or on technology. Therefore, I recommend you discuss the paper with a friend or colleague whose ideas you respect, yet often differ from your own.

Our Climate Predicament

Seventeen of the eighteen hottest years ever recorded have occurred since the year 2000 (IPCC, 2018). We have woken up to the warm dawn of a dangerously hot century. The colourless blanket of carbon gases wrapping our planet is trapping so much heat that forests are catching fire and harvests failing (Christian Aid, 2018)

For a moment, imagine that the building you are in whilst reading this paper is on fire. You would not call for fire safety consultants to advise you on reducing future risk. In the same way, our climate emergency needs firefighters not just fire safety consultants. Because this is not a drill, we must act on what is happening now, or more people will suffer and die than would otherwise. That may sound alarmist, and yet it is this difficult shift in perspective that is needed for us to engage in new kinds of conversations in the face of our climate tragedy.

Last year we saw how chaotic weather could begin to threaten our own lives in the West. In many European countries the production of grains and open-air vegetables fell by over twenty percent (Masante, et al, 2018). The old climate models suggest that 2018 was an anomaly. But some new models are suggesting otherwise (Xu et al, 2019; UNDRR, 2019). Meanwhile, actual measurements of carbon, temperature variability, storms, floods, droughts, fires and sea level rise, show changes beyond what the climate models predicted. People are rightly asking how bad it will get and what we can do about that (Wallace-Wells, 2018).

Total carbon concentration in our atmosphere just passed 415 parts per million (ppm). That is the highest level in about 4 million years, according to geologists. Back then, in what they term the Pliocene Era, global average temperatures were 2 to 3 degrees Celsius higher than today (Robinson et al, 2008) and sea levels may have been 25 metres higher (Dwyer and Chandler, 2009).

What does that mean for us? And why isn't that the case now? One reason is the time lag between the extra heat trapped in our atmosphere by CO2 and the consequent change our air temperatures, as well as tipping points in our ecosystems. That time lag between CO2 cause and atmospheric warming effect, has been estimated at up to 40 years (Hansen, et al 2005). Oceans are partly responsible for this lag. Far heavier than air, they have absorbed 90 percent of the extra warmth from human emissions (Zanna, et al, 2019). That heat won't just stay there. Just like a hot cup of coffee left on your desk, that heat will dissipate. There is a significant amount of atmospheric warming locked in due to the heat that is already in our oceans.

Ice is another reason for the lag in warming. If you have a glass of soda with ice in it, then the liquid stays cool. Once all the ice is gone, the drink warms to room temperature really quickly. The latent heat energy used up by melting ice, particularly in the Arctic, has been cooling our world. Once it goes, then the ocean will heat up faster. On top of that is the loss of white ice reflecting sunlight back into space, replaced by dark waters that absorb the heat. Professor Wadhams, one of the world's most renowned polar sciences has estimated that if all Arctic Ice disappears, then we may see a warming effect equivalent to half of all human carbon emissions (Wadhams, 2016). The latest data on rates of melting combined with new models suggest that an ice-free Arctic summer could occur by 2030 (Screen and Deser, 2019). Other individual scientists, like Wadhams, consider it a possibility within the next few years. Whatever the predictions, what is happening now is the release of increased amounts of methane from the permafrost surrounding the Arctic Ocean (Nisbet, et al 2019). Methane is many times more warming than CO2 and the amounts frozen in the Arctic are so large that significant releases could turn the planet into a Venus-style hothouse planet with little life left (Steffen, et al 2018).

The UN's Intergovernmental Panel on Climate Change (IPCC) reported in 2018 that to have a chance of not much more than 0.5 degree Celsius further global temperature rise, we need about a 50% cut in global emissions by 2030. That implies emissions cuts of about 5 percent of current levels each year, globally. However, we are speeding up in the opposite direction. The Global Carbon Project (2018) reported there was a 2.7 percent increase in global carbon emissions in 2018, which was the highest ever recorded. One overview of how countries are performing against their international

commitments, argued that we are on course for 5 degrees of global warming (Robiou du Pont and Meinshausen, 2018).

For those people who follow the climate topic closely, the IPCC is known for being conservative and not alarmist. It has decades of track record in being behind the curve on climate change. The main reason is that if consensus amongst scientists could not be achieved, the relevant data has often been omitted from their published reports. For instance, there wasn't consensus on the amount of melt water from ice on land, and so the data was left out of calculations of sea level rise (Spratt and Dunlop, 2018).

Due to its impacts on low-lying settlements and agricultural lands, global sea-level rise is concerning in itself. But more importantly for our understanding of our predicament, sea level rise is an indicator of the whole climate system. It rises through thermal expansion and inputs from melting ice. In March this year the World Meteorological Organisation (WMO) confirmed that global sea level rise is not linear – it is speeding up (WMO, 2018). Which means climate change is speeding up. Which indicates the self-reinforcing feedback loops of warming are underway (Xu et al, 2019). Which means the situation is not now under our control; if it ever was.

It is no longer possible to find some solace in a story that this terrifying description of our situation is merely the view of a few alarmist scientists. One after another of the world's most authoritative organisations are now declaring emergencies within their remits. In May 2019 the UN's leading organisation reported on biodiversity collapse threatening our future food supply (Bélanger and Pilling, D., 2019; IPBES, 2019). In the same month, the UN's leading organisation on disaster risk reported on weather variability threatening our future food supply (UNDRR, 2019). Awareness has spread globally amongst senior role holders. The 2019 Global Risks Report from the World Economic Forum (WEF) represents the opinions from surveyed senior officials in business and government. The top three most likely hazards to occur, identified by respondents, were all climate-related (WEF 2019).

Despite the title and focus of this paper, unfortunately there appears to be no simple technological fix for climate change. Recently the direct air capture of CO2 by new machines has been promoted in the media and imagined by the IPCC as playing an essential role to reduce carbon concentrations in the atmosphere (Wadhams, 2018). However, current technologies are inefficient and require large amounts of energy. My previous calculations found that the current deployment of the technology would need to be scaled by a factor of two million times, all powered by renewables, in order to make inroads into the rate of increase of carbon in our atmosphere (Bendell, 2018). Biological approaches to carbon capture, involving the restoration of ecosystems, appear more promising (Hawken and Wilkinson, 2017), but are also impractical to scale significantly within the timeframes now recognised as necessary by the IPCC.

Despite this range of frightening evidence that suggests climate change is proceeding apace and reinforcing itself, with devastating implications for both nature and human society, if this is the first time you have read such arguments, then it would be natural to wonder why this perspective is not mainstream. One reason has been the reticence of the scientific community to appear alarmist and the limitations of climate scientists in "joining the dots" beyond the focus of their individual studies to interpret implications for societies. Another reason is a range of psychological and institutional factors enabling denial of the fact that it might be too late to avert a catastrophe, embedded within the mindsets of people in the environmental profession and movement (Bendell, 2018). Yet another key reason is that recent measurements are revealing a climate that is changing far faster right now

than had been previously predicted and with more immediate consequences on weather and ecosystems than has been predicted (IPBES, 2019).

Awareness May Help, But Not Solve

Some people may look at evidence of increasing awareness, such as declarations of climate emergencies (Irish Times, 2019), and the rise of activism, such as the Extinction Rebellion protests and school strikes (Extinction Rebellion, 2019), with a wish to see it as an indication that humanity will find the political will and means to change the entire political and economic system, in every country, to stop climate change and prevent disruption. I would share that wish, but I can't let it determine my conclusion, for two reasons. First, because we already have so much warming within the oceans, and such high concentrations of CO2 in our atmosphere, alongside self-reinforcing feedbacks driving further heating, that disruptive climate change is already unfolding around us. This conclusion is not the scientific consensus within the IPCC, but is based on the evidence I referred to above. I hope to be proven wrong, but new reports or papers are published regularly which lend more weight to this view. Second, I assess the challenge to bring down global atmospheric carbon concentrations and effectively manage the disruptions to our agriculture and societies as beyond our existing political and economic systems, and the commerce-shaped cultural systems within which they exist. That is not a negative view of human nature itself, but on the power of the culture that has been created around and through each of us within advanced industrial consumer capitalism. This second reason for regarding it as impossible to make the necessary transformations, globally, in time to avert societies collapsing, typically requires some further explication, before moving ahead with my argument.

The central political, economic and cultural constraint on our ability to transform is that we exist within an economic system which requires continual growth of economic activity in order for new debt to be created, so that money can circulate, and therefore people can earn money to participate in society. In nearly all countries of the world, it is the private banking system that issues new money when they create new bank deposits upon issuing loans (Bank of England, 2014). Given that new money is a loan, it accrues interest, which means there is more debt in the world than money to pay it off. That means that when that debt is paid off, money disappears from circulation, and so the only way we avoid our economies grinding to a halt for lack of a means of exchange is by the banks issuing new loans. That is only done if there is an expanding amount of economic activity to finance, which involves the promotion of our desire to consume, and requires the use of more natural resources and associated production of wastes, including air pollution (Bendell, 2014). These mechanics of our monetary system are hidden from view. A minority of economists understand how the monetary system works, let alone financial journalists, or politicians, or the general public (Clarke, 2017). Given the power of the financial system in societies around the world, including influence over governments through lobbying, donations and the bond markets (Klein, 2014), it seems impossible to me that this situation will be changed rapidly and globally in time to point humanity in a different direction.

Though some people may prefer that we seek to address the situation without tackling fundamental imbalances of power in society or the economic systems that have produced this situation, that would overlook the last 30 years of ineffective action that was based on that view. It was in 1987 that the United Nations General Assembly agreed a report that said climate change is dangerous and that we are causing it (UN General Assembly, 1987). In 1992 the largest inter-governmental conference in history focused on this dilemma, announcing a new agenda of 'sustainable development' and yet more carbon has been emitted since then than during the whole of human

history before that conference.[1] Despite the supposed awakening to the climate emergency of senior officials surveyed in that report from the World Economic Forum, they display their incompetent priorities in that same report (WEF, 2019). They warn against populist criticism of the monetary system, and how central bank independence might be threatened. It is not simply a matter of senior people in powerful organisations not yet understanding the cause of our predicament. Their worldview is shaped by allegiance to incumbent power, which both funds their work and privileges their views. While it may be tempting to hope that existing systems and individuals of power might discover a new and bold benevolence for a quick route to global transformation, current evidence suggests that incumbent institutions may be barriers to needed change. They may be chattering in the emergency exits or pointing people towards the fire. Worse, studies of past societal collapses remind us that oppression and genocide organised by those with means to do that often arises when business-as-usual begins to breakdown (Neale, 2019)

The need for meaningful dialogue requires that we recognise how our climate emergency is not a pollution problem – it is a political problem. It is not a technological problem – it is a psychological problem. It does not invite a reformist agenda but a revolutionary one. Bold mitigation will remain as important as ever: to cut carbon emissions and drawdown carbon from the atmosphere (Hawken and Wilkinson, 2017). Re-wiring our economy via monetary reform would be essential for that happening at a pace and scale that will be significant for atmospheric carbon levels. But the climate emergency is as much about coping better in the face of climate change, as it is about slowing it. Therefore, it is important to go beyond a focus on cutting emissions and drawing down carbon - and explore means of adapting to the troubles ahead.

Examples of Technologies for Climate Adaptation

It is time for more of us to explore the role of technology in adapting to climate change. Some people may look to technology as the answer to every difficulty we face. Other people can look at technology as a distraction from addressing our climate emergency.The former might welcome all kinds of geoengineering, while the latter see all forms of geoengineering as a dangerous hubris (Ribeiro, 2018). I believe that we do not have time for either 'techno hubris' or 'techno phobia'. We need to look at all forms of technology on a case-by-case basis. Therefore, before outlining the Deep Adaptation approach, I will summarise a few areas where technology may be able to help.

First, there is food and water. We are a grain-based civilisation, with over 50 percent of our calories coming directly from grains, as do most of the calories needed by the meat and dairy sectors. We need to adapt our agriculture to a future where rainfed grain production at scale is no longer guaranteed. There is much we can do with simple technologies, from new reservoirs, irrigated potato farms, and greenhouses. Urban farming technologies, hydroponics, new forms of insect-based food production are also important (Denkenberger and Pearce, 2015). There is also the opportunity to transition to more agroecological approaches to farming (FAO, 2016). Scaling back beef and dairy farming is essential, despite the inevitable opposition from some business sectors. Because, increasingly, people not cattle will need to eat the calories we grow. We also need to diversify and re-localise, and innovations in technology for enabling community cooperation on production, distribution and preparation of food will be essential (Servigne, 2017). Many of these areas need to be supported even while they are not economic within existing market conditions. Because the human race can't be insured with a piece of paper. One can try to insure it through food, water, and solidarity.

[1] Data from https://www.climatewatchdata.org/ghg-emissions

Second, we need to pull back from certain technologies that are increasing our vulnerability. Ahead of any actual food shortages causing mayhem in the West, we could see the financial sector panicking and imploding our money system. We are increasingly reliant on global systems even for locally produced items. Those global systems rely on continual economic expansion, so it is only a matter of time before our financial systems experience a shock. Unless we address this vulnerability, a situation could arise when people can't even buy a locally baked loaf of bread because of the collapse of a reinsurance giant in a far-off city. The answers may be found in information technologies that enable alternative means of exchange to the main currencies like the Euro or Pound Sterling (Bendell, 2017). Such technologies will need to be open, accessible, fixable, appropriate and resilient to potential disruption to communications networks and the internet. Much developmental work has already been carried out in the community currency sector in creating these kinds of bottom-up payment systems (Bendell et al, 2015).

Third, technology needs to be made more available where it is desperately needed to reduce suffering and deepen adaptation. So much of technology is private property, and its use depends on the discretion of the owner. One area where such opening-up is urgent is to support mass psychological adaptation to our climate tragedy. Awareness of our situation is provoking many difficult emotions (Clayton, et al 2017; Woodbury, 2019). We will continue living with loss, grief, sadness, confusion, fear and anger. I think information technologies could help us with this psychological challenge. To support my own meditation, I currently use the Headspace app on my phone. But there need to be free services of similar quality. And there need to be free online training and peer mentoring services to help our teachers, counsellors, journalists and government officials with the difficult emotions involved in this agenda. There is a lot to be done to spread insights and practices to help reduce harm, by using the latest technologies while we still have them.

Fourth, we need technology to save the Arctic ice sheet. If it disappears, then the change in Northern Hemisphere weather will be catastrophic for grain harvests. It could also risk the mass release of methane. We will never know ahead of time exactly how much methane will be destabilised or when, but its release could threaten human extinction (Shakhova et al, 2010). That means we should try to cool the Arctic immediately. The best method I have learned about is Marine Cloud Brightening (MCB), which would pump sea water from the Arctic Ocean up pipes into the sky and spray it to increase and brighten clouds, which would reflect more of the sun's rays (Latham et al, 2014). We do not know for certain how it will work, so it will need to be tested. At present I am not in favour of any other geo-engineering. Given how it could affect air currents, I am not in favour of MCB being used anywhere other than the poles. Therefore, I will repeat the view that neither 'techno hubris' or 'techno phobia' is helpful and that we need to look at everything on a case-by-case basis.

Fifth, we need technology for helping people connect with others who are waking up to our climate tragedy, ahead of a wider awakening in society. The idea that it is too late to stop a breakdown in our way of life is still taboo and probably will remain so for a few more years. It is why we launched the Deep Adaptation Forum, as an international space for people who want to explore what they can do in their profession to promote collapse-readiness (www.deepadaptation.info). I describe Deep Adaptation as our personal and collective preparations for a collapse or breakdown in our society. I call it "deep" because it is not premised on the idea that our current society will continue with some adaptative measures. I believe it is too late for that. People who adopt this Deep Adaptation approach do not necessarily believe collapse is inevitable, but feel it is important to work as if it is coming. For some, it is already unfolding. Through the forum we are convening people

through professional interest groups that meet through videoconferences. They are developing tools and practices which can then be adopted by others in their profession when they are ready.

There will be many other areas where technology in general and information technology in particular, have roles to play in enabling deep adaptation to climate chaos. This topic touches on all kinds of areas, some covered by those who work on humanitarian action, global catastrophic risks, or food security. The areas outlined above are simply offered to demonstrate the kind of thinking that arises once one has accepted that we need to work on collapse-readiness.

The Deep Adaptation Approach to Climate Chaos

At the moment of writing in May 2019, the Occasional Paper "Deep Adaptation: A Map for Navigating Climate Tragedy" had been downloaded over 420,000 times, and the audio version listened to over 30,000 times. A Google search for news on "deep adaptation" will reveal that it has been mentioned in newspapers and on radio worldwide. It is widely credited with inspiring some of the main coordinators of the Extinction Rebellion protest movement (Humphrys, 2019). That paper appears to have touched a public nerve by articulating the perspective that it is now too late to stop a future collapse of our societies because of climate change, and that we must now explore ways in which to reduce harm. The Deep Adaptation approach was formulated to provide a way for people to have generative conversations about what to do, and what to stop doing, in light of our predicament. It based on a set of four questions, based on the assumption that a breakdown or collapse in our society is likely, inevitable or unfolding (Bendell, 2019). The approach is now being used to support facilitated conversations in communities, local governments, foreign ministries, and the European Commission. In this final section, I will briefly summarise the questions.

"How do we keep what we really want to keep?" is the first question to ask, as we seek resilience - the capacity to adapt to changing circumstances, so as to survive with valued norms and behaviours. Much of what I have described earlier about preparing for food shocks and financial shocks relate to this issue of resilience.

A second question to ask ourselves is "what do we need to let go of in order to not make matters worse?" This question helps us explore relinquishment, where people and communities will let go of certain assets, behaviours and beliefs where retaining them could make matters worse. Examples include withdrawing from coastlines, shutting down vulnerable industrial facilities, or giving up expectations for certain types of consumption. There will be the psychological challenge of how to help people who experience dread, grief and confusion. Much of what I described earlier about technologies to support mass psychological adaptation relate to this relinquishment.

The third question I suggest we ask is "What can we bring back to help us with the coming difficulties and tragedies?" It helps us explore the restoration of attitudes and approaches to life and organisation that our hydrocarbon-fuelled civilisation eroded. Examples include re-wilding landscapes, so they provide more ecological benefit, changing diets back to match the seasons, rediscovering non-electronically powered forms of play, and increased community-level productivity and support.

The fourth question I invite us all to consider is "what could I make peace with to lessen suffering?" As we contemplate endings our thoughts turn towards that kind of reconciliation: with our mistakes, with death, and some would add, with God. We can also seek to be part of reconciliations between peoples with different political persuasions, religions, nations, genders, classes and generations. Without this inner deep adaptation to climate collapse I fear we risk tearing societies apart. Unless we have found a way to accept the impermanence of our own lives and those we love (to be

reconciled with mortality) and a way to accept that we must act without knowing if we will succeed (to be reconciled with impotence), our future actions risk being a form of manic distraction that could lead to violence. The fourth R therefore relates to an intention of embodying and enabling loving responses to our predicament, at a time when various forms of blame could be promoted to manipulate people to hurt others.

Conclusions

It is obvious that this topic is not an easy one to think about, discuss or act upon. Therefore, it would be easy to slip back into conversations about preventing climate chaos and not listen to those who make arguments for why we should focus also on adaptation. One can find some solace in a hope that our situation is not so bad as I have described in this paper. Therefore, it is important that the DG Connect of the European Commission organised a conference on this topic, so people can come together - and belong together - in this difficult exploration. The more creative we are, then the more likely we can make the best of a worsening situation. That is where my intention, if not my hope, now lies.

Although this paper begins a conversation about technological means of deep adaptation, it is not intended to side-line the politics of our predicament. As awareness of our climate emergency grows, it will be helpful to avoid blame and promote collective responses. However, it would be a mistake to think that addressing difficult issues of power imbalances and economic systems is wrong because it might be divisive. The story that our current predicament can be responded to apolitically and technically would ignore what has been witnessed and learned from the insignificant impact of past decades of effort on sustainable development. Furthermore, we will need to increase the accountability of power in our society, as decisions will be made on the allocation of huge sums of money and on how to drastically change people's lives.

Deep Adaptation offers a framework for discussing how the whole of government could prepare for, and reduce the harm of, a forthcoming societal collapse. It may therefore be of use for other areas of European Commission business, beyond DG Connect. The need for urgent state intervention and subsidy has implications for competition law and state aid. The need for action on food security has implications for agricultural policies and subsidies. The need for action on payment system security has implications for banking and finance policy. Each Directorate General of the Commission must explore implications for their policy responsibilities, if only in the context of risk management. In addressing any of these areas, it will be important for us to remember that, wherever we work, our climate emergency calls us to be firefighters not just fire safety consultants. Because this is not a drill, we must act on what is already happening, or more people will suffer and die than might otherwise.

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