THE ONE DEGREE WAR PLAN

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ABSTRACT

The authors argue that public awareness of the dangers associated with climate change will increase over the next decade, to the level where the public will demand emergency action to cut global climate gas emissions. The authors argue that such emergency action ought to be based on a well prepared crisis response plan, seeking to keep global warming below plus one degree Centigrade over pre-industrial levels. The paper presents a first draft of the crisis response plan – "The One Degree War Plan" – and encourages further broad efforts to improve the plan.

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INTRODUCTION

It's like belonging to a secret society. Conversations held in quiet places, in cafes, bars and academic halls. Conversations held with furrowed brows and worried eyes. Conversations that sometimes give you goose bumps and shivers, and a sense of the surreal – is this conversation really happening?

This is what it's felt like over the past few years, to spend time with some of the world's leading thinkers and scientists on issues around climate change and sustainability. In public this group generally puts a positive, while still urgent interpretation of their views. The general public position is: "we face serious risks, potentially catastrophic, if we don't act urgently and strongly". Of course, "If we don't act" is the key qualifier, with very few prepared in public at least, to cross that dreaded line or to use those words "it's too late".

But in private, often late at night, when we reflect on what we *really* think and wonder if the battle is lost, it's a different conversation. The talk goes to the potential for self-reinforcing runaway loops and for civilisation's collapse. We discuss geopolitical breakdown, mass starvation and what earth would be like with just a few hundred million people. It's a very strange thing to calmly pontificate the realistic risk of the collapse of civilisation and then go back to work!

Why are the public conversations so different from the private ones?

Changing public opinion and galvanising political and market action is an art rather than a science, but an art made all the more complex by the array of human emotions that discussions like this provoke. If the messages is too soft – the "*win, win, we can do this, let's not dwell on doom and gloom*" approach – people don't confront the scale of the challenge and find endless reasons for delay. When change is difficult, or failure frightening, then avoidance is a welcome escape.

However, if the message is too hard – the "*we're doomed, it's a catastrophe, act now or we'll all die*" approach – then people can switch off, switch into denial or worse - into resistance.

The balance between these extremes has very much sat at the soft end in recent decades. A combination of fear of generating resistance or backlash and a desire not to be written off as too extreme (and at a personal level, not wanting to lose motivation) has tended to drive experts away from the hard conversations, at least in public.

This has recently become very challenging. The scientific evidence has become overwhelming and with few exceptions has tilted all the uncertainties the wrong way. The Arctic melting way ahead of all previous forecasts including worst case scenarios, the constantly increasing forecasts for sea level rise, the accelerating species loss, the worsening droughts, the melting glaciers, the tragic fires and so on, all take us to the

unavoidable conclusion - things are indeed, to use that delightfully understated English term, rather grim.

We now find ourselves at least once a week, having a discussion with someone who asks the question – "Is it too late?" which soon leads into "So what should we do now?" This paper is our answer to those two questions.

1. IT IS NOT TOO LATE ….. YET

Too late is not a single line to cross. Except in absolutely catastrophic collapse scenarios, there is no "too late", because action taken today will still reduce the level of future damage and human suffering.

Our view is however, that given the physical momentum for change already in the climate system and the continuing lack of serious commitment to action, it *is* now too late to prevent major disruption and damage in the decades ahead, as a result of inaction over the past several decades. We believe there *will* now be an ecological and economic crisis, of a scale that is significant in the history of human life on earth. However we certainly do *not* believe it is too late to prevent the collapse of civilisation.

This is because our work, described in this paper, leads us to conclude humanity can still prevent a process of runaway, self-reinforcing climate change and maintain a level of global control – i.e. a decision making framework and capacity to affect actions at a significant global scale. It will however require a level of mobilisation so far beyond the current debate that it will seem incomprehensible to most readers. Such mobilisation is, however, possible and could result in rapid and spectacular cuts in greenhouse gas emissions and a stable climate.

We firmly believe humanity can rise to the occasion, as evidenced by the mobilisation for, and the results of, the Second World War.

The main point of this paper is to detail what the level of mobilisation and action required to stop climate change could look like and to begin the process of refining such a plan.

2. SOCIETY WILL RESPOND WHEN IT PERCEIVES A CRISIS

It is clear that society is capable of responding dramatically to major threats when there is acceptance of a crisis. At that point, all previous arguments against action are consigned to the dustbin. Modern history's strongest example is WWII, others include 9/11 and the recent financial crisis.

This is how it will be on climate change, but not yet. While the increasingly urgent scientific warnings are causing rapid growth in the number of people who believe, as we do, that we are already facing a civilisation-threatening crisis, it is not yet the dominant view.

So the evidence will continue to build and then at some point, there will be a "Great Awakening" - a tipping point where, relatively suddenly, people perceive a real crisis.

Whether this is triggered by a climatic event, political leadership or just the great mass of evidence is, while interesting, actually unimportant. The great awakening will certainly occur.

This is because the momentum for change that humans have now built into the earth's climate system is like a fast moving, very heavy train. We are standing on the train line, in heavy fog. The fog will lift, or the train will be so close we can even see it in the fog. Then we will jump.

Perhaps it will be triggered by an event unrelated to actual climate change but symbolic, like lack of volcanic activity creating three record warm years in a row. Or perhaps when the Arctic summer is ice-free for the first time. Or by the current economic crisis bringing our economic growth model into question. Or it might just happen with no particular trigger.

Our judgement after decades of observation, recent interpretation of the high quality science and various social indicators is that this point will occur before 2020. We assume for the purposes of this plan it will occur in 2018.

When it occurs we will shift into a "whatever it takes" approach to solving the problem. Given the response will be "late" and climate change is driven by a series of leading causes (i.e. it takes time – decades – before the full impact is felt), the great awakening will generate demand for dramatic intervention.

At that time the global community will -- rapidly, though messily -- develop a global emergency response to cut climate emissions and pursue a safe climate "whatever the cost".

To succeed, this emergency response will require an extraordinary level of global cooperation and unity of purpose, well beyond anything we've ever seen and for which the only comparable, though still inadequate, example is the mobilisation of many parts of the world during WWII. It will require a clear goal (a picture of the enemy), rapid change, considerable dislocation and widespread sacrifice.

Humanity will then enter a multi-decade response period that will see civilisation teeter on the brink of collapse but most likely not fall over that cliff.

So how will all this unfold?

3. THE CRISIS WILL TRIGGER A DEMAND FOR A ONE DEGREE WAR PLAN

The logic in any crisis is very simple. The question becomes: What action is *necessary* to solve the problem? The mindset shifts dramatically and becomes, as articulated by Winston Churchill in WWII:

> *"It is no use saying, 'We are doing our best.' You have got to succeed in doing what is necessary."*

To the objective observer, the climate science is very clear on what is "necessary". Allowing even 2 degrees of warming is too dangerous. Although broadly accepted as an important goal, no mainstream science group actually argues this is a "safe" level. Rather it is assumed to be "the best we can do" based on the analysis of what is

politically "realistic". Two degrees will in fact lead to widespread environmental, social and economic disruption and -- most importantly -- pose a significant risk of a runaway, unstoppable warming period that could cause the collapse of civilisation. So it is an inadequate goal. It is a plan for failure.

The logical, science based response is to set a target that gives society a "safe" outcome. We believe, based on currently available science, that holding global warming below 1 degree Centigrade from pre-industrial levels, can be considered reasonably "safe" for humanity on a crowded planet. Staying below 1 degree, in other words, is the *solution to the problem*. It is "what is necessary".

Therefore society will, when the crisis hits and the scale of the threat is understood, demand a plan to achieve no more than 1 degree of warming.

We are therefore writing this paper to encourage people to think about a One Degree War Plan sooner rather than later. The longer humanity works on it, the more robust and effective it will be.

4. A ONE DEGREE WAR PLAN IS REALISTIC

The next question becomes, is a One Degree War Plan "realistic"? There are two parts to this question:

1. Is it technically and economically possible to rapidly reduce global greenhouse gas concentrations to a level that will bring warming back below 1 degree?
2. Is an agreement to achieve such a plan politically conceivable?

The answer to the first question is clearly yes. Our analysis indicates that based on current knowledge and technology, a 1 degree target is completely achievable at an acceptable cost. This paper details an example of a plan that would achieve it. It would be very disruptive to the economy and to many people, and it would require considerable sacrifice, but it can certainly "solve the problem".

It would require a level of mobilisation and global cooperation similar to that of a world war, but society is capable of such a mobilisation - *when* it finally decides to solve the problem. Therefore the key issue is not the technical / economic question - *can* we achieve it, but the political question *is it conceivable that society would decide to do so*.

Clearly agreement to a One Degree War Plan is hard to imagine in today's world. However in both WWII and the current financial crisis, there are clear examples of how fast things can change. In the case of WWII the speed of response by the US was extraordinary. Whereas in 1940, defence spending was just 1.6% of the economy (measured as GDP), within three years it had increased to 32%, and by 1945 to 37%. But the GDP increased itself by 75% in that time, making the observed increases even more extraordinary. The war effort demonstrated a tenfold increase in (inflation adjusted) dollars spent in just 4 years from 1941 and 1945.[1]

So it *can* be done, but *how* will it be done? It is unlikely that the One Degree War will result from a universal global agreement. More likely a small number of powerful countries, a kind of "Coalition of the Cooling", will decide to act and then others will

[1] Source: http://eh.net/encyclopedia/article/tassava.WWII

follow. Some will follow in order to align with the major powers, and some under military, economic and diplomatic pressure. In a technical sense this process is quite easy. A full 50 % of global climate gas emissions will be covered if 3 "countries" (China, US and EU-27) agree to act. If we add another 4 countries (Russia, India, Japan, and Brazil) the coalition will control 67 % of global emissions[2].

So the issue is not humanity's *capacity* to act, but the conditions being such that humanity *decides* to act. This will be when it is broadly accepted that the threat posed by not acting is greater than the threats posed by acting.

Core to our argument is that the physical momentum for continued change in the climate system is now so strong that it is *inevitable* the public view will change. Physical reality will overcome feeble attempts at adaptation and mitigation. Sooner or later the dominant view will become that climate change threatens the viability of civilisation. Then a crisis response will rapidly follow.

In other words, either the fog will lift, or the train will be so close we can see it in the fog. Then society will respond with "what is necessary". While inevitable, the timing is debatable. It is our view that these conditions will emerge before 2020. For planning purposes, we are assuming 2018.

5. THE ONE DEGREE WAR PLAN IN OVERVIEW

As stated earlier, our objective is a safe climate for humanity and that requires, on current science, ultimate temperature increase limited to about 1 ºC. This is the objective of the One Degree War Plan and would be the outcome if this draft plan was implemented.

In order to achieve this humanity will need quick and dramatic reductions in emissions of climate gases. Achieving these reductions is the core of our plan. However because of the long lag between emissions reduction and impact on temperature, these reductions will need to be supplemented with actions that directly slow the rate of temperature increase and we also propose these. Both these measures will need to be supplemented with adaptation measures, for example to reduce the impact of unavoidable migration and widespread hardship. Adaptation measures will be important parts of a mature One Degree War Plan, but this version focuses primarily on effort the solve the underlying emissions problem.

It is a symptom of the magnitude of the task, that even with the dramatic action we propose, our plan sees warming increase above one degree temporarily in the middle of this century, before falling back to plus 1 ºC by 2100.

We suggest fighting the One Degree War in three phases:

1. **Climate War. Years 1 - 5**. Modelled on the action following the entry of the US into World War II, this would be the launch of a war level of global mobilisation to achieve a reduction of 50% in climate gas emissions within 5 years. This crisis response would shock the system into change, and get half of the job done. We call it "C-war" for brevity. This is detailed in section 6 including a

[2] Source: http://cait.wri.org/cait.php?page=yearly accessed May 11, 2009

summary of the C- War's emissions reductions and their distribution among sectors (Table 2).

2. **Climate Neutrality. Years 5 - 20.** This would be a 15 year long push to lock in the 50% emergency reductions, and move the world to net zero climate emissions by year 20 (Year 2038 on our assumptions). This will be a major global undertaking, requiring full utilization of all technological opportunities supported by behaviour and culture change. We call it "C-push". This is detailed in section 7.
3. **Climate Recovery. Years 20 - 100.** This would be the long haul effort towards global climate control - the effort to create a stable global climate and a sustainable global economy. Achieving this will require a long period of negative emissions to move the climate back towards the preindustrial "normal". For instance, some refreezing of the Arctic icecap will require removing CO2 from the atmosphere through geo-engineering actions, like burning plantation wood in power stations and storing the emissions underground using CCS. Also enough solar capacity will have to be introduced to power and heat the world without the use of fossil fuels. We believe humanity can complete the job by year 2100, and name it "C-century". This is detailed in section 8.

The overall emission reductions proposed (including the suggested distribution among sectors) are shown below in Table 1. The emissions pathway over time is shown at Figure 1.

We have tested our suggested emission cuts in a global climate model[3], and confirmed that implementation would deliver the following results:

- The CO2e concentration falls below 390ppm by the end of the century, after peaking at around 450 ppm. See Figure 2.
- Global temperature does temporarily rise above plus 1 ºC, in mid-century, but then falls below plus 1 ºC around the end of this century. See figure 3.
- The average sea level rises by ½ metre around 2100, and continues rising to a peak of 1 1/4 metre around 2300. While still very disruptive, we believe this is manageable with good preparation given the longer time frames. See figure 4.

The following sections 6, 7 and 8 provide more details for each phase of the plan.

We note that the science will continue to develop and that different targets for CO2e concentrations, temperature and sea-level rise may well become more appropriate as humanity gets greater clarity on what is "safe" and what is "necessary".

[3] We ran our assumed emission scenario (along with an IPCC Business As Usual scenario) through the C-ROADS model with the kind help of Lori Siegel. See: Fiddaman, T., Siegel, L., Sawin, E., Jones, A., Sterman, J., 2009: C-ROADS Simulator Reference Guide. Ventana Systems, Sustainability Institute, and MIT Sloan School of Management. www.climateinteractive.org.

TABLE 1: OVERVIEW OF ONE DEGREE WAR
(all items in billion tons of CO2-equivalents per year (GtCO2e/yr))

Source	**Emissions in** **2018**	**Emissions after C-war** **2023**	**Emissions after C-push** **2038**	**Emissions after C-century** **2100**
Energy supply	15	8	1	0
Transport	7	4	1	0
Buildings	4	1	0	0
Industry	11	6	0	0
Agriculture	8	4	- 1	- 3
Forestry	10	5	- 1	- 3
Waste	2	1	0	0
SUM EMISSIONS	= 56	= 28	= 0	= - 6

Figure 1 GHG Emissions into the Atmosphere – GtCO2e/year

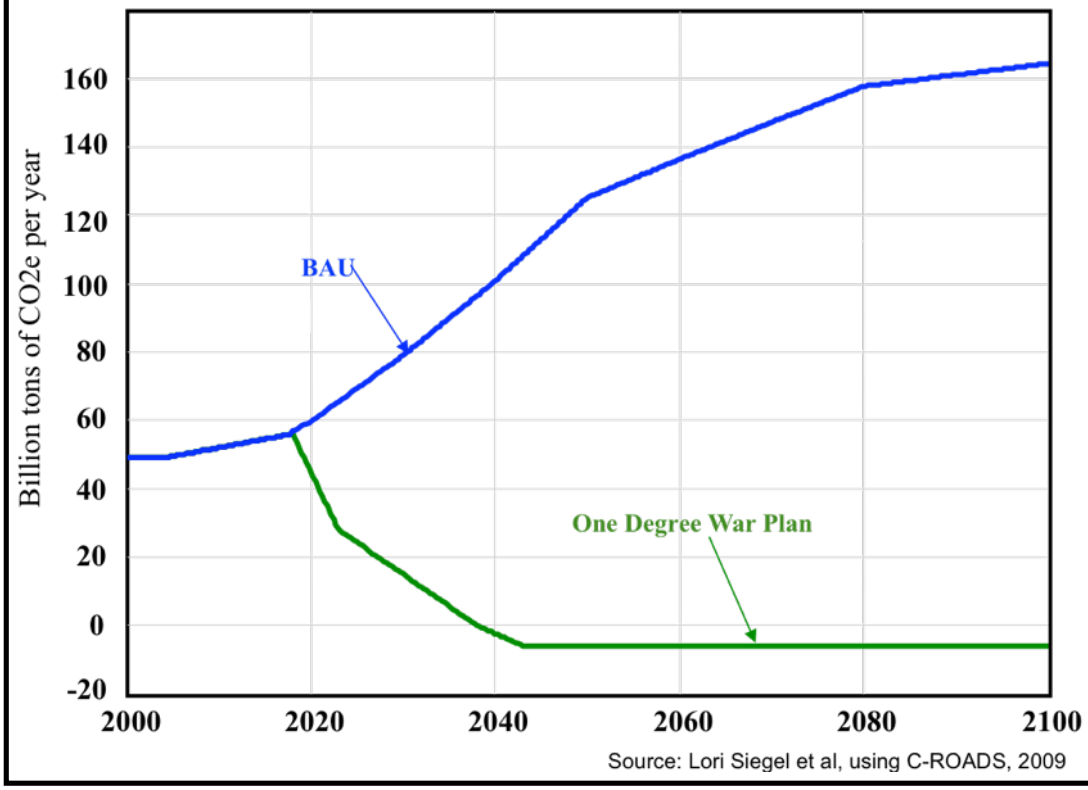


Figure 2 GHG Concentration in the Atmosphere – ppm CO2e

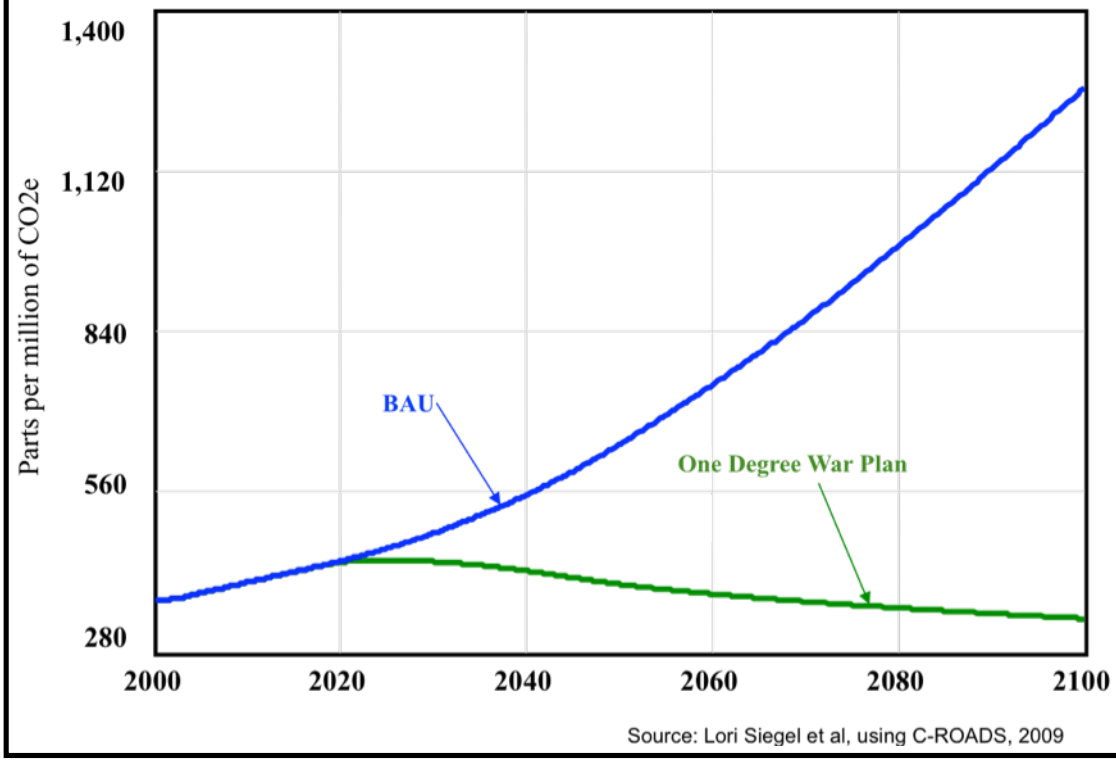
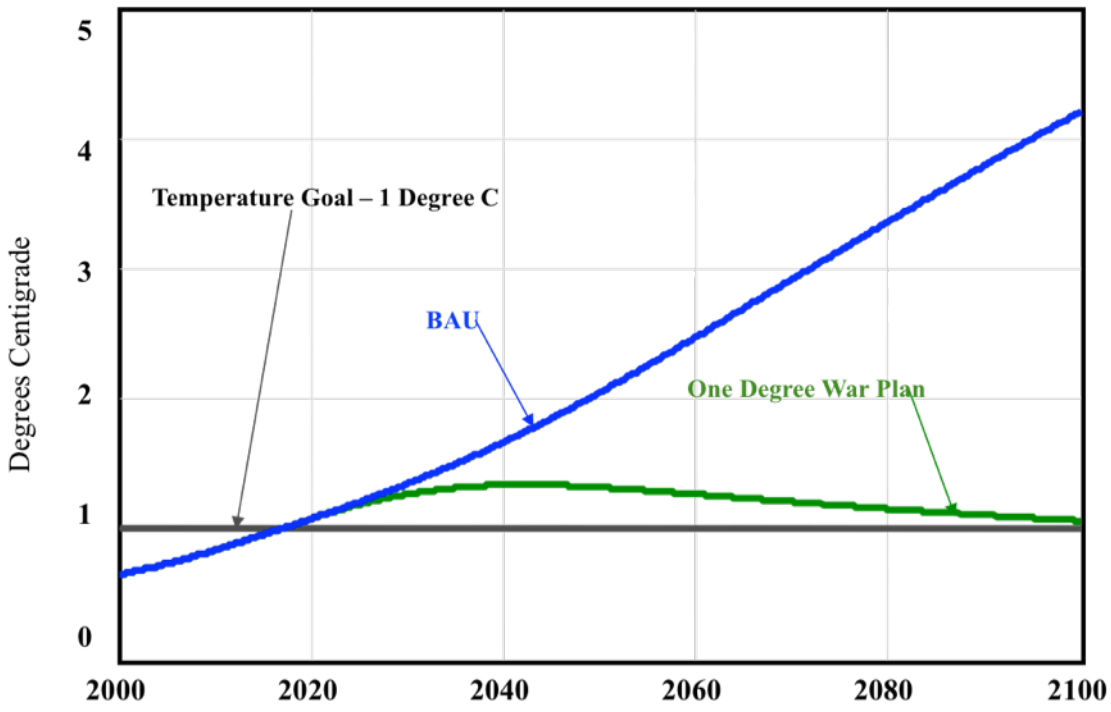
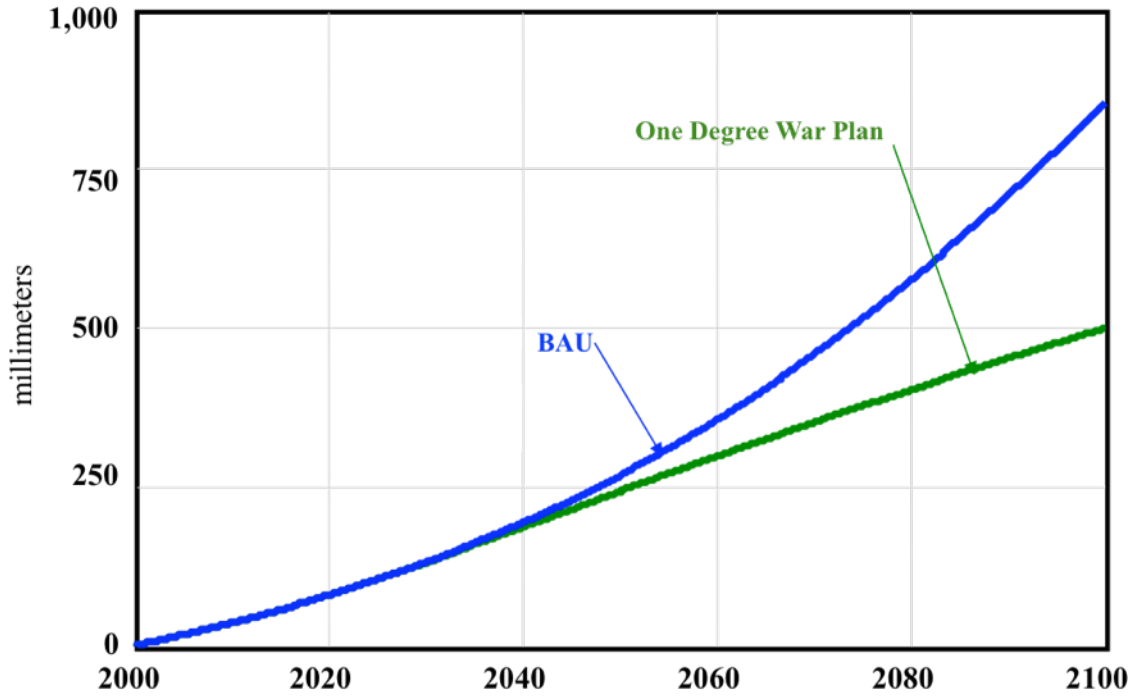


Figure 3 Global Temperature Change Relative to Pre-Industrial



Source: Lori Siegel et al, using C-ROADS, 2009

Figure 4 Sea Level Rise from Year 2000



Source: Lori Siegel et al, using C-ROADS, 2009

6. PHASE 1 – CLIMATE WAR YEARS 1 - 5

OVERVIEW

We propose a forceful start of the One Degree War, for two reasons

1. There is disproportionate value in early actions.[4] Given society will be starting action with the crisis in full swing, a forceful start will be necessary and beneficial.
2. History indicates successful responses to crises tend to involve urgent, dramatic actions rather than slower, steady ones. This engages the public and breaks the tyranny of tradition. It can also be easier to get support for spectacular decisions.

Our One Degree War Plan therefore proposes a series of global measures to achieve a rapid halving of CO2-emissions during the initial 5-year C-war, through linear reductions of 10% per year.

Other authors, like IPCC and McKinsey & Co, have described climate gas reduction strategies, aiming for deep cuts by 2030 or 2050. These amount to reducing emissions by one third and two thirds by 2030[5]. But in order for the world to stay below 1 degree warming, more dramatic cuts are necessary. The C-ROADS model shows that it is necessary to make cuts of 50 % by 2023 to reach our goal. And this cut must then be followed by reductions to zero net emissions by 2038 and net absorption of 6 GtCO2e/year for the rest of the century. So while this initial 50% in 5-years approach is very challenging it is doable. Critically, a slower start would make it very challenging to achieve the 1 ºC goal because of the physical challenge of removing additional billions of tonnes of climate gases from the atmosphere.

The good news is that cutting by 50 % by 2023 can be achieved with the types of initiatives that McKinsey thinks will cost society less than 60 euro/tCO2e. The bad news is that doing these cuts at our faster speed will increase the cost, because much infrastructure will have to be scrapped before the end of its useful life, and because technologies will have to be implemented before they are commercially mature. This is the unfortunate consequence of acting late, as we are now, but delaying action longer will just make that worse.

The following actions, or others with equivalent impact, would be required to ultimately bring global temperature increase below plus 1 ºC. Our list is not a fully and comprehensively analysed plan, but a draft for discussion to establish the approach as viable. The plan is divided into four sections:

1. Actions to immediately slow temperature increase
2. Actions to reduce emissions
3. Actions to organise and finance the war
4. Actions to improve adaptation

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[4] McKinsey & Co *Pathways to a Low-Carbon Economy* 2009, shows how postponement for a decade amounts to an increase in of 55 ppm in atmospheric concentration of CO2e. Stern also argues the economic value case for early action in his study.

[5] Other cut strategies have been outlined, for example in IPCC *Fourth Assessment Report 2007, Synthesis Report, Summary for Policy Makers* p 16, and McKinsey & Co *Pathways to a Low-Carbon Economy* 2009, *Summary of Findings*, p 11.

1. ACTIONS TO IMMEDIATELY SLOW TEMPERATURE INCREASE

Our One Degree War Plan will achieve significant reductions within 5 years, but won't lower global temperatures until much later (after 2040 see figure 3). In order to reduce the risk of triggering runaway positive feedbacks[6] in the meantime, we propose an urgent initiative to lower the temperature immediately by temporary means. We conclude the safest and fastest way to achieve this is by directly increasing the reflectivity of the earth. Alas, it may prove necessary to do much more risky geo-engineering – like introducing particles in the atmosphere to reduce the incoming solar heat – if we want to have significant effect. Or to invest in much more expensive projects – like placing huge shades in space. We would rather avoid these, if at all possible but they should be further investigated.

➢ The White Roofs Campaign

What we do propose for implementation because it is very low risk, is a "White Roofs Campaign" to paint white (or cover with highly reflective materials) most upward sloping surfaces in urban areas to substantially increase the reflectivity of the planet. By reflecting back some of the incoming solar energy, one can compensate for the warming effect of part of the CO2 in the atmosphere. Doing the math, this effort may have to be supplemented with efforts to increase the reflectivity of other large areas: like brighter agricultural crops or mirrors in the deserts.[7] Such actions to brighten the world would not solve the climate problem, but could give society some more time to get the One Degree War up to speed and to understand tipping point risks.

The White Roofs Campaign would deliver a powerful signal. It has the great benefit of being easy to implement without negative impacts on the local ecosystem, at least compared to other geo-engineering proposals such as dumping iron in the oceans. It would also have excellent symbolic impact, be capable of engaging people everywhere and create a large numbers of jobs.

The white roofs would have a limited, but lasting cooling effect (at least as long as they stay white). But white roofs would do nothing to reduce the climate gas concentration in the atmosphere, nor the increasing acidity of the ocean. All it would do is to delay the temperature rise. Thus the campaign should only be used to compensate for the lateness of action, not to replace other actions. The White Roofs campaign would simply give us more time to win the One Degree War[8].

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[6] One of the key reasons scientists fear higher temperatures is that they may trigger runaway climate change (i.e. warming or its impacts accelerating beyond our ability to control them through emissions reduction). This is so called self-reinforcing or positive feedbacks. One such feedback process is the loss of reflectivity caused by the loss of ice. Ice as a highly reflective surface reflects radiation from the sun back into space, thereby reducing the amount of heat trapped on earth. When sea-ice is replaced by dark blue water it absorbs more heat and creates greater warming, which then melts more ice, potentially creating a self-reinforcing or positive feedback.

[7] See Lenton T.M. and Vaughan N.E. The Radiative Forcing Potential of Different Climate Geoengineering Options, Atmos. Chem. Phys. Discuss., 9, 1-50, 2009. Also available at www.atmos-chem-phys-discuss.net/9/1/2009. This paper compares the effectiveness of a large number of techniques to counteract the warming effect of increased climate gas concentrations in the atmosphere.

[8] We have not included the impact of the White Roofs Campaign in Figures 1-4 because it is unclear how effective it would be in quantitative terms.

2. ACTIONS TO REDUCE EMISSIONS

We propose the following actions to reduce global climate gas emissions by 50% during the 5 year long Climate War:

- **Cut deforestation and other logging by 50 %**

  Reduce by one half the ongoing net forest removal and land clearing across the world, including tropical deforestation. At the same time concentrate commercial forestry operations into plantations managed to maximize carbon uptake. This will require significant payments to developing countries, for the climate services provided by their intact forests, but is surprisingly cost effective and doable.[9]

- **Close 1,000 dirty coal power plants within 5 years**

  Close down a sufficient number of the world's dirtiest coal fired power plants to cut the climate gas emissions from power production by one third. We estimate this implies closing down 1,000 plants[10], resulting in a parallel reduction in power production of one sixth. (Power production would fall proportionally less than emissions, because the dirtiest plants emit more CO2 per unit of energy).

- **Ration electricity, get dressed for the war and rapidly drive efficiency**

  In response to lower supply, launch an urgent efficiency campaign matched with power rationing. Include a global campaign to change the temperature by 1 - 2 ºC in all buildings (increase/decrease according to season). Make this part of the "war effort" as a public engagement technique with large immediate power savings. On the back of this, launch a mass retrofit program including insulating walls and ceilings, installing efficient lighting and appliances, solar hot water, and so on.

- **Erect a windmill or solar plant in every town**

  Build in every town of 1,000 inhabitants or more at least one windmill/windfarm. If there is no meaningful wind, build a solar thermal or solar power plant instead. Beyond the CO2 and technology acceleration benefits, this would have the powerful impact of giving most people in the world a tangible, physical connection to the "war effort".

- **Retrofit 1,000 coal power plants with CCS**

  Build CO2-capture and storage capacity on 1,000 of the remaining power plants (see footnote 9). This huge investment would be much simpler through international standardisation. The CCS technology will be also be needed for removal of CO2 from the atmosphere later in the One Degree War (generating power using biomass and sequestrating the CO2). CCS is not yet commercially viable, and will require heavy government intervention such as in the US Auto industry in WWII.

- **Create huge wind and solar farms in suitable deserts**

  Launch a massive renewable energy program focused primarily on solar thermal, solar PV and wind power – on land and off shore. Given the urgency, this will need to be located in those areas with most short-term potential for mass roll-out and paid for by global agreement to finance this.

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[9] See Prince's Rainforests Project "An Emergency Package for Tropical Forests" March 2009. http://www.princeofwales.gov.uk/content/documents/Report%20-%20March%202009.pdf

[10] In this paper we assume there will be some 6,000 major power plants in operation in 2018 (against some 5.000 today). We assume that 1,000 of these are closed down during the C-war in 2018-23 (reducing emissions by 5 GtCO2e/yr), and that a further 1,000 plants will be retrofitted with CCS equipment (reducing emissions by a further 2 GtCO2e by 2023). A big CCS plant sequesters on average 2 MtCO2/yr – roughly 1 in a gas fired utility, and roughly 3 in a coal fired utility).

- **Let no waste go to waste**

Ensure that all used materials are recycled and reused, at the very least to recover the embedded energy. To force this, limit production of virgin aluminum, cement, iron and forest products – possibly through international agreements to restrict their use through higher price or a special global emissions tax on virgin materials.

- **Ration use of dirty cars to cut transport emissions by 50 %**

Launch large-scale replacement of fossil fuel cars with chargeable electric vehicles – running on climate neutral power – along with a massive boost in fuel efficiency standards, bans on gas-guzzlers and greater use of hybrid cars. Public repurchase and destruction of the most inefficient vehicles would help speed the transition. Given the time it will take to scale up production there will need to be rationing of the purchase of fossil fuels, which would also drive uptake of electric and efficient vehicles. The rapid transition by the auto industry to military production in WWII provides a good model for strong government intervention. The recent government control of much of the US auto industry could provide particular opportunities.

- **Prepare for bio-power with CCS**

Interestingly the C-war may not see a large increase in the use of biofuels for transport (not even second generation fuels made from cellulose). It seems better for the climate to grow the cellulose and burn it in power stations with CCS, thereby removing CO2 from the atmosphere while making power and heat. For this reason, boosting cellulose production (in plantations and elsewhere) will be key.

- **Strand half of the world's aircraft**

Reduce airplane capacity by a linear 10% per year through regulatory intervention and pricing to achieve a 50% reduction in airline emissions by the end of year 5. This will force the rapid development of bio-fuels for aircraft and force a cultural shift to electronic communication.

- **Capture or burn methane**

Put in place a global program to ensure that a significant proportion of the methane from agricultural production and landfills are either captured for energy purposes or at least burnt to reduce the warming effect of that methane by a factor of 23.

- **Move away from climate unfriendly protein**

Move society towards a diet with much less climate unfriendly red meat -- through public education backed by legislation and pricing. This should not be against particular meat, but against the associated emissions, so that preference is given to protein produced with lower emissions. While there is still scientific debate on this, there are clearly large differences between protein types – from soy, chicken, pork and beef (and within beef, grass vs grain fed). Therefore science-based policy should encourage the most impactful behaviour change. Allowance would thereby also be made for different farming techniques that bind carbon in the soil.

- **Bind 1 Giga tonnes of CO2 in the soil**

Introduce agricultural methods that reduce climate gas emissions from agriculture and maximise soil carbon. Link this to meat consumption as above to re-educate farmers and consumers. Achieve binding of 1 GtCO2 during the C-war - as preparation for the large scale absorption of 3 GtCO2e/yr during C-century.

While all these actions may seem draconian or unrealistic by the standards of today's debate, they will seem far less so when society moves to a war footing and a focus on "what is necessary".

3. ACTIONS TO ORGANISE AND FINANCE THE WAR

These actions address the most challenging area of climate change action, global distribution of actions, costs and benefits. Like in any war, this will inevitably end up as a compromise between real power, equity and what can be achieved.

Our suggested framework consists of four key actions, described below: Establishing a multinational command structure, imposing a globally harmonised carbon tax, establishing a system for distributing the funds and stopping pollution subsidies.

- **Establish the Climate War Command**

  Create a "Climate War Command" controlled by those countries participating in the war. Combine the expertise and the lessons of institutions like the IMF (for professional advice on macroeconomics), the IPCC (for advice on climate issues) and various multi-national military commands. The Climate War Command would have a variety of powers including the authority to ensure that funds are distributed according to a harmonised global strategy, and to impose equivalent tariffs on imports from any countries that don't agree to the tax.

- **Introduce a carbon tax of US$ 100 per tonne of CO2e.**

  Impose a global tax on CO2 levied at source on all fossil fuels (ie coal, oil and gas), Start at US$ 20 / tonne in year 1 and increasing by US$20 / tonne per year over the 5 year duration of the C-war. This would initially raise some US$800 billion per annum, increasing to US$1,900 billion per annum in year 5[11].

- **Redistribute the proceeds of the carbon tax**

  The global carbon tax should be used for two purposes: to fund the war effort (ie the development and implementation of the various actions described above) and to alleviate the resulting hardship – primarily among the poor (globally speaking).

  The latter could be achieved through equal payments from the Climate War Command to all global citizens of one half of the proceeds of the global carbon tax. They would start at US$45 per person year and increase to US$225 at the end of the C-war.

  This compensation for the disproportionate hardship of the poor during the One Degree War, probably should be supplemented by rationing systems to ensure that each global citizen receives a fair share of those goods and services that temporarily will be in short supply – for example food, power and fuel.

  The remaining funds should be used as agreed by the War Command to help fund the development of new technology, to help pay for restructuring costs including paying developing countries an annual fee for prevented deforestation and to finance disaster response and adaptation costs.

- **Shift subsidies from fossil energy to human employment**

  Phase out over 5 years all subsidies that support climate gas emissions, and use the proceeds to help soften the unemployment problems arising from the C-war. By some estimates these subsidies amount to US$ 700 billion per year globally.[12]

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[11] Assuming that two thirds of all emissions come from fossil sources (according to Table 1 this is .67*56=38 GtCO2e/yr in 2018 and .67*28=19GtCO2e/yr in 2023) and that the tax goes from 20 US$/tCO2e in 2018 to 100 US$/tCO2e in 2023.

[12] See for example Lester Brown at http://www.earthpolicy.org/Books/Seg/PB2ch04_ss7.htm

4. ACTIONS TO IMPROVE ADAPATION

The accelerating deterioration of the ecosystem and the slow human response is exacerbating what was already inadequate planning for adaptation to climate impacts. This situation can be expected to worsen by 2018.

Thus a mature One Degree War Plan will need to address urgent adaptation needs. The following three areas will be central:

- **A resettlement plan for millions of climate refugees**

  Many of these refugees will be internal, but many will need to cross international borders to find suitable homes. The wealthy countries will have to contribute substantially to addressing this migration challenge.

- **An adaptation strategy for low lying coastal areas**

  The sea level will rise during the 21st century and adaptation efforts will be required at the local and national level. International cooperation will increase the effectiveness and reduce the cost of such measures, for example dikes, staged retreat, floating cities and flood resistant agriculture. This challenge is certainly not limited to developing countries, the industrial world has significant sea rise challenges, for example in Florida and the Netherlands.

- **A mitigation strategy for large scale famine**

  Climate change is very likely to impact negatively on the world's agriculture, particularly in the longer term – towards the middle of the century. But local crop failures may occur, and disaster relief organisations and the military should make plans for such developments and their geo political implications.

CONCLUSIONS ON THE CHALLENGES OF THE C-WAR

Of course the whole approach we outline is hard to imagine in the current context, but again we remind readers how fast things changed in WWII and how quickly things changed recently during the global financial crisis.

Humanity is capable of extraordinary change when it decides to act. Nevertheless, there will be some critical challenges to manage well during this process and this is worthy of considerable discussion as this plan is revised.

The main challenge, beyond agreeing to start the C-war, will be in softening the problems for those hardest hit from expensive or unavailable energy, food, transport and housing. As suggested above this can best be addressed through a combination of economic compensation and rationing. Our plan generates at year 5 around $2,500 billion per annum to be used for compensation, structural adjustment in the economy and adaptation planning. We also propose a well functioning rationing system to ensure a fixed minimum amount of these commodities for each global inhabitant. While these are important, it should be noted that this plan is going to require sacrifice and this cannot be avoided.

Against this, we have as our constant reference point the human suffering and economic cost of the alternative of a collapsing civilisation.

The second challenge would be to help those who lose their jobs in the transition. This could be done by diverting current subsidies and using tax income, but also would be helped by the significant employment effect of the warlike production increase in climate friendly output and other actions such as the White Roofs campaign.

Thirdly and perhaps hardest to plan for, will be the dramatic need for leadership globally, but also at the national level and then further down in the climate army. The Climate War Command could help at the global level, but good ideas are necessary for getting in place sufficient leadership at the national and local level.

Although not the focus of this plan, we see great potential for bottom up community action and leadership in this overall effort. While we don't analyse this in detail here because its hard to quantify its potential, we see enormous potential and note the efforts underway all around the world such as the Transition Towns movement.

TABLE 2: DETAILS OF PHASE 1 -- CLIMATE WAR (in GtCO2e per year)

SOURCE	EMISSIONS 2018	EMISSIONS 2023	INITIATIVES
ENERGY SUPPLY	15	8	Close the 1,000 most climate intensive power plants. Introduce CCS on 1,000 of the remaining plants. Large-scale expansion of wind and solar energy.
TRANSPORT	7	4	Rapid electrification of car fleet, forced shift to small cars and rationing of daily driving. Dramatic reduction in air travel.
BUILDINGS	4	1	Dramatic increase in energy efficiency. Change indoor temp 2 °C
INDUSTRY	11	6	Shift to recycled metals and fibre, limit production of aluminium, cement, iron and forest products. Shifting to renewable materials and increasing energy efficiency.
AGRICULTURE	8	4	Shift away from red meat, increase the carbon content of the soil.
FORESTRY	10	5	Halving of all harvesting of wood
WASTE	2	1	Capturing all methane from landfills, and burning all waste for energy
SUM	= 56	= 28	

7. PHASE 2 – CLIMATE NEUTRALITY YEARS 6 - 20

Phase 2 would be a 15-year continuing push to lock in the 50% reductions achieved during the C-war, making them permanent and launching the programs that would see global CO2e neutrality (of the economy's emissions) by year 20 (year 2038).

The actions in phase 2 would be influenced by the experience of the 5 year C-war and the scientific and technological developments of the time. In most cases it would be a

matter of continuing these programs and expanding them, but in some cases new initiatives would be taken. Examples of approaches might include:

- Create the global "Climate Stability Commission" to determine the required level of CO2 concentration to stabilise the climate as the science develops, to investigate and agree necessary geo-engineering projects to achieve stabilisation, and to monitor their implementation. This review would include CCS with biofuels to remove CO2 from the atmosphere, massive reforestation, soil carbon and soil char in all its forms, the white roofs campaign, mirrors in the desert, atmospheric seeding, reflectors in space and all other ideas.
- Rapidly rollout any geo-engineering projects with short term benefits.
- Eliminate all remaining net deforestation and promote the widespread and preferential use of timber in buildings and other products to lock up CO2.
- Implement adaptation plans designed during the C-War including preparing for migration, sea level rise, and famine.
- Regulatory action to close the loop on all consumer products and the diversion of all waste from landfill to force greater recycling. This should include the composting of all organic waste to immediately reduces waste volumes and prevent longer-term methane emissions from organic waste.
- Continue the massive renewable energy program to first replace supply for the dirty generators turned off and then to turn off the remaining dirty coal generators by the end of year 10 and most gas generators by year 15.[13]
- Continue the transport replacement program from the C-War so that all transport is zero CO2e by the end of year 20.
- Continue the energy efficiency program with incentives to reduce rationing of supply to the most efficient houses and buildings.

8. PHASE 3 – CLIMATE RECOVERY YEARS 21 - 100

For years 21 – 100, the challenge will be to rebuild the global economy based on renewable (solar, wind, hydro, geo etc) energy in a sustainable model, to lock in the reductions achieved and to then stabilise the global climate by taking greenhouse gases out of the atmosphere. Actions might include:

- Launch those geo-engineering projects that were found acceptable by the Climate Stability Commission's investigations.
- This will presumably involve removing CO2e from the atmosphere through a series of programs involving bio-sequestration and under ground storage.
- Rebuild the global economy with a focus on sustainability, the elimination of poverty and closed loop, zero waste and zero net CO2e production and consumption. Shift economic policy to a focus on quality of life vs material growth for its own sake.
- Widespread application of approaches to help stabilise the climate, probably primarily agricultural, forestry and soil carbon related activities.

[13] We assume that by 2038 most power plants have been replaced by renewable energy, or have been retrofitted with CCS.

9. CONCLUSIONS AND NEXT STEPS

What this paper shows, at least at a high level, is basically good news, and writing it lifted our spirits. It showed that even though we will inevitably respond to climate change "late", it will still be possible to stabilise the climate and human society.

Advocating urgent action remains crucial because the earlier we act, the safer we will be, and the less disruptive the inevitable process of rapid change will be.

While hard to imagine today, this plan can be implemented relatively cheaply compared to the costs of failure. Various analyses made since 2005 indicate a societal cost of drastic emission cuts of about 1 % of the Gross World Product. The costs will be higher when the One Degree War Plan is implemented in its rushed manner. But there is every reason to believe that the war can be won with 5-10% of annual GDP allocated to the task. That would in turn translate into using roughly 5 -10 % of the workforce, and result in 5 -10 % drop in average disposable income. It is not without sacrifice, and certainly involves significant dislocation for many people, but again not compared to the alternative of a collapsing economy and society.

Over the ensuing period of restructuring, wealth levels would gradually move back toward current levels, though distribution would be more even. Wellbeing may increase with stronger common purpose and sense of community, stronger global governance and cooperation and many improvements in transport, urban design and energy.

While the total cost is manageable, the distribution of costs and the benefits will raise some very challenging political and social issues, as indicated by the actions we have proposed in order to finance the One Degree War and distribute the burden. This would particularly apply to industries heavily affected and to developing countries, particularly poor people within them.

Society has some experience of managing economic restructuring under emergency conditions. Sometimes it is done well and sometimes less so. It is clear the better one plans, the less painful the transition will be for those most affected. The problems cannot be eliminated (again war provides a good analogy), so it will be important for both humanitarian and pragmatic reasons (i.e. likelihood of success) to prepare well.

Since it appears likely that humanity will not respond until the approaching damage is perceived as a true crisis, society should get to work on the crisis response plan now. Only this way will it be well developed when needed.

Our next step will be to embark upon a global engagement program to seek continued refinement of our crisis response war. We want to make it as robust and well thought through as possible. We invite scientists, social thinkers and commentators, political and business strategists, concerned individuals, military planners, pressure groups and policy makers to help us refine the One Degree War Plan. Your input to this process would be most welcome and we invite your comments at www.onedegreewar.com

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