Fossil fuels helped us to fight wars of a horror never contemplated before, but they also reduced the need for war. For the first time in human history - indeed for the first time in biological history - there was a surplus of available energy. We could survive without having to fight someone for the resources we needed. Our freedoms, our comforts, our prosperity are all the products of fossil carbon, whose combustion creates the gas carbon dioxide, which is primarily responsible for global warming.

Ours are the most fortunate generations that have ever lived. Ours might also be the most fortunate generations that ever will. We inhabit the brief historical interlude between ecological constraint and ecological catastrophe.

—commentator George Monbiot, 2006

Before, if we screwed up, we could move on. But now we don't have an exit option. We don't have another planet.

—climate scientist Will Steffen, 2005

Economists may tell you that it will take twenty years—but when there is a war on, you get it done in a few years.

—biologist Tim Flannery, 2007

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Arming for a Great War

In *Collapse*, his survey of past societies that failed and succeeded in dealing with collapse-threatening environmental change, Jared Diamond identified three stages in avoiding collapse.

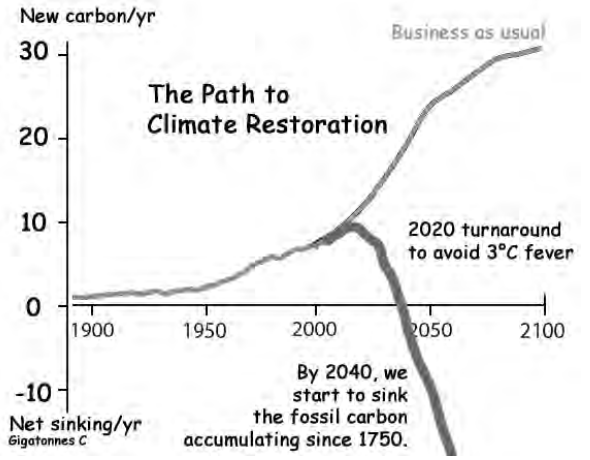
First, it took each society a while to identify that there was a problem. For our present carbon creep, this realization happened between 1938 and 1965 for the relevant scientists, long after the creep began around 1750. In terms of identifying that we are already in dangerous territory for experiencing abrupt climate shifts, I'd guess it dawned on many climate scientists between 1998 and 2005.

Second, Diamond observed, comes the discovery of some ways of coping with the problem. Cap-and-trade, the cornerstone of the 1997 Kyoto agreement, ironically arose out of the success of the U.S. experience with tackling smokestack sulfur ("acid rain") emissions using cap-and-trade.

Third is actually doing something about the problem. Europeans made effective starts before 1980. But it will

now take about six times the Kyoto goals just to cancel out the subsequent increases in yearly emissions from China and the United States. And Kyoto was an inadequate goal.

Now we need that first turnaround accomplished before 2020.



Can we do so much by 2020? You only have to look back to see great spurts of scientific and technological progress. Who in 1992, trying out the first web browser via a phone line modem as I did, would have thought that the web would expand so fast? It went from one page to a billion in only four years, indexed by free search engines.

The first industrial revolution, spanning the 1770s to the 1860s, saw the earlier scientific inventions such as the battery extended to create the telegraph and electric motor. The steam engine led to steamboats and locomotives. Photography. Anesthesia. Refrigeration.

Then progress sped up. The second industrial revolution from the 1870s to the 1910s built on this industrial base and the mid-nineteenth-century discoveries in physics and chemistry. And so in its first twenty years we got the telephone, the internal combustion engine, the light bulb, hydroelectric dams, the linotype machine, and a primitive car. Science surged again, producing the germ theory of disease, genetics, and artificial vaccines.

In the next twenty years, 1890 to 1910, we got the theory of relativity, the photoelectric effect, the first textbook of psychology, and such marvels as neurosurgery, motion pictures, air conditioning, airplanes, and radio.

In the 1940s and 1950s, we discovered the jet stream, DNA, and global warming. We invented the computer, nuclear power stations, the transistor, fiber optics, satellites in orbit, the Pill, antibiotics, and major psychoactive drugs. Polio vaccines saved millions the prospect of life in an iron lung. Television surged. Films were in color.

In the 1960s and 1970s, we discovered continental drift, put communication satellites in geosynchronous orbits, went to the moon, did heart transplants, invented the Internet, and created personal computers. Scientists started using email and spreadsheets.

A lot can happen in only twenty years—especially with our current scientific momentum. We cannot rely on future progress to save the situation, but there are good reasons to think that some parts of the problem may prove tractable, given enough effort.

Next, consider the surprises that might interrupt our orderly efforts to turn around and restore the climate.

Suppose storm surges from ocean warming scour those vulnerable coastal cities that were slow to build surge barriers. Besides all of the loss of life, there will be an enormous expense from rescue, temporary housing, and rebuilding. Then there will be a crash effort to construct sea walls and surge barriers. It will be the New Orleans problem, repeating in other coastal cities. Will there be time and C-free energy in sufficient quantities to do both that and clean up the CO_2?

Or suppose that floods and droughts create a large homeless population that moves across national borders? Or that an unpaid hungry army goes foraging in the country next door—and the reaction starts a war? There will surely be a lot of these unhappy events. Should charismatic leadership arise, something like what we are now seeing in the radical jihadists, terrorists might effectively disrupt the developed countries to exact "relief aid" in a classic protection racket. And so the immediate demands of war would again override the necessary environmental infrastructure investments.

A similar effect would occur from revolutions. A major country might descend into civil war for any of the usual reasons. New reasons for civil war might include frustration with a government that is too slow to act on climate ("Our laws are not a suicide pact!") or intergenerational conflict between those guarding their assets for an uncertain retirement and the asset-poor younger

generation, insisting on taxes for expensive infrastructure improvements.

Whatever the cause of a schism, countries take many decades to recover from such national traumas and that will be time lost—time that the world cannot afford when trying to head off runaway climate change.

Before 2040, we need to reduce net CO_2 additions to zero—and begin reversing the CO_2 concentration back toward 1939 values. (I pick that year only because that's when I began personally adding to the CO_2 problem.) This will only happen if the technology of the developed world has become good enough to compensate for what's still going on in failed nations and others too disorganized to get their energy act together.

Wisdom, it is said, requires an ability to understand human nature, perceive a situation clearly, and decide despite ambiguity and uncertainty. It requires an ability to get past the common roadblocks, such as denial. By this standard, much of the political leadership is not wise when it comes to climate change.

Remember that foresight is not about predicting the future. Rather, foresight allows you to mold the future. We'd better hurry implementing that foresight because positive feedbacks seem to have put the climate machine into Fast Forward.

We are already in dangerous territory and have to act quickly to avoid triggering widespread catastrophes. The only good analogy is arming for a great war, doing what must be done regardless of cost and convenience.

GLOBAL FEVER

How to Treat Climate Change

WILLIAM H. CALVIN

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