

AUTHORS' PREFACE

Civilization may well be facing the biggest crises in its ten-thousand year history: global warming, and the related problems of pollution and mass extinction of species — all related to one factor: large increases in the human population.

With a myriad of books available on climate change, why do we need another? Notably, it is because our book has a stronger emphasis on the social sciences and especially the free-riding problems. Although our book also explains the earth science, atmospheric science, and engineering challenges, it focuses a lot more on the critical political and economic obstacles confronting any serious attempts to solve these crises. And just as some technical engineering is impossible today (like nuclear fusion power), so it is with some social engineering.

Perhaps the best way to illustrate our perspective is with a simple analogy. Advocating that the world should stop burning fossil fuels and emitting greenhouse gases is like advocating that the world should stop spending on its armed forces. Although we agree that widespread disarmament would be wonderful from a collective point of view, it's simply not going to happen. This is because countries have primarily their own interests at heart, not the world's.

It is the same with fighting climate change. It is not worth it for each of the world's 195 countries to make large sacrifices that benefit the other 194 countries more than themselves.¹ Worse, the benefits and harms of climate change are unevenly distributed across countries, and expensive sacrifices over many decades will not yield noticeable benefits for many decades.

One may retort that there are politicians who have been signing treaties that are against their own self-interests. However, we argue this perception is illusory. If they — or more likely their successors — were to ever attempt to execute and enforce measures that would result in meaningful reductions in living standards for the sake of the planet, they would be quickly replaced by politicians who would instead offer higher local living standards sooner.

Many scientific and even most economic approaches to climate change have been distracted by arguments over globally optimal responses. Yet

¹Contrary to popular belief and thus not contrary to our main thesis, the EPA had calculated that the 1987 Montreal Protocol did not impose costs on the United States. See Chapter 7.

whether it is globally optimal to stop arming or to stop emitting greenhouse gases seems largely irrelevant to us. We believe that most of the important countries (locked in their own geopolitical struggles) will do neither.

Please do not shoot the messenger. We would love to see good new international agreements, a global carbon tax, and fewer military expenditures. We just don't believe they is a realistic perspective. Other serious researchers are more optimistic in this respect than we are. We hope that they will be proven right, but we are not counting on it.

Climate change is also not a problem that the U.S. and Europe can solve alone. The U.S. accounts for about 12 percent of global emissions. Add Europe, and it is 20 percent. China alone already emits more than both together. India and the rest of Asia are ramping up aggressively. Even if the U.S. and Europe had an iron will — and they do not — and halved their emissions — an unachievable goal for many decades unless a technological breakthrough occurs — that would still leave the world with more than 90% of today's emissions. (See Figure 2.4 on page 54.) Indeed, world emissions would exceed today's emissions even if the U.S. and Europe were to vanish from the earth within one generation.

In total, the emissions of all OECD countries together will account for less than one quarter of world emissions by 2050. Thus, the central problem today can no longer be solved by the one billion people in rich countries alone (let alone the 0.1 billion wealthier 10% therein). Emissions are a problem that needs to be tackled even more by the seven (soon to be eight) billion people in poorer countries. These people also aspire to reach modest standards of living and who won't tolerate any delay for the sake of the planet.

As social scientists, we need to think about what environmentalism can accomplish when faced with the tough realities of the world. Environmentalists should be aware of what they can and cannot achieve. Reality denial is as unproductive as climate-change denial.

TODAY'S ACTIVISM

In our view, much climate-change activism today seems performative — akin to a “personal wellness approach to climate change” — more feel-good than effective. The evidence is in the air, and it suggests that most climate-change activism to date has been wasted energy. Earth would probably be in roughly the same spot now if climate-change activism had never occurred in the first place.

Naïve environmentalists have been committing two sins that, sadly, don't cancel out each other — they have been thinking too big, and they have been thinking too small.

Thinking too big, too many analysts (including many economists) have focused on advocating for coordinated global action. We also would love to see this happen, but as we just explained, debating how to achieve this goal seems to us like arguing about how many angels can dance on the head of a pin. The fact is that there is no global government that could enforce global coordinated action. Treaties are no substitutes, either. In the real world, treaties only have a reasonable chance of success if they are in the signers' self-interests or at least not greatly against them. Treaties cannot succeed when they demand large sacrifices today and will show tangible results only after decades. Most of humanity is too poor to afford large payments for the world's common good, and the remainder would never be willing to pay for all of humanity in order to avoid a climate disaster in fifty years.² Whether you or others personally believe the world's people should or should not voluntarily take on large sacrifices doesn't matter. It simply won't happen.

Thinking too small, many environmentalists have advocated slogans such as “every little bit counts,” “we have to start somewhere,” “we must do our fair share,” “we must set an example,” or “we must reduce our personal carbon footprints.” These approaches will not be able to meaningfully change the worldwide CO₂ concentration in the atmosphere, either. When solutions do not have a dynamic that will make them scale to billions of people, they will never [move the needle](#) in any meaningful way. If the goal is to truly bring down the CO₂ concentration in the atmosphere, the equivalents of New Year Resolutions simply won't make a difference. It is important to have the appropriate perspective: not only does your own carbon footprint not matter,

²For perspective, you can think of the cost as approximately the equivalent of 1 to 3 months' rent per year; we explain this yardstick later in the book.

but even the entire United States' carbon footprint is no longer what matters most. Eliminating the emissions of all 0.3 billion Americans is of much less importance now than reducing the emissions of the other 7.5 billion people.

Environmentalists also tend to have another collective shortcoming. They need to be not just *against* but also *for* some big policies, even painful ones. The requirement of zero environmental harm on every dimension cannot possibly change the world for the better. It only empowers the *status quo* when many environmentalists are against fossil fuels, [nuclear power](#), [hydroelectric dams](#), [geothermal plants](#), [lithium mining](#), [solar cells](#), [windmills](#), new [electric transmission lines](#), and [tree felling](#) at the same time. What compromises is environmentalism really ready for? Activists who want to change the world should be able to articulate alternatives, be clear as to what difference the results will make, why the alternatives can be net cost-effective, and explain who will *realistically* pay for them. Environmentalist alternatives must also assure that poor and rich economies alike have reliable energy — or the affected people will not accept them. Our book limits its recommendations to alternatives that we and many experts consider to be viable and effective — even though they are also imperfect.

We are not against feel-good activism — unless misguided activism saps the energy from a smarter environmentalism that can make the world better. Rearranging the deck chairs on the Titanic is fine, but only if it does not distract from readying the rescue boats.

VIABLE APPROACHES

Despite the enormous magnitude of the problem, we remain cautiously optimistic. Yes, change will be difficult in an era of pandemics, global poverty, wealth inequality,³ economic stagnation, high taxes and tax evasion, political, cultural and religious strife, and many oppressive and corrupt governments. These are all serious problems — but as bad as they are today, many of them are [not as bad today](#) as they were in the past. Yet the world also faces novel challenges: our much larger human population, a bad head-start on environmental degradation, and more pervasive misinformation and effective propaganda.

³Fair contributions are not just a problem across rich and poor countries, and across rich and poor within the same country. Depending on the country and cutoff, the rich in poor countries are often [much richer](#) than the poor in rich countries.

Our book argues that the only viable solutions to the world's climate problem will be based on human ingenuity. And fortunately the rapidly declining prices of cleaner technologies are now giving civilization the ability to solve many of its environmental problems. Our most important suggestion for countries and individuals is therefore to work on accelerating research and development. Engineering progress can nudge the big ship that is Earth — with all of humanity that it contains — in the right direction, even if the ship turns more slowly than activists would wish. Prodding, pushing, and nudging — smart environmentalism can move the needle now. And part of what we want to happen is action now, rather than debating what we should do in decades hence. We wrote this book partly to explain how.

Because we think it is irrelevant, we do not need to get involved in the debate about exactly how bad the world's situation is. We can take it as given that fossil fuel pollution today is already bad enough to warrant appropriate reductions. From a social perspective, humanity today is burning way too much fossil fuel (resulting in millions of deaths every year), and it will almost surely burn more fossil fuels *very soon*. We can thus shift away from some of the most heated arguments among politicians and climate scientists over how aggressively and quickly humanity must wean itself off fossil fuels to stem global warming — 10 years, 30 years, or 100 years, with carbon taxes of \$50 or \$500 per ton of CO₂. Although we would like to see such CO₂ taxes, too, we think that this debate is as divisive as it is irrelevant in practice. We don't think high CO₂ taxes are going to be enacted in the countries housing 7-8 billion people today.

Instead, we think everyone should be focusing on how to induce decision-makers — including in poorer countries — to move more aggressively towards cleaner solutions. What actions can countries, organizations, and individuals take to *move the needle* now? Fortunately, there are many actions that are cheap and locally advantageous enough to be already worthwhile, many that are possible to accelerate at modest cost, and many more that will become feasible soon. We will cover many promising approaches in Chapter 13.⁴

Of course, many readers will think that we are going too far, and many others will think that we are not going far enough. We expect only a small minority of readers to like everything we write. At some points, we will

⁴In particular, if the energy storage cost problem (explained in Chapter 10) can be solved, it will be lights out for most uses of fossil fuels.

offend many climate-change activists; at other points, many climate-change skeptics. We consider no cow sacred. However, we hope that all our readers will appreciate the honesty of our presentation and analysis, whether they will end up agreeing with us or not.

THE EDUCATIONAL COMPONENT

Our book has a strong educational component. It is designed to be suitable not only as a general interest book for the concerned citizens of the world but also as a course textbook. It is written for interested students at any level — from our teenage children to our political leaders (though sometimes we are not sure which is which). Our readers should come away with a clear understanding of the problems and tradeoffs associated with energy provision, emissions, and climate change. We have tried to keep the book brief and to the point, self-contained, and easy to understand. (The key facts on which our book relies are summarized in our six-page Appendix, itself enough a reason to buy this book.) Our book’s target audience is anyone who enjoys reading a newspaper like the *New York Times* or the *Wall Street Journal*.

One problem in learning about energy, emissions, climate change, economics, and technology is not a lack of information. Instead, there is too much information (often biased and false) all over the Internet. You can probably find everything that we discuss here somewhere else. An important goal of our book is vetting and distilling the most important facts.

Our book’s first task is thus organizing information into a form that does not miss the forest for the trees. Although many concerned people have read about global warming, most do not fully understand it. (Admittedly, though interested, we did not, either, until we researched more to write this book.) Most people have glimpsed only [parts of the elephant](#). And this elephant is big. It includes earth-science aspects (energy, emissions, planetary changes); social-science aspects (public goods, cost economics, social costs of carbon, coordination); engineering aspects (the viability of potential technologies, electricity, storage, agriculture, geoengineering); and an understanding of feasible large-scale potential solutions. For example, batteries work well for cell phones — but could they really power the daily needs of eight billion people? Where are we right now on the “clean-energy revolution”? And so on.

We want to present information in a fair and unbiased way. Both climate activists and climate skeptics sometimes share a penchant to suppress [inconvenient truths](#). Many environmentalists do not like contrary arguments, because they are afraid that their airing could reduce the alarm and poison the determination of the faithful. Many climate-change skeptics are in a worse predicament, because they have to disavow much of the scientific evidence.⁵ Moreover, the vitriol and accusations of ignorance and bad faith on both sides when there are legitimate uncertainties, unresolved issues, and dilemmas is, at times, stunning. Hired trolls further fan the flames.

Our goal is to air all reasonable and important arguments — even if we disagree with them — and to do so with appropriate respect. (And for non-reasonable arguments, this can mean zero respect.) We do not want to discourage our readers from forming their own points of view and disagreeing with us. However, we do want our readers to understand why answers may not be as obvious as they might have thought. In many cases — though not all — honest, smart people can and do come to different conclusions.

Our book does not cover one important area of climate change — adaptation. This is not because this area is unimportant (on the contrary, it is *very* important!), but because adaptation is usually in the self-interest of the affected parties. The focus of our book is on how global greenhouse gas emissions could be reduced.

ABOUT THE AUTHORS

We are not earth scientists; we are not engineers; we are social scientists. We are not even among those economists who have dedicated their lives to studying energy provision and climate change. We think that our background offers both advantages and disadvantages. On the positive side, being economists allows us to see more forest than trees and not get lost in too many specific details. As first-time authors on these subjects (though not others in our area of economics), we also have no horse in any particular race. We can present what we believe to be fair and objective perspectives on the evidence. On the negative side, our detail knowledge is not as deep as that of our fellow scientists in their specific fields. We are not producers, but rather intelligent consumers of the research we present. We have fact-checked

⁵The journalist Katie Worth has written an interesting account of how climate change has become [a divisive and partisan issue](#) full of distortions and misinformation.

the information we are presenting, but we always welcome corrections and clarifications.

We are not claiming originality for the many ideas in this book. Our impression is that most good ideas have occurred many times to many people, often independently. Thus, our book should not be viewed as an original research treatise. Its originality is in the exposition of the information in our own particular way.



There is one bias that we do have. We are not simply uninvolved scientists objectively analyzing an interesting intellectual puzzle. We view ourselves as cool-headed environmentalists, advocating choices that are technically viable, economically affordable, and politically feasible. We want to tackle environmental problems sooner rather than later. We want to *move the needle* now in the most sensible ways possible.

Grant me the serenity to accept the things I cannot change, the courage to change the things I can, and the wisdom to know the difference.

— [Serenity Prayer](#), Reinhold Niebuhr

Conflict of Interest Disclosure: Neither of us has ever been supported by grants or otherwise from lobbies, either environmentalist or fossil-fuel. We are not shells for anyone.

PS: The book contains cartoons (mostly from [cartoonstock.com](#)) and jokes. Even if the subject matter is deadly serious, jokes are exactly that — not to be taken seriously much less indicative of our own views.

quote

Ridicule is man's most potent weapon. It is almost impossible to counteract ridicule.
— [Saul Alinsky, 1971](#).