

## CHAPTER 1

# The Role of Myths in Our Climate-Energy Challenge

We are all capable of believing things we know to be untrue . . . the only check on it is that sooner or later a false belief bumps up against solid reality, usually on a battlefield.

*George Orwell*

**I**N THE SUMMER OF 1990, AS HE ANNOUNCED HIS ARMY'S SURPRISE invasion of Kuwait, the Iraqi dictator Saddam Hussein told his people that the neighboring oil-rich country was rightfully theirs. Many believed him. When he announced Kuwait's annexation, as Iraq's 19th province, they celebrated with patriotic fervor.

Several months later, a US-led military coalition, which included Arab states, threatened to expel the Iraqi occupiers. Undaunted, Hussein assured his people that their army would annihilate its foes in the "mother of all battles."<sup>1</sup> By this time, some Iraqis were probably questioning, at least to themselves, the veracity of Saddam's claims. But under his brutal dictatorship there was little they could do. In early 1991, they watched in horror as coalition forces destroyed the fleeing Iraqi army. Thousands of their sons, brothers, and husbands were helplessly slaughtered in the desert by the massive firepower of the coalition.

As George Orwell said, a battlefield provides a solid reality check on false beliefs.

The US president who led the coalition was George H. W. Bush. His forces could easily have taken Baghdad and overthrown Hussein. Instead, they halted their advance in southern Iraq and then withdrew. They had

achieved their objective of liberating Kuwait – not to mention ensuring that this country would remain a reliable US oil supplier.

Twelve years later, however, Bush's son, following his father's footsteps in the presidency, told Americans that Saddam Hussein was developing weapons of mass destruction that could be used against the US homeland, threatening a repeat of attacks like those of September 11, 2001. Most Americans trusted the second President George Bush and supported his 2003 invasion of Iraq. They believed that overthrowing Hussein would ultimately save American lives by establishing a peaceful, democratic Iraqi government allied with the US.

Six weeks after the attack, under a banner that read Mission Accomplished, Bush declared the end of the conflict. By this time, many Americans were questioning the veracity of his claims. They could no longer overlook daily news of a growing insurgency against the occupying forces and intensified sectarian violence. In the ensuing chaos, most came to realize that the second President Bush and key members of his executive had overstated the threat Hussein posed to their security, and in the process deluded themselves and fellow Americans about the ability of military intervention to transform Iraq into a stable ally. Eventually, the government quietly acknowledged that it had found no weapons of mass destruction in Iraq.

In 1991, many Americans were amused at the blatant self-delusion of Saddam Hussein and his followers in the first Iraq war. The term “mother of all (fill in any word)” became a popular joke.

By 2003, however, the tables had turned. Although few were initially willing to admit it, many came to realize that in the second Iraq war it was the US government and most of its citizens who were delusional. Apparently, even a democratic country like the US, with its educated populace, independent media, separate judiciary, professional intelligence service, and established tradition of political opposition, is vulnerable to collective self-delusion.<sup>2</sup> George Orwell's comment about war's role in correcting delusion can apply to anyone, not just a people under the heel of a despot.

These contrasting histories of the first and second Iraq wars under the first and second George Bush presidents are a reminder that being selective with the facts cannot be dismissed as a temporary phenomenon

that only began in 2016 with the US election campaign and presidency of Donald Trump. Certainly, many of Trump's followers seem especially prone to ignore or disbelieve inconvenient evidence, preferring to accept his 'fake news' response to media reports of his falsehoods. But were the enthusiastic supporters of the second Iraq war really so different in their eagerness to see a threat, despite independent UN weapons inspectors saying otherwise?

Indeed, to all but the extremely naïve, it should be obvious that we humans have a propensity to delude ourselves and others. And though we can sometimes detect the delusions of others, we're less good at detecting our own, even when faced with contradictory evidence.

But that seems strange. Surely being incorrect about reality is a detriment to survival, and this must have always been the case. Or was it?

My dictionary defines delusion as "believing a falsehood to be true." This sounds like a fault we would want to correct. If we didn't correct it, surely nature would teach us some hard lessons.

Where survival is at stake, evolution would have forced our ancestors to develop critical thinking skills, to be vigilant for evidence that contradicted their beliefs about the real world in order to correct those beliefs. Otherwise, they might believe a shaman who prophesied that the prey they were stalking would migrate in one direction when evidence suggested otherwise. Or, they might succumb to the wishful belief that the neighboring tribe had peaceful intentions despite strong evidence to the contrary.

But as I read further in my dictionary, the story gets complicated. For the word delusion is akin to the word myth, which is defined as "a commonly held view about the world that may lack factual basis or historical accuracy." Anthropologists tell us that myths have played an important role in social evolution. Commonly held views about our origins, and the religious and social rules that govern our obligations to our families and tribes, ensured the social cohesion with which our pre-historic ancestors survived in nature and outcompeted other humans. Myths about the special powers and authority of individuals and groups among us fostered increasingly effective societal coordination and control, whether for making food or making war.

Thus, myths are stories about the world that can bind and strengthen us collectively in our competition with others. We are more likely to believe them when told by people we trust. And the people we trust are more likely to belong to our family or to groups with whose survival interests we most closely associate – whether tribal, ethnic, religious, socio-economic, or national. This combination of trust and shared belief enables people to coordinate their actions to mutual benefit.<sup>3</sup>

Even so, this strength from shared myths does not negate the fact that trusting a deluded leader is risky. Iraqis paid dearly for Saddam Hussein's delusion about the resolve and capability of countries that would oppose his occupation of Kuwait. Americans paid dearly for the second George Bush's delusion about the resolve and capability of groups that would oppose his occupation of Iraq.

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In the 30 years that I have led a graduate seminar in sustainable energy at my university in Vancouver, a mainstay of the first week of class is an exercise in which I ask the students to give their opinion on one of the controversial options to address climate-changing greenhouse gas (GHG) emissions. These options include massive expansion of nuclear power, greater use of biofuels like ethanol, widespread deployment of carbon capture and storage at coal-fired power plants, major development of large hydropower dams, and geoengineering of the earth's climate. Most of the students have strongly negative views of these options, and explain why with detailed, passionate arguments. Being in an environmental program, they usually argue that the only valid options are energy efficiency and renewable energy. And since their views are similar, I watch them nodding in approval as each presents his or her arguments.

Then comes part two of the exercise. I make them reverse their positions. I make them each provide the best possible evidence and argument for an option they don't like.

At least, that's what they're supposed to do. Most of them do a terrible job. They present feeble, easily countered arguments in support of nuclear power, geoengineering, and so on. So I make them do it again. And again. Eventually, some of them progress. Some even embrace the

exercise, keenly probing for the most convincing evidence and arguments in favor of a position they initially opposed.

Others, however, continue to perform poorly. As Chris Mooney noted in a 2011 essay in *Mother Jones*, they can't shift from "thinking like a lawyer to thinking like a scientist."<sup>4</sup> A lawyer is a hired gun, who must focus only on evidence and clever arguments to support the interests of those who hire him or her. In contrast, a scientist can change sides. Indeed, ideal scientists are alert to the best evidence and arguments that counter their current view, and are willing to embrace these. And there is no better way to understand a contrary position than by earnestly presenting it in its best light.

Note that I said 'ideal scientists.' I'm not suggesting all scientists behave this way all the time. But the ideal scientific model is to apply critical skepticism to positions one currently accepts, an open mind to positions one currently rejects, and a willingness to change one's mind after an unbiased assessment of previously unconsidered evidence and arguments. As I tell these graduate students, if they are to do well as academic researchers, they need to be excellent critical thinkers, and they need to apply that talent to their own currently held views.

In my career, I have tried to follow this model. I have pushed myself and research collaborators to know intimately the best evidence and counter-arguments to positions we hold, to even be excited at the prospect of changing our views in the face of new evidence.

This approach has led me to change my mind during the course of my career, sometimes rejecting arguments I once thought irrefutable. One example is the profitability of energy efficiency. In my early days as an academic, I believed we would make money acquiring energy-efficient vehicles, furnaces, appliances, building insulation, light bulbs, industrial equipment, and so on. The higher up-front cost of home insulation, a more efficient furnace, or a high-efficiency light bulb would be compensated by lower energy bills over time. But evidence from leading researchers in top academic journals kept poking holes in this assumption, so I focused my reading on carefully designed research making this case, and even applied some of my research to the topic. Eventually, the evidence compelled me to shift position. For a number of reasons, the unbiased evidence – rather than evidence produced by efficiency

advocates – shows that energy efficiency investments are often far less profitable than they initially appear. Researchers conducting hindsight studies find, for example, that insulating an older house often costs more than expected, while the energy savings are often less than expected. My own experiences over three decades of investing in efficiency in seven different houses, with careful recording of all costs and bill savings, provided supporting anecdotal evidence.

Maybe my position on the profitability of energy efficiency will change again. That would be fine. What matters is that my ideas are consistent with evidence and logic from leading independent research. If not, I should be conducting quality research that slowly compels other researchers to reconsider their views.

Another of my early assumptions was that we were rapidly exhausting our fossil fuel reserves, which would result in continuously rising prices of oil, natural gas, and coal. But contrary evidence undermined that assumption. Leading researchers kept demonstrating that the planet's fossil fuel resources are plentiful, especially if our estimates include unconventional forms of oil and natural gas, such as the huge quantities of these resources contained in shale rocks. And evidence from periods of high fossil fuel prices showed how quickly the improved potential for profits can trigger innovations and intensified exploration that increases global estimates of the reserves that are economical to exploit. Certainly, on a finite planet, fossil fuels are finite. But their exploitable quantity is enormous compared to what humans have thus far consumed. This means that innovations might at any time drive their cost of production, and therefore their price, down rather than up.

The emerging evidence two decades ago on the higher cost of energy efficiency and the abundance of fossil fuels changed my assumptions on these two issues. But some of my other early assumptions about energy have survived because the research of leading scholars continues to support them.

Many researchers, including me, have long shown how we have the technological capability to transform the global energy system to one with much lower GHG emissions. Although some people with a vested interest in the fossil fuel status quo have questioned this finding, researchers continue to demonstrate that at a moderate cost we can

transition the growing global energy system over several decades. This low-GHG energy system would be dominated by renewable energy, likely in combination with some nuclear power as well as natural gas and coal, where these latter two were used with carbon capture and storage technologies.

This transformation is popularly referred to as ‘deep decarbonization,’ since carbon dioxide is the most significant greenhouse gas.<sup>5</sup> Estimates of the cost of this energy transition have changed little since calculations by me and many other researchers decades ago. If realized gradually over several decades, it would cost just a few percentage points of Gross Domestic Product (GDP), which is equivalent to losing one year of economic growth over a 30-year period of sustained growth. This modest cost should be compared to the far greater cost and planetary chaos from instead continuing on our rising GHG path.

We have known this for some time. Ongoing research helps refine the numbers but does not affect the validity of this widely held view of the net benefit of an energy transition that would dramatically reduce GHG emissions. Thus, while climate scientists have long agreed on the fundamentals of GHG emissions and their effects, most energy-climate economists have held fairly similar views on the costs of deep decarbonization of the global energy system. Their views have a somewhat wider range when it comes to the monetary value of the damages from GHG emissions. But that is to be expected, given the difficulty of estimating the probabilities and impacts of catastrophic events (hurricanes, relentless droughts and wildfires, fast melting of permafrost and ice sheets, reversal of ocean currents), likely monetary values for biodiversity losses (such as the extinction of polar bears), and the relative weighting of far-distant versus near-term costs (what economists call ‘the choice of discount rate’).

Given this general consensus among climate scientists and near-consensus among climate-energy economists, our political leaders should have been implementing serious policies at least three decades ago to cause the energy transition, and by now global GHG emissions should be falling. But this did not happen. Instead, while some jurisdictions have recently stabilized and even slowly decreased their emissions, global emissions are still rising.<sup>6</sup> Many researchers now admit it is virtually

impossible to prevent global temperatures from rising by at least 2°C; there is too much inertia in the energy system for the rapid transformation required to stay within this limit.

But why did it come to this? Why were we unable to act on the climate-energy challenge three decades ago? Why are we still not acting today at anywhere near the required effort? And what can we learn about our past failures to rapidly reduce GHG emissions?

The longer I have worked on this issue, the more my focus has been drawn from my traditional field of expertise – the modeling of energy-economy systems – to the disciplines of political science, public policy, behavioral economics, sociology, psychology, and global diplomacy. It seems almost pointless for experts like me to produce yet another study showing how deep decarbonization is achievable and affordable if that finding continues to have negligible effect on the decisions made by individuals, firms, and governments.

I now believe that people with my expertise must learn from these other disciplines so that we might integrate our knowledge of the energy-economy system with their knowledge of how people make personal and collective decisions, including how they respond to challenges to their worldviews. From this perspective, the psychological research on our all-too-human propensity to delude is critical.

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The recent history of the two Iraq–US wars illustrates delusion operating at the level of countries. Sociologists, psychologists, and other social scientists also focus on delusion among individuals and groups. At the individual level, perhaps it's a friend who denies he has a drinking problem, or a relative who ignores her financially ruinous gambling addiction, or neighbors who insist that their son is an angel when he is a well-known bully. We have all encountered someone who refuses to accept an inconvenient truth that is obvious to those around them.

While we want to help people who are seriously deluded, many false personal views are not easily shed. And it can seem like meddling if we challenge the dearly held illusions of our friends, family, and neighbors.

Sometimes, however, we are forced to meddle. If someone's behavior threatens not just themselves, but others, we may have no alternative.



What if the drinker is poisoning his liver, but also jeopardizing innocent people by driving under the influence? What if the gambler is falling deep into debt, but also stealing from you to support her habit? What if the bully's threats, initially verbal, escalate to physical abuse of your children?

In some cases, events force individuals to acknowledge reality. The threat of divorce motivates the drinker to acknowledge his problem and act to save his marriage. Bankruptcy proceedings lead the gambler to admit her addiction and seek help. The bully's suspension from school motivates his parents to address his behavior. Indeed, our societies have developed legal and institutional mechanisms to protect people when the delusions of some could harm others. Drunk driving is illegal. Bankruptcy leads to loss of credit. Physical abuse incurs criminal assault charges.

In the case of individuals, perhaps a trusted friend, relative, or neighbor will intervene before our delusion gets crushed by reality. Because of that trust, we might be willing to listen. But when it comes to groups, the people we trust often harbor the same delusion.

In an oft-cited 1950s psychology experiment, students from two Ivy League schools, Dartmouth and Princeton, were separately shown the film of a previous game between their football teams.<sup>7</sup> This had been a controversial match, after which the Princeton team had accused Dartmouth of numerous flagrant fouls. But when each movie viewer was asked to record the number of Dartmouth fouls, Dartmouth students noticed only half as many as Princeton students. Depending on their group allegiance, the students saw different realities.

According to Yale professor Dan Kahan, who today conducts similar experiments, 'group ties' are responsible.<sup>8</sup> Just as our perception of reality is biased by our individual self-interest, so too is that perception biased by our group self-interest. In the football game, the students' school loyalty led to a cognitive bias toward evidence that supported the self-interests of their school. And this bias existed not just during the intense emotions of watching the game live in the stadium, but also in the dispassionate setting of a film screening room months later. And it didn't matter that these students attended elite institutions with reputations for promoting objectivity.

Watch any sporting event, professional or amateur, and you will see ample evidence of group cognitive bias. Fortunately, with sports the stakes are not high – although don't try saying that to the parents screaming at the umpire of a Little League baseball game. Unfortunately, group cognitive bias is strongly evident even when the stakes are high.

During his presidential campaign, many of Donald Trump's unfounded claims in speeches and on Twitter presented a textbook case of cognitive bias. He treated as factual unfounded insinuations about his political opponents, whether it was the true birthplace of Barack Obama or the US security threat from Hillary Clinton's use of a private e-mail server. What is interesting from the perspective of group delusion, however, is the striking difference in how those who voted for and against Trump dealt with evidence about him. He promised transparent and corruption-free government yet would not disclose his income taxes. He said he respected women, yet a video of his confidential comments and testimonials from several women indicated the opposite. He claimed he was an honest and sincere person, yet repeatedly made statements that were blatantly false.

Opponents of Trump have a long list of these indictments. Yet almost half of American voters opted for Trump on election day. When pollsters asked why, some explained that they didn't trust Hillary Clinton, so Trump was the lesser of two evils. But many of his supporters said they could not believe bad news about him once they had decided that, as the Republican nominee, he best represented their interests and views. Getting specific facts right didn't matter.

Salena Zito, writing in 2016 in the *Atlantic Monthly*, noted that "Trump's supporters took him seriously but not literally, while the press (and his opponents) took him literally, but not seriously."<sup>9</sup> In other words, the people who ultimately supported Trump came to feel he was more likely than Hillary Clinton to be a member of their group, more likely to be someone who shared their values, faith, views on government, and aspirations for resurrecting American dominance of the world's economy and politics. And, as they came

to recognize their group affiliation with Trump, these supporters took his intentions seriously, while becoming selective and dismissive of negative evidence about him. This was easier when one's friends and fellow supporters did the same. And with today's ideologically segregated media and the echo-chamber effect of social media, it was easy for his supporters to downplay and avoid evidence about Trump. Members of the group reinforced each other's cognitive biases.

But while Trump's supporters provide an obvious example, it would be a mistake to think that only one side in the US election campaign was prone to self-delusion. Hillary Clinton's supporters had theirs, as did supporters of her Democratic rival Bernie Sanders. Many of his supporters believed that, if elected president, he would be able to implement left-of-center policies, like tuition-free university, nationalized universal health care, and massive tax increases on the wealthy, in spite of the need to garner majority support for such policies from senators and representatives with far different views.

Such manifestations of group cognitive bias in the US 2016 election should not come as a surprise. The election might have been more extreme than usual in US politics (who knows what the future holds?), but the phenomenon is ubiquitous. In politics and elsewhere we favor evidence and arguments that are consistent with the worldview, self-interest and convenience of groups with which we identify, and we put greater trust in people who have a similar worldview and interests.

But being too far out of sync with reality, whether as individuals, countries, or groups, is risky. For, like Saddam Hussein and the second George Bush, we may one day bump up against that reality, causing great harm to ourselves and others. In the case of GHG emissions and climate change, the independent experts agree, and have agreed for a long time, that the reality we are heading toward is an increasingly harsh one of heat waves, hurricanes, floods, forest fires, rising sea levels, species extinctions, acidifying oceans, and mass migrations of people fleeing devastated areas.



"Thankfully, doctor, I don't suffer from delusion."

Figure 1.1 Cartoon by Jacob Fox

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In 2005, I published a book that summarized the state of research about our energy system and its environmental impacts. I titled the book *Sustainable Fossil Fuels: The Unusual Suspect in the Quest for Clean and Enduring Energy*.<sup>10</sup> I chose this provocative title in hopes that it might stir experts and non-experts to reconsider some of their firmly held beliefs about energy and the climate change threat.

I was already familiar with our human propensity to delude. After all, by 2005 I had been advising governments for over a decade on climate-energy policy. I had seen the challenges for climate-sincere politicians when it came to implementing policies that would reduce our reliance on burning fossil fuels. Nonetheless, I was still surprised at the book's reception from some people. On the one hand, many leading scholars endorsed the book. On the other, the reaction of some people revealed our ability to be selective with evidence.

Those who want to believe that climate change is not caused by humans quickly dismissed my recap of the leading climate science.

Many of the same people, however, accepted my summary of the research confirming that fossil fuels are plentiful. The latter was consistent with their preferences; the former was not.

Those who want to believe we will soon exhaust fossil fuels rejected the research from leading academics showing the abundance of these resources. (When I published the book, the 'peak oil' myth was popular, as it tends to be when oil prices are high.) Yet many of the same people were favorable to my evidence showing we can reduce GHG emissions at a reasonable cost.

Those holding the simplistic view that fossil fuels are evil and renewables good were unwilling to accept evidence that in some locations it might be cheaper and even better for the environment to continue using fossil fuels, albeit while capturing and storing most of the carbon emissions. But they readily accepted the evidence showing that renewables could one day, if we so desired, replace all uses of fossil fuels at an acceptable cost.

As I noted above, these selective interpretations of the book's evidence in conjunction with my growing experience as a climate-energy policy advisor in several jurisdictions gradually shifted my interest from the technical and economic analysis of our energy options to the political, psychological, and sociological challenges of the much-needed energy transition. A special motivator was the ongoing failure of most jurisdictions to implement effective policies, even when experts agreed on the best policies.

My reading of the research was reinforced by these years of real-world personal experiences of policy and political frustrations. As early as 1989, as a novice professor, I was sent by the Canadian government to an expert meeting at the International Energy Agency in Paris to discuss policy options for GHG reduction. We participants were mostly energy economists. We easily agreed that the governments of industrialized countries should immediately implement modest, gradually rising carbon taxes. I helped get the word back to my government. In response, it said the right things, but ultimately didn't act.

From 1992 to 1997, I served as chair of my province's energy regulatory agency, the British Columbia Utilities Commission. In that role, I learned about the challenges of motivating energy utilities to

implement energy efficiency and energy substitution programs to reduce GHG emissions. I also served on the Intergovernmental Panel on Climate Change (IPCC), working with other academics to propose and assess climate-energy policies. The disconnect was striking between our policy prognoses in the IPCC reports and what most governments were willing to do. Their initiatives were usually confined to non-compulsory policies, like information programs and subsidies, with negligible effect on fossil fuel burning, and thus GHG emissions.

After Canada signed the Kyoto Protocol in 1997, the university research team I direct was selected by the Canadian government to do the modeling of alternative policy portfolios in a major national policy design process. Later, the government ignored the policy proposals issuing from this multi-year negotiation, and instead trotted out a long list of ineffective policies. In frustration, I co-authored a couple of additional books in the 2000s. *The Cost of Climate Policy* explained the compulsory policies the Canadian government should have implemented to reach its Kyoto commitment.<sup>11</sup> *Hot Air* explored the real-world political calculations behind the government's failure to implement effective climate-energy policies. It helped that one of my co-authors was Jeffrey Simpson, Canada's leading political columnist at the time.<sup>12</sup>

Societal interest in climate change is cyclical, thus so too is political interest. In the period between Hurricane Katrina in 2005 and the global financial crisis in 2008, climate change was a major concern in industrialized countries and increasingly the rest of the world. Al Gore's book and movie, *An Inconvenient Truth*<sup>13</sup> appeared in 2006, as did Nicholas Stern's high-profile report for the UK government, *The Economics of Climate Change*.<sup>14</sup>

As a non-partisan advisor to several Canadian political leaders (our federal government, ten provincial governments, and three territorial governments all expressed interest in GHG reduction), I again experienced first-hand the challenge of enacting policies to cause a major energy transition. I helped design British Columbia's carbon tax of 2007, quickly recognized as the leading climate policy in North America. But during the exhausting and frustrating period of defending the tax against severe misinformation campaigns, I learned the

importance of understanding the myths that can confound and defeat the efforts of sincere politicians.

I needed no more hard lessons in real-world policy-making. Unfortunately, it seems that others did. When Stephane Dion, the leader of Canada's federal Liberal party, contemplated a national carbon tax as the central plank of his 2009 election platform, he first asked my advice. In suggesting he consider less politically risky policies, such as the regulations being adopted in California at the time, I said "while the carbon tax might be good policy, it doesn't appear to be good politics." He responded with "I think good policy *is* good politics!" I seem to recall mumbling, "We live on different planets," but perhaps I said that to myself on the bus ride home.

It was obvious to me that his carbon tax proposal would cost him the election, which it did. Prime Minister Stephen Harper, leader of the Conservative Party, focused his campaign on saving Canadians from "job-killing carbon taxes." His victory helped sustain almost a decade of faking-it federal climate policies, along with the aggressive GHG-increasing development of Alberta's oil sands. Thanks to Dion's carbon tax campaign, Canada's emissions went up rather than down.

There is a saying that we should not let perfection be the enemy of good. The carbon tax is, from an economic efficiency perspective, the perfect policy, which is why lots of people, especially economists, keep saying *we must price carbon emissions*. But this statement is factually incorrect; even 100% decarbonization can be achieved by regulations alone. And, in the real world of politics and policy, the selection of GHG-reducing policies involves a trade-off between cost-effectiveness and the likelihood of implementation. Single-mindedly pursue carbon pricing and we could end up with nothing, which is exactly what happened in Canada in the 2000s. I have used this experience, and observations from policy struggles in Australia, France, the US, and other countries, to motivate my research into the trade-offs between academically ideal policies and politically achievable policies. If the latter get implemented and the former don't, which are the better climate-energy policies?

As a university student, I witnessed steady progress in addressing several energy-related environmental challenges, including smog, acid rain, and lead emissions. Early in my academic career, I assumed we

would soon achieve similar success with GHG emissions. At one time, I even wondered if we might solve the climate threat too quickly for my intended career as a sustainable energy economist. How's that for delusional thinking?

Instead, the climate-energy issue has emerged as the 'mother of all environmental challenges.' We may reduce other emissions and effluents, restore wetlands, preserve soils, protect threatened ecosystems, but all of this environmental progress will be fruitless if we don't also dramatically reduce GHG emissions, because these impact *everything*. Each decade a new multi-country agreement raises hopes of a serious global effort, only to prove ineffective with the passage of time. In the Toronto agreement of 1988, G7 countries committed to reducing their GHG emissions, but afterwards failed to implement the necessary policies. In the Kyoto Protocol of 1997, all industrialized countries promised to reduce their emissions, but in the ensuing decade the US withdrew and other countries like Canada failed to implement effective policies. In the Copenhagen commitment of 2009, industrialized countries set 2050 targets as a face-saving gesture, after failing to achieve a global agreement requiring immediate action.

A fully global agreement was finally signed in Paris in 2015, but this was only possible by allowing each country to set its own emissions targets, which collectively are far too high for the 2 degrees Celsius limit, and by again avoiding a mandatory compliance mechanism.<sup>15</sup> In sum, after three decades of acknowledged concern by world political leaders, the global effort to reduce GHG emissions is still feeble and sporadic, while fossil fuel-based economic growth, especially in the developing world, increases emissions. Initially, the seemingly achievable goal was to prevent any temperature increase beyond what had happened since the start of industrialization around 1800. But with no action and increasing emissions, the goal has shifted to preventing more than a 2°C increase by 2100, which itself is seriously in doubt.

Our inability to reverse the upward trajectory of GHG emissions is explained in the first instance by our lack of a global governance system combined with the long-standing assumption in international negotiations that voluntarily *all countries will agree on climate fairness*. And while we wait for this impossible agreement to materialize, the effect on national



governments is paralyzing. Since none can solve the problem on their own, there are strong incentives to delay a serious effort.

And if climate-sincere politicians in individual jurisdictions wish to show global climate-energy leadership, they must overcome conscious and unconscious myths that hinder their efforts. People who feel committed to fossil fuels, whether for financial benefit or fear of wasteful government policies, deny or obfuscate the climate science, and some of them foster the outlandish claim that *climate scientists are conspirators*. Even people who accept climate science may advance deliberate or inadvertent myths that delay national efforts. Those whose wealth or income is still tied to fossil fuels justify ongoing expansion by fabricating the myth that *this fossil fuel project is essential*—claiming that we must have its jobs and tax revenues, while its share of global emissions is inconsequential. Other people, ignoring the huge quantities of oil in the earth's crust, worry that oil depletion is an imminent threat to sustainability. But the myth that *peak oil will get us first anyway* only helps fossil fuel interests convince governments that regulatory and carbon pricing policies are not needed, since GHG emissions will soon decline as we exhaust fossil fuels.

People who sincerely want rapid decarbonization are also not free of myths that can hinder progress. Those who believe *we must change our behavior* make the solution more difficult than it is by suggesting that climate success requires everyone to live as transit-riding, airplane-avoiding vegetarians. Others believe that instead of changing behavior *we can be carbon neutral* by buying offsets as we continue to drive in cars, fly in planes, eat meat, and so on. Unfortunately, the evidence is clear that many offsets don't reduce GHG emissions.

Some people argue that *energy efficiency is profitable*, because the extra costs of the most efficient appliances, vehicles, buildings, and equipment is repaid many times over from energy bill savings. Unfortunately, independent research shows this to rarely be true. This wishful thinking bias seems innocent enough, but it inadvertently reduces the pressure on politicians to enact regulations and carbon pricing. If firms and households save money by making energy efficiency investments that also reduce GHG emissions, there is no compelling argument for stringent climate-energy policies.

A similar problem arises from the belief that the costs of solar, wind, and other low-emission energy sources have fallen below that of fossil fuels, suggesting to some people that *renewables have won* the economic contest. Unfortunately, this too is a myth. While the costs of some renewables like solar and wind have fallen dramatically in the past two decades, which is a wonderful development, fossil fuels are still the best option for developing countries to access energy and this won't change any time soon. Renewable advocates and hopeful environmentalists must not allow their wishful thinking bias to inadvertently enable procrastinating politicians to argue that market forces will inevitably reduce GHG emissions because a field of solar panels is cheaper than a coal plant. The accurate and essential message is that renewables, and other zero-emission options like nuclear, won't outcompete fossil fuels until governments regulate or price carbon emissions.

These beliefs that I presented in italics in the above paragraphs, and which are the titles of this book's chapters, are the most salient myths that hinder our progress on climate. Unfortunately, our ongoing failure on the climate-energy challenge has provided the opportunity for many other people to attach additional myths. One prominent example is the belief that *we must abolish capitalism* for climate success. But there are many others.

Trying to make sense of this cacophony of barriers, distractions, and seemingly essential solutions is a nightmare for the climate-concerned citizen. They hear about breakthrough global agreements to save the planet. But in the succeeding months and years they see these agreements unravel while emissions keep rising.

They elect politicians who profess sincerity. But eventually the media confirms their suspicions that little is happening. Even the sincere politicians seem constrained by powerful corporate interests fighting to sustain fossil fuels until the next political or economic crisis shifts everyone's attention, and the climate-energy effort once again dissipates.

They hear inspiring accounts of people taking individual initiatives – abstaining from driving, flying, eating meat, using plastics. But eventually they notice that these people remain a small minority, with little effect on a global problem whose solution requires transformation of the entire

global energy system, and a set of compulsory policies in every country to cause the essential decarbonization.

The concerned citizen wants effective action from the global community and their own government, and they want to act now along with fellow citizens. But how do they make governments act effectively? And what can they do individually?

I wrote *The Citizen's Guide to Climate Success* to answer these questions.

By presenting the key takeaways from three decades of experiences and social science research, and by identifying and separating deliberate and inadvertent myths from the evidence on which most leading researchers can agree, my goal is to help concerned citizens become effective as change agents in the face of our daunting climate-energy challenge, strategically recognizing the few tasks on which we must focus our efforts.

I conclude this opening chapter with a synopsis of the book's evidence and arguments. The titles of Chapters 3 through 12 are statements reflecting beliefs that are widely held, but range from blatantly wrong to questionable, once we probe the evidence. Some of these, like the idea that climate scientists are conspirators, are the fabrication of powerful economic interests trying to slow humanity's response to the climate threat in order to continue earning personal wealth from fossil fuels. Some are beliefs of sincere climate-concerned people, like the assumption that renewables are cheaper than fossil fuels, that may inadvertently retard our efforts to reduce GHG emissions. Fortunately, the challenge is simpler than most people realize. We need to quickly decarbonize a few key sectors of our economy, and there are only a couple of policies that can do that. We need to make sure that our politicians understand that a global effort requires realism about international politics, and always act on this understanding. We need to strategically focus ourselves, our friends, our fellow citizens, and our political leaders on these few sectors, actions, domestic policies, and international mechanisms on *the simple path to success with our climate-energy challenge*.

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The combustion of fossil fuels is the primary cause of rising global GHG emissions. Because the global energy system is more than 80%

dominated by fossil fuels, the transformation to reduce emissions is a major undertaking. It is especially challenging because fossil fuels are wonderful sources of energy that have provided great benefits to humanity over the last two centuries, and still do. The rapid improvement in human material well-being in China from 1985 to 2015 is the latest testament to how fossil fuels can enable a tremendous increase in human welfare, albeit while also rapidly increasing GHG emissions. And because fossil fuels are the incumbent energy source in our global energy system, many people associate their personal self-interest either with the fossil fuel supply industry or with the consumption of fossil fuels, as coal in their power plants, gasoline in their cars, and natural gas in their homes. These people have difficulty accepting the idea that we must quickly phase out fossil fuel extraction and the technologies that combust fossil fuels, and some have worked hard to prevent or slow this development by deluding themselves and others about the problem and its possible solutions.

The reduction of GHG emissions is a 'global collective action problem' in that all countries must act together for success. Otherwise, the GHG reduction efforts of some countries will be defeated by increasing emissions from other countries that continue to benefit from developing and consuming fossil fuels. Because we do not have a global government, we must agree on effective global mechanisms that incentivize and enforce the GHG-reducing efforts of all countries. Unfortunately, the global community of nations has had only limited success in developing such mechanisms.

One success was the voluntary global agreement, the Montreal Protocol of 1987, that quickly phased-out emissions of chemicals that were destroying the ozone layer. For some, this agreement is a sign for optimism for negotiating a voluntary global agreement on GHG emissions.

However, the dominance of fossil fuels in the global energy system, and the enormous benefits they provide, make GHG reduction a challenge of far greater magnitude. In particular, the interests of different countries diverge dramatically. Some countries that are endowed with valuable fossil fuel reserves are less enthusiastic about a global agreement, and some are downright obstructionist. Most

poorer countries, even if they have no fossil fuels, are not willing to forgo the economic development benefits of importing and consuming fossil fuels, just as China did, unless wealthier countries will help them with the higher costs of restricting themselves to low-emission energy alternatives.

Yet, in spite of these strong incentives against an effective global agreement, and 30 years of demonstrated failure, international negotiations are still dominated by the assumption that countries will somehow agree *voluntarily* on a fair allocation of the burden. This assumption must change, but this requires individual countries to accept sooner rather than later the role that unilaterally imposed carbon tariffs must play in assembling a true global effort.

These two constraints – the global dominance of fossil fuels as a valuable commodity and the global governance nature of the GHG reduction challenge – make it extremely difficult to motivate effective domestic GHG-reducing efforts by national and sub-national levels of government. If one government alone forces its industries to reduce emissions, these will accuse it of foolishly destroying the domestic economy for no global benefit, since competing industries in laggard countries will gain market share, the result being a loss of jobs and wealth with no net reduction in global emissions. In fossil fuel endowed countries, the same argument applies. Why constrain one's extraction and export of coal, oil, or gas if this domestic restriction will inevitably be offset by expanded fossil fuel production elsewhere?

These constraints help explain the wide gap between the promises of national political leaders when making long-term GHG commitments, and their short-term enactment of feeble policies with negligible effect. If individual governments are to make headway, they must realize, as some now are, that their domestic decarbonization efforts should focus on sectors of their economy and energy systems that are less vulnerable to international competition. Significantly decarbonizing the electricity system and energy used in transportation, buildings, and low energy-intensity economic sectors, including agriculture and forestry, is possible without detrimentally affecting the competitive position of most countries. Electricity and transportation stand out because these two sectors

count for more than 50% of expected global emissions growth over the next two decades, with most of this occurring in developing countries.

And when climate-leading countries finally recognize the necessity of carbon tariffs, they should join forces with like-minded countries to form 'climate clubs' that establish consistent carbon tariffs on the imports from laggard countries. This will incentivize these latter to take their own domestic GHG-reducing actions to avoid the imposition of tariffs. This hard-nosed approach to GHG emissions offers the best prospects for finally forging an effective global climate effort.

It also improves the prospects for aggressive domestic action. It is easier to convince people to support such actions in one jurisdiction when they can see that their efforts are not futile, but instead part of a successful global strategy to address the global collective action problem.

Unfortunately, our prolonged failure in implementing a successful global strategy has bought time for defenders of the fossil fuel status quo to hone their techniques for deluding people that the climate science is still uncertain or that this particular fossil fuel project is essential or that policies are unnecessary because we'll soon run out of fossil fuels thanks to peak oil.

Faced with this desperate situation, the citizen has two options. One is to avoid thinking about climate change. Since one person is powerless in the face of such an enormous problem, it does no good to keep worrying about it. Understandably, many people have consciously or unconsciously taken this approach.

The other option is to think strategically about how to apply one's efforts to greatest effect. This book is for these people. Drawing on leading independent research, I provide guidance for citizens seeking to act more effectively as consumers, neighbors, investors, participants in social and conventional media, voters, and political and social activists. We must improve at distinguishing efforts that are strategically effective from the many distractions that reduce our chance of success. If, for example, we are personally focused on energy efficiency or behavioral change or carbon neutrality, we need to incorporate lessons from leading research to guide us in integrating these efforts with strategic political pressure to attain climate-energy policies that will amplify our efforts. We

need to understand which policies and individual actions are more effective and, of these, which have a better chance at political acceptance and collective success.

Citizens should understand that while the situation is dire, it is not hopeless. Several converging developments may soon help humanity reach a tipping point beyond which our global deep decarbonization efforts will accelerate. One of these developments, albeit not a happy one, is that GHG impacts are intensifying, making it increasingly difficult to delude people about the climate science. Scientists predicted rising temperatures and an increasing intensity and quantity of hurricanes, droughts, wildfires, heat waves, and other extreme events, and these are now appearing on cue. Just like the previous shift in public beliefs about the cancer threat from smoking, several decades of evidence are gradually shifting public views, and thus the public's readiness to accept more serious government efforts to cause an energy transition.

Another encouraging development is the falling cost of key low-emission alternatives to burning fossil fuels. Electricity from wind power and solar power, when matched with reliable backup such as natural gas turbines, pumped hydro, or batteries, costs much less than just a decade ago, and costs are still falling. As several jurisdictions are demonstrating, rapid reduction in GHG emissions in the electricity sector can be achieved without dramatic increases in electricity prices – a possibility that seemed fanciful just two decades ago. Likewise, electric vehicles are now rapidly penetrating the market, allowing leading jurisdictions to target the complete phase-out of gasoline vehicle sales within a decade. Electric cars still cost more to purchase, but their operating costs can be one quarter that of an equivalent gasoline or diesel vehicle. And their initially high purchase price is rapidly falling.

A third positive development is the growing recognition in developing countries of the co-benefits of deep decarbonization, especially in the electricity and transportation sectors. The choking smog caused in large part by coal-fired power plants and fuel-burning vehicles threatens the health of urban elites in developing countries. National political leaders in capital cities like Beijing, Delhi, Jakarta, and Mexico City are concerned about the impacts of urban air pollution on their fellow citizens and their own families, and are starting to pursue energy transformation

without waiting for financial support from wealthier countries. With a strong set of policies, China now leads the world in generating electricity from wind and solar and in the production and consumption of electric cars. The benefit from decarbonizing electricity generation and urban transportation presents an attractive model for all developing countries, even if they do not yet feel financially able to pursue GHG reduction as a stand-alone objective.

A decade ago, middle-class citizens, whether in well-off or less well-off countries, were severely limited in their ability to voluntarily reduce their individual emissions. Since the energy system was completely structured around fossil fuels, they would have had to stop using electricity, stop driving, and stop heating and cooling their homes to reduce emissions. Today, however, electricity generation emissions in most developed countries are falling as the output of coal-fired power plants declines, which in turn dramatically increases the GHG impact of switching from a gasoline to an electric car, and from switching to electric heating and cooling. These changes are not always cheap. But they are also not exorbitant, increasing the cost of household energy services by 5 to 15% in a typical jurisdiction. And since energy services normally account for only 5 to 8% of typical household budgets in developed countries, and in the middle-class urban areas of developing countries, this is a small cost to prevent climate change. Thus, anyone with a middle-class income can today become zero-emission in their home energy use and personal mobility. Imagine the effect as more people pursue this path and demonstrate for neighbors, friends, and family the ease of achieving zero-emission daily living through their technological choices.

As individual consumers, we still have no way to avoid the fossil fuels used by airplanes, steel plants, cement plants, and plastic manufacturers. But as we decarbonize electricity, transportation, and buildings, the pressure on these other sectors intensifies. Yes, policy implementation is more difficult in these sectors because of their exposure to international competition. But we now have commercialized bio-jet fuels, steel plants that can include carbon capture and storage, and cement plants that can use biofuels and bio-rich municipal solid wastes while capturing and storing their process emissions. In all cases, the cost of near-zero-emission plane travel and producing commodities like steel, plastic, and



cement would increase, but not enough to significantly increase the cost of final manufactured goods, like houses, cars, wind turbines, and solar panels.

Thus, we can now take actions as consumers that directly reduce emissions from our homes and vehicles, and this increases the chance that our friends, family, and neighbors will follow our lead. We can also be more focused in our social, political, and civil efforts by distinguishing faking-it policies from real policies. We now know that politicians in well-off countries should have already implemented regulations that phase out coal plants and required their replacement by low-GHG electricity generating alternatives, mostly renewables. We now know that these politicians must immediately implement carbon pricing or regulations that phase out gasoline and diesel in transportation, triggering the wholesale shift to electric, hydrogen, and biofuel vehicles. We also know that domestic efforts to decarbonize electricity and transportation must be combined with international efforts to develop carbon tariffs with other climate-leading countries. Otherwise, our domestic efforts will be inconsequential against a global challenge, and opponents of GHG reduction are experts at convincing many people of this futility.

The good news, if we can call it that, is that effective actions and policies are easier to detect because, as the situation becomes urgent, we know they must cause a clear and rapid decarbonization of electricity and transport. Actions and policies that are tangential or even working at cross-purposes should be viewed with skepticism.

But my goal is not to convince people to abandon strategies they support in the decarbonization effort. Rather, I suggest how they might integrate their advocacy of behavioral change, carbon neutrality, energy efficiency, renewable energy, and political change, with the few key actions and policies that are essential for the energy transition. Challenging people's perceptions and priorities is never easy. My hope is that by showing what leading scholars agree on, I might nudge people toward a more effective individual and collective effort by integrating their pursuits with those that are clearly essential. And by being more open to options they had previously rejected for some reason.

Thus, I challenge readers in the same way that I challenge the new graduate students each year in my sustainable energy course. If you have

firm views on some aspect of the climate threat, I ask you to find the best possible counter-arguments to your view. If you believe that nuclear power must be phased out, force yourself to develop an argument that nuclear power could be sustained where plants already exist, and perhaps in other jurisdictions, especially if safer technologies and radioactive waste disposal are developed. If you believe nuclear power must be expanded, ask yourself why that might not be necessary, and why it will be so difficult to convince a sufficient number of people to support the location of new nuclear plants near their homes.

If you believe no amount of biofuels should be allowed because this option would inevitably destroy rainforests and raise food prices, force yourself to design a regulatory regime in which some amount of biofuels could be produced in environmentally benign methods to replace only a segment of oil demand, such as jet fuel or diesel for long-distance trucking. If you are certain that energy efficiency is important, challenge yourself to think about how a singular policy focus on energy efficiency is endorsed by the fossil fuel industry if this helps delay implementation of the essential fuel-switching policies. And if you believe that carbon pricing is essential, force yourself to argue for equally effective policies that have a greater chance of political success in the drive to deep decarbonization.

The goal of this exercise in critical thinking and reverse argumentation is not to cause people to completely abandon their beliefs and strategies. Rather, the exercise is of value if it prompts some to explore ways of integrating their favored action or action-motivating policy with that small subset of actions and policies that is absolutely essential. The text box summarizes these essential elements of the path to success with the climate-energy challenge.

Decarbonizing the global energy system is a global collective action problem, but humanity lacks global governance mechanisms for allocating costs among countries and enforcing universal compliance.

A 'voluntary' global agreement is unattainable because country interests differ greatly.

1. Poorer countries want substantial support to forgo fossil fuels in favor of low-emission energy, which wealthier countries will only partly provide.
2. Fossil fuel-rich jurisdictions are resistant to rapid decarbonization.

The simple path to climate success requires leader countries to pursue three strategies.

1. Apply regulations and/or carbon pricing to decarbonize domestic electricity and transportation, and work with other leader countries to globalize this effort.
2. Apply carbon tariffs on imports from climate-laggard countries and work with other leader countries to form climate clubs that globalize this effort.
3. Assist poorer countries in adopting low-emission energy, especially where this meets air quality and other co-benefit objectives.

Citizens must focus their governments on the strategic path, which requires overcoming deliberate and inadvertent myths that deflect us from these strategies.

This task of focusing our political leaders on the simple path sounds simple. But it isn't. The lack of global governance, the delusional tactics of vested interests, and our widespread propensity for wishful thinking combine to produce climate-insincere governments. This leads to the critical question: What should climate-concerned citizens do when their compatriots elect such governments?

The range of options for the concerned citizen is wider than most people are willing to consider. But if ever there was a time to recognize the full extent of that range, this is it. Thus, if unwilling or insincere politicians succeed electorally in a given jurisdiction, concerned individuals and groups should be willing to frequently, loudly, and non-violently express the strength of their conviction about the need to address this threat. Demonstrations and other acts of civil expression,

perhaps even passive civil disobedience, may be required. Citizens concerned about the climate-energy threat need to understand the instrumental role that a relatively small number of committed people can play in driving change. As Margaret Mead is purported to have said, “Never doubt that a small group of thoughtful, committed citizens can change the world. Indeed, it’s the only thing that ever has.”<sup>16</sup>

We have to be honest with ourselves about our responsibilities with this daunting global challenge. For if we cannot quickly focus on this strategic path, including on our efforts as individual and groups of citizens, we are, as George Orwell might have suggested, destined to bump up against hard reality – on a planet that looks increasingly like a battlefield.