

CHAPTER 13

The Simple Path to Success with Our Climate-Energy Challenge

I say the debate is over. We know the science. We see the threat. The time for action is now.

Arnold Schwarzenegger

 ON AUGUST 6, 2003, ON JAY LENO'S TONIGHT SHOW, ARNOLD Schwarzenegger announced his decision to run for governor of California. Later, in a public interview, he explained how he made such a momentous decision during his trip to Leno's TV studio.

I thought this will freak everyone out. It will be *so* funny. I'll announce that I am running. I told Leno I was running. And two months later I was governor. What the fuck is that? . . . It was the most difficult decision in my entire life – except in 1978 when I decided to get a bikini wax.¹

Whatever your feelings about The Governator or The Terminator or Mr. Universe, you have to marvel at Arnold's multiple A-list lives. Born in a small town in Austria, he dreamed of playing professional soccer, but was more likely destined for a tradesman's life, as his mother hoped. Instead, his exceptional drive meshed with a teenage interest in bodybuilding, and as a 20-year-old in 1967 he overcame enormous odds to capture his first Mr. Universe title, becoming world famous overnight. A great plot for one of those overcoming-the-odds Hollywood movies.

But realizing a Hollywood-style achievement was not enough for Arnold. Why not *become* a Hollywood movie star? Although his initial movie roles, including the *Terminator*, were fodder for acting critics, he again beat the odds. Decent performances in more challenging roles, like

Junior, earned him grudging respect as an actor, and a lot of money. After marrying Maria Shriver of the Kennedy clan, the Austrian hulk with the excruciating accent was now entrenched among America's rich and famous. Again, a great Hollywood plot. Again, not enough for Arnold.

To those fixated on politics, his decision to enter their arena produced derision and despair. Surely he would flop as governor, making a laughing stock of California in the process. Surely he would achieve nothing of lasting significance. As a Republican, though married into an iconic Democratic family, Schwarzenegger's prior political commentary followed the standard conservative line. "Government should reduce taxes, cut red tape. Environmentalists exaggerate, as do advocates for the poor and the disadvantaged. People should pull up their socks, unfetter the market, and let American ingenuity improve lives."

Schwarzenegger stuck to this script for his first two years as governor. With California's finances in trouble, he played the typical Republican governor, focused on spending cuts. Then the world changed. Hurricane Katrina struck in August 2005 and, along with other developments, created a policy window for serious climate-energy initiatives. Depending on various factors, politicians of similar political views may react quite differently. Some may show leadership. Some may appear concerned, but instead delay, waiting for the policy window to close.

No delay for Schwarzenegger. He was keenly interested in the claims of scientists, and once convinced the threat was real, morphed into the action hero for global warming commitment, becoming the overnight darling of environmentalists and Hollywood celebrities. The Democrat-dominated California legislature shared his concern. But he made global warming *his* issue, associated with his striking image and personality.

In the fall of 2006, Schwarzenegger signed the *Global Warming Solutions Act*.² This directed the California Air Resources Board, an arms-length regulatory agency, to consult interest groups, experts, and the public in developing a plan to reduce California's carbon pollution back to its 1990 level by 2020 – a 30% reduction from where emissions would otherwise be.

California has long relied on its air resources board to implement environmental policy, starting with its multi-decade battle with Los Angeles' infamous smog in the late 1960s. Like other non-legislative

bodies, the air resources board lacks authority to tax carbon. But, as I described in Chapter 6, it can price it indirectly by implementing cap-and-trade, which it did in 2012, and can implement prescriptive and flexible regulations on different forms of energy, with its low carbon fuel standard, and on technologies, with its low- and zero-emission vehicle standards. In addition, the California Public Utilities Commission, which regulates electric utilities, controls the state's renewable portfolio standard, and the California Energy Commission implements regulations and incentive programs to increase energy efficiency as well as mandating technologies like rooftop photovoltaic panels.

The climate policy window closed in 2008. The global financial and economic meltdown took care of that. And in 2011 Schwarzenegger's term ended. Yet, even without its climate commander, California has soldiered on. Jerry Brown replaced Schwarzenegger as governor, showing the same climate concern and policy determination during his two terms. His replacement in 2018, Gavin Newsome, shares his priorities. Independent analysts say that California, one of the world's largest economies, is still on track with its ambitious emission targets for 2030 and 2050. While the climate efforts of many jurisdictions have waxed and waned, California's has been steadfast.

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Deep decarbonization is a global collective action problem. Over the next decades, we need wealthier countries to rapidly decarbonize and developing countries to slow and then reverse the growth of their emissions. For this, we must have an international enforcement mechanism, probably carbon tariffs, to ensure that politicians in individual countries cannot win elections by promising to abandon their countries' efforts and free-ride on the efforts of other countries. Without such a mechanism, global decarbonization won't happen.

Since this mechanism is unlikely to result from consensus-based international negotiations, its emergence depends on leadership by a group of motivated countries – a climate club – that implement domestic decarbonization policies and together establish a system of carbon tariffs. Ideally, wealthier countries would transfer revenue from their tariffs to support adoption of low-GHG technologies in developing countries, but

we can't bank on an increase in international generosity from the voters of wealthier countries.

Yet for almost three decades, international negotiators have pursued a voluntary agreement in which all countries agree on their reductions, and on the financial and technological transfers from wealthier to poorer countries. This approach's continued failure will most negatively impact the poorest people in the poorest countries. They and their governments are least able to withstand increasing droughts, wildfires, floods, diseases, crop failures, hurricanes, heat waves, ocean acidification, and sea-level rise. An intensifying global crisis, including mass migrations of climate refugees, awaits us if we cannot quickly replace international wishful thinking with international *realpolitik*. An enduring global effort is unachievable without enforcement mechanisms that will be objectionable to some countries, at least initially.

Politicians showing leadership in their own jurisdictions must also replace domestic wishful thinking with domestic *realpolitik*. They must understand that explicit carbon pricing favored by economists will rarely play the lead role in energy system transformation. Politicians who promote carbon pricing as lead policy are an easy target for opponents who deceive voters by promising lower gasoline and electricity prices and magically reduced GHG emissions.

Fortunately, carbon pricing is not essential for deep decarbonization. While many jurisdictions have carbon pricing, it is never used as lead policy. Instead, climate-sincere jurisdictions usually combine modest carbon prices with flexible regulations, prescriptive regulations, and subsidies. If designed well, these policy packages offer flexibility for consumers and producers, which reduces their economic efficiency disadvantage relative to pure carbon pricing.

When viewed from the perspective of political acceptability, flex-regs outperform carbon pricing, especially in the early stages of the energy transformation. But even flex-regs aren't easy to implement at stringent levels. They meet concerted resistance from fossil fuel companies, electric utilities, vehicle manufacturers and other interests. For a government trying to lead on climate-energy policy, however, it is less difficult to overcome these sector-specific corporate interests, which themselves are not particularly popular, than to survive the anger of voters in key

electoral districts who succumb to lies trumpeting the punitive nature and ineffectiveness of carbon pricing.

Energy transformation is also difficult because its short-term costs are concentrated in regions that rely on fossil fuels for electricity supply, such as the US Midwest with coal-fired power, or regions whose economies are highly dependent on fossil fuel development and export, such as Texas. Some people in these regions experience climate action as an attack on their livelihood, and are therefore vulnerable to the argument that climate scientists distort evidence.

Challenging this myth with evidence and logic is difficult, as we are all susceptible to biases that align with our self-interest, especially when these are reinforced by well-funded misinformation campaigns. Over the last 20 years, advocates for climate-energy policies have tried various narratives to shift the views of the climate science skeptics. Will their views shift if we better explain the science? Or if scientists talk more about catastrophic outcomes? Or if we emphasize the co-benefits of GHG reduction, such as improved air quality? Or if we trumpet the innovation and jobs created by renewable energy? Or if we use carbon tax revenues to compensate fossil fuel-dependent regions and retrain workers in a 'just transition' strategy?

Unfortunately, no storyline has emerged as the silver bullet for countering climate science skepticism. As we know from the experience with smoking and lung cancer, myths based on our perceived self-interest and convenience are hard to undermine. Decades of accumulated scientific evidence slowly changed beliefs. Finally, public views on the risks of smoking passed a tipping point to reach wider acceptance. Climate science views may have reached a similar stage, in part because, as with smoking, some impacts are now obvious and immediate. But a significant percentage of people will still deny the science, or reject the need to act. If these action-resistant views align with political partisanship, as in the US, rising public acceptance still might not lead to effective economy-wide policies. Focusing on key sectors and less difficult policies is especially important in this context.

Even if most people in a fossil fuel-endowed region may accept the climate science, those whose financial interests align with expanded production are motivated to convince themselves and others to accept

their project: it produces only a tiny percentage of global emissions; it is essential for our economy; it is cleaner than others; it will help the developing world. These rationales hinder people from 'connecting the dots' – realizing that the long lifespans of new fossil fuel projects far exceed the short timeframe for global decarbonization.

Fossil fuel-endowed regions would benefit if some of their trusted leaders questioned the prudence of doubling-down on coal, oil, and even natural gas. Such visionaries would argue that fossil fuel expansion increases their region's economic vulnerability to the future time when humanity finally accelerates on the decarbonization path. Unfortunately, such regions tend to produce political and corporate leaders who perpetuate the myth that they can thrive indefinitely on the fossil fuel path, simply by repelling attacks from environmentalists, foreign billionaires, Hollywood celebrities, and neighboring jurisdictions. This is why, sadly, sudden economic decline is the more likely future for most fossil fuel-dependent regions.

Fortunately, one myth that has kept humanity on the rising GHG path is fading. While some people still believe peak oil is nigh, it's now difficult to convince anyone that imminent oil exhaustion obviates the need for decarbonization policies. Technological advances of the last 15 years, notably the fracking and horizontal drilling that enable oil and gas extraction from shale rock, have greatly increased estimated global reserves. The price of oil may still jump at times, being a valued commodity vulnerable to geopolitical crises, and this may rekindle peak oil concerns. But we can now confront peak oil catastrophists with the crescendo of climate-related disasters to convince them that the priority must be stringent climate-energy policies. And we can note that such policies will, serendipitously, cause oil production to peak long before we run out – peak demand preventing peak oil.

As carbon pricing or regulations that phase out coal and gasoline increase in stringency, they spur behavioral change, energy efficiency, and renewable energy, and other policies can reduce inequities within and between countries. But our pursuit of these laudable objectives must not retard energy system transformation. If we argue, in spite of the evidence, that energy efficiency is cheap and easy, we inadvertently reduce the pressure on politicians to enact regulations or carbon pricing.

If we say consumer behavioral change is essential, we again let politicians off the hook, enabling them to claim that they are waiting for that behavioral change.

The same good intentions that motivate efforts to change consumer behavior also motivate the practice of offsetting. Feeling helpless with the ineffectiveness of climate policy, some of us purchase offsets. The sentiment is worthy, but the outcome is not, for many carbon offsets have little effect on emissions. We should instead consider contributing our offset money to the politicians and campaigns that demand the regulatory and pricing policies we know are essential. Deep decarbonization only happens if *every* polluter pays, not just the environmentally conscious.

Many people are rightly bullish about renewables, especially given the falling cost of wind turbines, photovoltaic panels, and the batteries, gas turbines, and other technologies that enable these intermittent sources to provide reliable electricity. But fossil fuels will not be swept away by market forces in the absence of rising carbon prices or stringent regulations. Renewable portfolio standards and tax credits in the US, producer subsidies and regulations in Europe, and government support in China have caused the dramatic growth in wind, solar, and other renewables. The stringency of these policies needs to increase because when they cause a declining demand for coal and oil, they also cause declining prices for these commodities, which slows the market penetration of renewables. This is why renewables advocates must demand stringent climate-energy policies. Proclamations that renewables are already cheaper are welcomed by fossil fuel advocates, helping them convince politicians that politically difficult policies can be avoided, thus slowing or preventing decarbonization.

While I am sympathetic to arguments that the global economic system should do much better in terms of equity within and between countries, attaching ambitious agendas to the deep decarbonization project only increases the difficulty of what is already an extremely difficult task. The resulting failure on climate makes global inequity even worse, since it is the poorest people who are most adversely affected, and this is already happening. Radical transformation of our economic system and our social relations, desirable as these may be for some, are not essential for

deep decarbonization, as several GHG-reducing jurisdictions are demonstrating.

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In my graduate seminar in sustainable energy, I ask students why California advanced its climate-energy policies from 2008 to 2013, while most jurisdictions halted their efforts and focused on the economic crisis.³ This question triggers a bustle of evidence-gathering and speculation.

Prior to 2008, California was one of many US states and Canadian provinces negotiating a cap-and-trade system, which European countries had implemented the previous year for large industrial emitters. The idea was that this multi-jurisdictional initiative would eventually cover so much of the US economy that federal legislators would be compelled to implement a national policy, if only to reduce regulatory complexity for industry. Then came the financial crisis of 2008, followed by the global recession. While climate-energy policy initiatives were delayed or abandoned elsewhere, California soldiered on – tightening its renewable portfolio standard and vehicle emissions standards, initiating its innovative low carbon fuel standard, increasing the stringency of its energy efficiency regulations, and rolling out its cap-and-trade system.

The students offer several hypotheses for California's continued efforts: frequent wildfires making the climate threat real; Democratic political domination; influential Hollywood movie stars; conflation of LA smog reduction with GHG reduction; Schwarzenegger; etc. Perhaps all of these played a part. But as they investigate further, some students note how climate-energy policies are designed and implemented in California, in particular the lead role of the California Air Resources Board, with contributions from other state agencies like the California Energy Commission and the California Public Utilities Commission. These are quasi-judicial agencies to which the California legislature and governor delegate some regulatory authority.

Having chaired the British Columbia Utilities Commission for five years, I am familiar with the procedures of such regulatory bodies. They hold public hearings in a court-like setting, involving expert evidence, testimony, and cross-examination. Panel members are

treated like judges. (I enjoyed the tradition of participants deferentially standing when the Chair entered the hearing room!) The California Air Resources Board is mandated by legislation to achieve the state's GHG targets using its regulatory powers, and to stay the course as long as that mandate has not changed. While the US government and other states have environmental protection agencies, only California has delegated to its agencies such powers to ensure GHG reductions.

Delegating climate-energy policy implementation to an arms-length regulatory agency is also beneficial if such institutions can better resist the inevitable push-back from some industries and voters. Since politicians hope to please everyone, they are vulnerable to lobbyists arguing that non-compulsory policies are effective. A regulatory agency, with the expertise to distinguish effective from ineffective policies, is less likely to succumb to this wishful thinking bias. And it may be more trusted than politicians, which researchers suggest is important when it comes to public acceptance of climate-energy policies.⁴

My students acknowledge that California's sustained leadership is not only a result of its policy delegation to regulatory agencies. But they believe such agencies may be helpful with a multi-decade task like deep decarbonization, especially given the partisan positioning and short attention spans of democratically elected governments. We must not bet the planet on every jurisdiction electing a steady stream of Arnold Schwarzeneggers.

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People tell me they feel hopeless against the climate threat. They are horrified by the daily news of extreme events and dire scientific warnings. They want action. But they don't know what to do themselves or what actions to demand of leaders. They can't assess the personal or political implications from the activist campaigns that come and go – the 350 parts per million campaign, the 450 parts per million campaign, the 1.5°C target, the 2°C target, the youth climate emergency campaign of Greta Thunberg, and so on. People have trouble distinguishing effective from ineffective policies, and hence sincere from insincere politicians. They don't see how actions in their one jurisdiction can solve a global problem.

And they are overwhelmed by the myriad suggestions for changing their daily lives.

I have written this book for these people – citizens of countries, citizens of our planet.

My paramount message in this book is that climate-concerned citizens must concentrate on transforming a few key sectors of our economies, on focusing our politicians on a few key policies, and on changing a few key technologies. These simple tasks substantially improve our chance of climate success. Without them, climate failure is guaranteed. I now recap what we need to do, how to do it, and why each part matters.

The global nature of the problem complicates the decarbonization task. However, some sectors within our economies primarily provide domestic services. These include electricity generation, transportation, heating and cooling of buildings, firms for whom energy use is a small part of their costs, and our land-use practices in cities, agriculture, and forestry.

Electricity and transportation are especially important, and that's where we must focus. These two sectors are a major source of GHG emissions in developed and increasingly developing countries. Their decarbonization in a given jurisdiction will have negligible effect on the cost of producing goods that are subject to global competition, because near-zero-emission commercial technologies are already available at a reasonable cost.

In electricity, we need to regulate the rapid phase-out of coal plants (if lacking carbon capture and storage) while ensuring that natural gas plays only a modest, backup role for intermittent renewables. Canada has a regulation to phase out all coal plants by 2030, repeating the successful effort a decade ago in Ontario. The UK has a policy that combines carbon pricing, an emissions intensity regulation, and renewables subsidies for the same outcome. Many other countries are contemplating similar policies, and coal use is falling in most developed countries. Even in the US, in spite of promises from President Trump, coal-fired power plants are in decline thanks to a combination of renewable portfolio standards, tax incentives, tighter regulations, and low natural gas prices. This trend in wealthier countries to stop burning coal must extend to developing countries, albeit with a lag to reflect their reduced financial

capacity and growing energy needs. China may have stopped growing its coal-fired power, but it needs a sustained decline, thereby providing an alternative model for other developing countries, like India.

In transportation, we need to regulate the phase-out of gasoline and diesel use in vehicles and other transportation equipment (buses, local delivery trucks, long-haul trucks, transit, trains, ships). Increasingly, electricity will play a dominant role with cars and some trucks, as governments at national, sub-national, and city levels commit to phase out sales of gasoline and diesel vehicles. Instead of carbon pricing playing the leading role, other key policies may include a zero-emission vehicle standard or a low carbon fuel standard, or both, as in California. Purchase subsidies and vehicle tax changes may also contribute, as Norway has demonstrated.

Long-haul trucks, buses, trains, and ships might switch to biodiesel, ethanol-gasoline blends, or hydrogen, perhaps in conjunction with electricity (plug-in hybrid trucks for example). These forms of energy must be produced in low-emission processes, with only minor impacts on forest and crop lands. A low carbon fuel standard, perhaps in conjunction with biofuel blending mandates, can achieve this shift, and is more likely than carbon pricing to play the lead role. But subsidies can contribute, since these improve the political acceptability of deep decarbonization policies, even if their GHG-reducing effectiveness is suspect.

Since unilateral decarbonization of electricity and transportation are the least-difficult actions, with the biggest impacts, citizens of wealthier countries must push their governments for a complete transition in these two sectors. They must also demand that this domestic progress be coordinated with a globalization effort to extend the transition to developing countries. The already-existing Powering Past Coal Alliance needs to add countries, and should be partnered with a new Driving Past Gasoline Alliance, the latter linking jurisdictions like Norway, California, China, and soon others on an accelerated gasoline phase-out.

This globalization of the energy transformation in electricity and transportation is essential because reducing developing country emissions is critical to climate success. The two pie charts in Figure 13.1 represent fossil fuel-caused CO₂ emissions in 2050 in a 'reference case' forecast of future emissions if we continue our procrastination. The

CO₂ emissions in gigatonnes in 2050

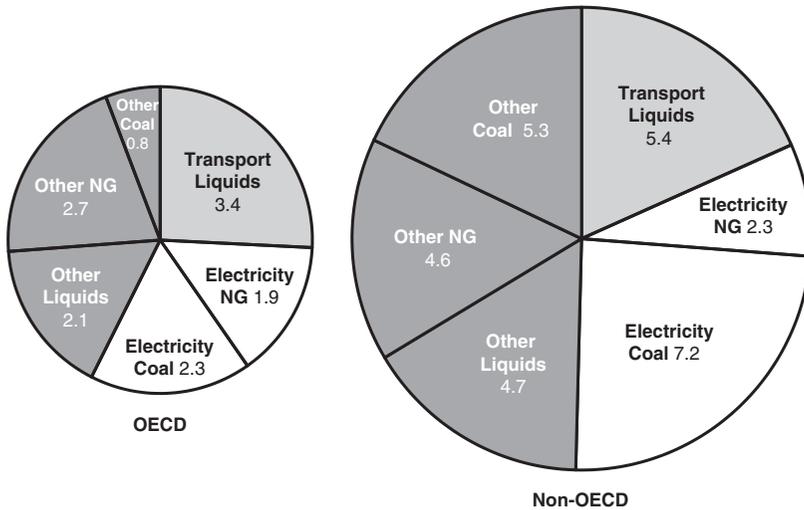


Figure 13.1 Global CO₂ emissions in 2050 reference case

emissions pie for developing and emerging-economy countries ('non-OECD') is more than twice that of wealthier countries ('OECD') – 30 billion metric tons per year versus 13 billion.

By 2050, fossil fuels in electricity generation, mostly coal and natural gas (NG), and fossil fuel transport liquids, mostly gasoline and diesel, will account for 50% of combustion emissions in non-OECD countries and more than 50% in OECD countries. Quickly decarbonizing these two sectors in wealthier countries sets a model for, and helps lower the costs of, a similar effort in developing countries. Significant decarbonization of these two sectors in OECD countries over the next 15 years, followed by a slowing of growth and then a downward trend in emissions in these sectors in non-OECD countries after 2035, would cause declining global emissions after 2035, assuming modest progress in other sectors and with other GHGs.

My focus on fuel switching in electricity and transportation does not imply that we ignore other sectors. But Figure 13.1 demonstrates that the climate-energy challenge is simpler than often presented. Yes, we want more livable cities, greater energy efficiency, and behavioral change like reduced meat consumption and more use of public transit. Yes, we want

to preserve rainforests and adopt more sustainable agricultural practices. Yes, we want significant GHG reductions in emissions-intensive industries.

But we know with certainty that we must quickly decarbonize electricity and transportation, which individual countries can do without waiting for a global agreement. We know that decarbonization in these two sectors are linked, since zero-emission electricity is a key input for decarbonizing transportation. We know that if carbon pricing is politically constrained as the lead policy, there are sector-specific flexible regulations that are less politically difficult, with only a modest loss of economic efficiency. And we know that success in these two sectors puts us on the deep decarbonization trajectory, creating a tipping point within countries and globally for the consolidating next step of implementing economy-wide policies. Success in these two sectors has the greatest spillover potential for the global effort. We must think globally when deciding how to act locally.

In contrast with electricity and transportation, decarbonization of emissions-intensive trade-exposed industries requires a different strategy. Shifting to near-zero-emission production of steel, cement, aluminum, and petrochemicals will increase their production costs. But while the costs for primary materials (steel ingots, aluminum slabs, polyethylene) may rise by as much as 40% when switching to low-emission processes, the costs of intermediate products (metal brackets, aluminum frames, plastic molding) won't increase more than 10%, and that of most final products (vehicles, buildings) no more than 3%. My former student, Chris Bataille, is an expert on decarbonization of emissions-intensive industries, and publications from his collaborative research show an encouraging potential for these sectors.⁵

Even though these costs of decarbonizing emissions-intensive trade-exposed sectors are reasonable for humanity on a global scale, a unilateral effort in just one jurisdiction would be political suicide. Industries facing substantial decarbonization costs would threaten plant closures because of unfair competition from industries in countries with less stringent policies. This 'emissions leakage' could even increase global emissions if plants in these free-riding jurisdictions have higher emission intensities. So unilateral decarbonization is unlikely without

major cost-reducing innovations for near-zero-emission production processes.

But the inability to quickly decarbonize these industries should not give them a free ride. When implementing its cap-and-trade system for industry in 2005, the European Union granted allowances to industries based on their historical emissions, but ensured that the policy included the incentive to reduce emissions, since doing so would generate surplus permits that could be sold to other industries. Another approach is the 'output-based pricing system' which was initiated in the province of Alberta and is now a nation-wide policy in Canada. In this system, companies pay a carbon price only on the amount by which they exceed emission-intensity targets, such as CO₂ per ton of steel. This incentivizes investments to reduce emissions without significantly raising production costs. My former student, Nic Rivers, explained the benefits of the initial Alberta policy in a 2010 paper.⁶

Governments can also use carbon pricing revenues to subsidize GHG reductions in emission-intensive industries. And if they implement what are called 'border carbon adjustments,' they could use revenue from tariffs on the imports from high-emission jurisdictions to offset their domestic industry's policy-induced cost increases.⁷ But this approach is only necessary if domestic industries are forced by policy to significantly decarbonize, which governments have not been willing to require of their domestic trade-exposed industries. As an alternative strategy, leading jurisdictions would together pursue single-industry globalization agreements, such as a global steel-GHG pact, a global cement-GHG pact, and so on. While still difficult to negotiate, single-sector international agreements would be less difficult than the current process, which futilely pursues a voluntary international consensus covering all sectors of all countries.

For decarbonizing electricity and transportation in developing countries, wealthier countries should provide financial support. But there is no evidence the taxpayers in wealthier countries will suddenly become more generous, so we can't depend on this. And because some wealthier countries will elect climate-insincere leaders, the sincere governments must combine their domestic efforts with the real threat of carbon tariffs. Ideally, some of the revenue from carbon tariffs would be transferred to

developing countries to help with decarbonization costs. But I would not bet the planet on that level of generosity.

Fortunately, low-emission electricity and urban transportation provide important co-benefits by improving air quality, and this is highly valued in the smog-choked cities of developing countries, which also happen to be where political leaders and their families live. It is thus encouraging, but not entirely a surprise, that with rising wealth China has suddenly become the leading producer and consumer of electric vehicles. Other developing countries may follow.

The following text box situates this ‘focused deep decarbonization strategy’ within the major themes of this book. Several jurisdictions are starting to pursue key elements of this strategy.

Decarbonizing the global energy system is a global collective action problem, but humanity lacks global governance mechanisms for allocating costs and ensuring compliance. A voluntary global agreement is unattainable because national interests differ greatly (poorer vs wealthier; fossil fuel-rich vs fossil fuel-poor).

National governments need to recognize the constraints of this situation and develop a strategy that has the greatest chance of a global impact. The strategy includes the following.

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.

In selecting domestic decarbonization policies, jurisdictions should be prepared to trade off economic efficiency against the likelihood of implementation. Although this exercise will depend on numerous jurisdiction-specific factors, such as public trust in

government, electoral system, and institutional arrangements for policy-making, the guiding principle should be to not let perfection be the enemy of good. Carbon taxes are particularly problematic if proposed as the sole lead policy for deep decarbonization.

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In Chapter 1, I described how each year I make the new graduate students in my sustainable energy seminar argue convincingly for and against our technological options on the deep decarbonization path. With practice, this exercise enables them to see the pro and con complexity of our options. It undermines the comfort of seeing the world as black and white. But it improves their ability to compromise, an essential condition for climate success. It is consistent with my theme that we must not let perfection be the enemy of good in the pursuit of climate success. This means that it's time to consider carefully questions like the ones below.

What will be the role of natural gas in a decarbonized energy system? It can make a significant contribution in backing-up solar and wind, and perhaps a modest contribution in transportation. But our coal phase-out policies should not allow natural gas to play significantly more than a supportive role, unless used with carbon capture and storage. For while natural gas can contribute to decarbonization, it is not the 'bridge' to a decarbonized future, an issue my former student Stephen Healey explored in a recent paper.⁸

What will be the role of nuclear power? I don't have a strong preference. I worry, however, that climate-concerned people will waste time and energy battling each other over nuclear power. If a jurisdiction wants nuclear power as part of its GHG-reducing effort, it will have to overcome the well-known challenges of plant siting, permitting, safety, storage of radioactive wastes, cost overruns, and public opposition. Expanding nuclear power in a wealthy country is a long shot if that country has zero-emission options for dispatchable electricity at reasonable cost. Some observers note that nuclear power has better growth prospects in countries ruled by autocratic governments, where siting is easier because public opposition can be suppressed. But is it advisable that governments

with poor records on civil rights, freedom of information, and safety standards build and operate a fleet of nuclear plants?

What will be the role of carbon capture and storage? Again, I am indifferent, and I ask other people to consider the merits of being neutral about this. If a particular fossil fuel-rich region wants to continue using its resources by converting them to electricity and hydrogen without causing GHG emissions, why oppose it? Recent IPCC reports note that because we have already put too much CO₂ into the atmosphere, we now need to extract it and return it to the earth's crust – hence the increasing importance of bioenergy with carbon capture and storage in scenarios that prevent more than a 2°C increase. I ask climate-concerned people to keep an open mind about carbon capture and storage, whether matched with fossil fuels or biomass. With fossil fuels, it can help get buy-in for the climate effort from fossil fuel-endowed regions. With biomass, it can help reverse our mistakes of the past. Humanity has procrastinated too long for us to now rule out options that, while not perfect, could help accelerate the global decarbonization effort.

What will be the role of biofuels? Again, I ask climate-concerned citizens to avoid blanket rejection. Yes, a global-scale replacement of *all* fossil fuel-derived gasoline and diesel with biofuels will negatively affect food prices and biodiversity. But Brazil's sugar cane production of biofuels presents a low-cost model for gasoline phase-out and economic development that other tropical and semi-tropical countries can emulate. Biofuels will never be impact-free. Indeed, none of our energy options are completely green or clean in spite of the claims of promoters and politicians. But by carefully choosing our biofuel providers, whether domestic or imported, we can influence how biofuels are produced, which is the current strategy of the European Union. It would be tragic if, instead, we rejected all biofuels because of modest environmental harms in some locations, and thus inadvertently accelerated climate change that disrupts *all* environments in *all* locations.

What will be the role of geoengineering? It will be significant, whether we like it or not. We have dithered for so long that geoengineering options are now unavoidably in the climate toolbox. In the coming decades, we will extract carbon from the atmosphere, deflect solar radiation, neutralize ocean acidification, cause snowfall at the poles, and

employ other unimaginable and risky technological fixes. We'll accept the risks of these and other options to avert the worst devastation from climate change, because we didn't act in time to avoid them.

Indeed, we cannot be rigid about solutions. We must pay attention to technical, economic, political, and social feasibility, and be willing to shift our preference for a particular action or policy if one of these factors presents an insurmountable barrier to its contribution.

Sadly, I all too often encounter arguments by experts and media commentators that *this* particular action or policy is essential for deep decarbonization, in spite of it being especially difficult for political, social, or psychological reasons, and not actually being essential. Some seem to revel in arguing that citizens must quickly accept a particular solution.

One frequent argument, for example, is that massive expansion of nuclear power is essential, and if citizens can't quickly accept living beside nuclear plants, then humanity will fail. But I sometimes wonder if people making this argument are simply expressing their own need to feel superior in their understanding of risk. Yes, researchers know that many people have an exaggerated view of the risks from a nearby nuclear plant, especially in comparison to the daily risks from our current energy system (a building gas explosion, vehicle exhaust, car fire, coal plant emissions, and fires, storms, and floods from climate change). And yes, researchers know that nuclear power could make a significant contribution to decarbonization. But to argue that nuclear power is essential is to deliberately ignore all of the sound research by the IPCC and other leading institutions showing decarbonization scenarios with little or no nuclear, albeit with slightly higher energy service costs. Arguing that nuclear is essential, while ignoring the challenges of getting people to accept a nuclear plant in their midst, presents a take-your-medicine-or-else myth that only hinders our progress with the climate threat.

While arguing that nuclear power is essential provides an example of this attitude toward GHG-reducing *actions*, arguing that carbon pricing is essential provides an example of it with climate-energy *policies*. It is not true that carbon pricing is essential. Someone who says this is simply expressing their preference that we decarbonize in

the most economically efficient manner, even if the single-minded pursuit of that approach results in continued policy failure, and thus climate failure. Again, this logic seems to be more revealing of its proponent than our policy choices. For if some people are unwilling or unable to accept the economic efficiency lessons from an Economics 100 textbook, does that really justify refusing second-best policies, even if these latter have a far higher likelihood of political, and therefore climate, success?

Our chances increase significantly if more of the people who claim to want climate success incorporate into their prescriptions the key lessons from research on human cognitive imperfections when assessing the relative risks of actions, such as nuclear power versus alternatives, or the relative efficiency and fairness of decarbonization policies, such as carbon pricing versus flexible regulations. I say it again. With the climate-energy challenge, perfectionist prescriptions are the enemy of success. Those advocating them need to look in the mirror when allocating blame for humanity's continued failure on this critical challenge.

* * *

This leaves one last task on the simple path to climate success. We must be able to detect and elect climate-sincere politicians, and then pressure them to implement a few simple policies, such that any citizen can detect procrastination and evasion. The nature of this task crystalized for me a few years ago during the question period after one of my talks. Someone in the audience asked, "Don't we need to better inform our political leaders about climate science and effective policy options? Some are skeptical of the science. Some acknowledge the science, but oppose carbon taxes and other strong policies. Don't we need to send politicians to remedial school for the climate?" Before I could respond, a woman waiting at the other mic engaged the questioner.

"There is nothing we can tell politicians they don't already know about the climate threat and GHG reduction policies."

"How can you be sure?"

"I spent years as a senior political advisor. Believe me, *they know.*"

"Then what would cause them to act?"

"A policy window of the kind that influenced right-of-center politicians in the mid-2000s like Arnold Schwarzenegger, John McCain and Mitt Romney in the US, and Gordon Campbell in British Columbia."

"But how does a policy window happen? Do we need more devastating hurricanes, floods and wildfires?"

"Probably. Our political system is not configured to take difficult steps in the present to avoid great harm in the future. We don't reward politicians for thinking and acting that way."

"So that's it? There's no hope? Nothing that might change their minds before the calamity?"

"There certainly is. Politicians will abandon a position if the political costs are excessive. Simply put, if the political costs exceed the political benefits."

"But how can that happen with the climate threat?"

"We need to *create* the policy window. We need enough people to act in ways that catch the media's attention and pressure politicians. Easiest is to engage politically. Citizens active in the political process are important, although the effect is impossible to measure. Unfortunately, phasing out fossil fuels directly threatens powerful and wealthy people who have political influence. So creating a policy window may entail a bigger personal commitment as past successful social movements have shown, whether for civil rights, women's rights or opposition to war. Options include boycotts, protests, demonstrations, even acts of civil disobedience to alert fellow citizens to the importance of the issue."

"And then the politicians will do the right thing?"

"Maybe. But then you're still not out of the woods. Politicians have short attention spans. You probably need to convince them to create regulatory institutions that will sustain the policies regardless of the next distraction. Something like the California Air Resources Board. Tell the politicians this delegation of climate policy responsibility is in their best interests, since effective policies are not vote-getters!"

She had left nothing for me to say. But I really appreciated her response. It made me reflect on my responsibilities as a citizen. Until then, I was generally satisfied with my comfortable role as independent expert, helping sincere politicians with policy advice and analysis,

exposing insincere politicians with my energy-policy modeling for think tanks, non-government organizations, and the media. But with the climate threat, was that enough?

When I later recounted this exchange to my research group, one grad student said, “You should produce a flow chart.” He noted that engineers draw flow charts to guide them with contingent decisions – if A, do X; if B, do Y. That night I produced the diagram in Figure 13.2. While it might strike some as playful, it’s not meant to be. It’s my “guide to citizen behavior for climate success.”

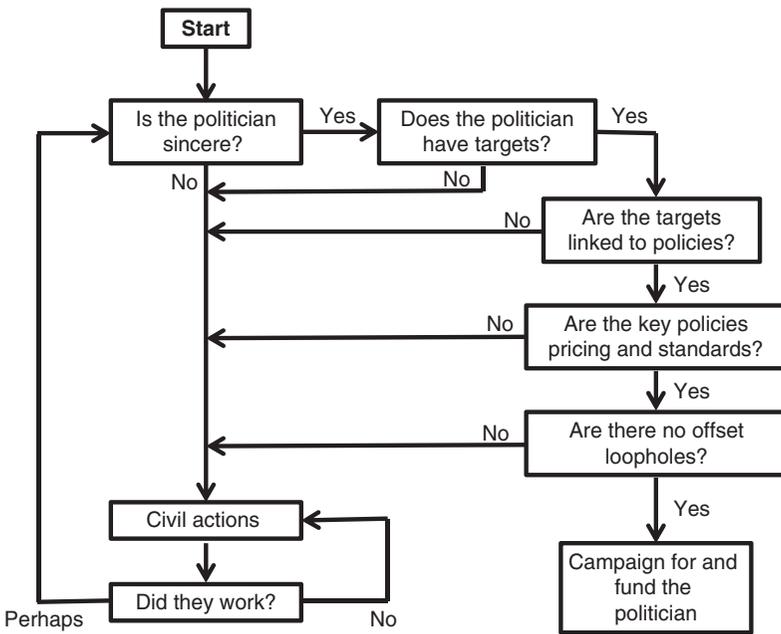


Figure 13.2 Guide to citizen behavior for climate success

Moving to the right along the top of the diagram, we see that finding a climate-sincere politician is just the first of many steps. Lots can go wrong. The politician must set targets. But even insincere politicians do that. The political benefit-cost ratio for setting targets while doing nothing is strongly positive, especially if these are distant targets beyond the politician’s elected life expectancy. Mid-century is ideal, but 2030 is still pretty safe. (In my career, I have assessed GHG targets for the years 2000, 2005, 2010, 2020, 2030, 2050, and 2100. Do I sound jaded?)

The targets must be linked to policies. The danger at this stage lies in the policy-making process. A common avoidance strategy is to create a “citizen climate advisory committee.” The politician selects members of the public (not policy experts) and gives them lots of resources and time – the longer the better. Eventually, the committee produces a melange of GHG-reducing actions and policies, such as “increased wind power” as one item and a “renewable portfolio standard” as another. But as I explained in Chapter 6, because policies cause actions, these cannot be mixed. A climate plan should *only* contain policies, because it explains the policies government will implement to cause GHG-reducing actions by citizens and corporations. It can include a forecast of the possible technological and behavioral actions caused by the policies – which should be produced by independent and credible policy forecasting experts. But the policies are all the plan should list and that list should be very small. It might be a single economy-wide carbon tax, but I would be happy with five or six flex-regs each applying to a different sector of the economy.

Instead, the ineffective climate plan (of which I have read over a hundred from jurisdictions around the world) will look like a long to-do list. In addition to actions that should not be in there, it will include numerous small-effect policies that would not be needed if the essential carbon pricing or flex-reg policies were implemented. These might include funding for electric vehicle rechargers, a tax-break for wind power, training for electric car technicians, grants for biofuel producers, climate research, adaptation planning, an educational kit for schools, a carpooling website, behavioral change information, a scrap-it program for old vehicles, a carbon offset program, subsidies for home insulation, incentives for efficient natural gas appliances, funding for urban transit feasibility studies, and so on.

Even if the politician sincerely intends to one day implement carbon pricing or regulations, it's easier to start with small-effect policies. In public speeches and media sound-bites, the politician rhymes through the list, ticking off achievements to show progress, noting that the regulations and pricing will happen, but these take longer to implement (which is not true). Later, the politician acknowledges that the year

before an election is not a good time to impose carbon pricing or regulations (which is true), so more delay is needed.

After almost two decades of these delaying tactics in most jurisdictions, governments have finally been implementing some compulsory policies. Evidence against the ineffective policies became too obvious, as jurisdictions missed target after target. Now the issue is stringency. While flex-regs might be less difficult than carbon pricing, for a given amount of GHG reduction, both types of compulsory policy are difficult as we increase their stringency, as I illustrated with my “political difficulty of climate policies” Figure 6.5 in Chapter 6. This is why concerned citizens today must focus on the stringency of a few decarbonization policies in a few key sectors.

In this final chapter I’ve explained why those key sectors are electricity and transportation, and how to get higher stringency by targeting a rapid phase-out of coal plants and gasoline vehicles in wealthy countries. This transformation must extend to developing countries via falling costs of clean alternatives, transfers to support clean investment where wealthier countries are able to show some generosity, and carbon tariffs by a club of climate leaders that disincentivize other countries from free-riding. When a government sincerely advances along this policy and action trajectory, we must support it vigorously. Sadly, that is not always the case, as an example from my own country illustrates.

In the period 2015–2019, the Canadian government showed global leadership by rapidly developing policies to phase out coal plants, regulate methane emissions, implement national carbon pricing, fund transit, implement an output-based pricing system for emissions-intensive trade-exposed industries, and apply a clean fuel standard (a flex-reg like the low carbon fuel standard) to coal, oil, and natural gas. It also launched with the UK the Powering Past Coal Alliance to lead a growing movement of jurisdictions acting to phase out coal-fired power – the very strategic global spillover of national policies that I had been championing.⁹ Yet, few environmentalists in Canada gave the government credit for these impressive efforts. Because the government leads a diverse country with conflicting regional interests, it also supported a new pipeline from the Alberta oil sands. To many environmentalists, this one decision equated this government with the previous Canadian

government, which had faked it completely on climate for a decade. If we cannot support climate-sincere politicians, warts and all, they won't survive, and we further reduce our chances of climate success.

But what if our political leaders are insincere on the climate threat, as is so often the case? What should we do then? Descending the left side of Figure 13.2 leads to a box labeled "civil actions." This covers all types of public engagement, including social media, discussions with friends and neighbors, donations, volunteering with environmental organizations and their public awareness campaigns, letters to newspapers, calls to radio shows, boycotts, and demonstrations. We may take these actions to influence and support the decisions of sincere politicians too, just as protests against the Keystone XL pipeline facilitated its rejection by President Obama, a climate-sincere politician.

In this book I have often noted why success with the climate threat is so difficult: a global governance problem without a global government; phasing out the combustion of high-quality fossil fuels that have so benefited humanity and could still benefit the poorest among us; the combination of wealth and power seeking to continue the burning of fossil fuels for self-interest reasons; the inability of our national and sub-national democratic processes to initiate and sustain an effective decarbonization effort; and our human penchant for self-delusion in the face of inconvenient truths. In this light, our decades of failure are not surprising.

Moreover, with atmospheric CO₂ concentrations now well above 400 parts per million and rising rapidly, and the impacts of climate change increasing in intensity, reasonable people are seriously studying risky geoengineering options. What was for years seen as the 'climate threat' is increasingly recognized as the 'climate emergency.'

In this context, a growing number of otherwise law-abiding citizens are considering the option of peaceful civil disobedience. I am one of these. Civil disobedience takes me far outside my comfort zone. I believe we should obey laws created by our democratic institutions. To disobey a law, even as an act of peaceful protest, even with a willingness to take the legal and economic consequences, is to me a profoundly troubling act. The situation must be dire.

Until reaching my mid-50s, I never imagined engaging in civil disobedience. I had been lucky that my career as a climate-energy policy expert offered so many avenues for expressing my views and educating others, whether conducting policy effectiveness research, exposing faking-it politicians, advising sincere politicians, providing media commentary, or public speaking.

However, the situation in Canada and in my province of British Columbia around 2011 became especially desperate. Prime Minister Stephen Harper, who had defeated the Liberals under Stephane Dion in 2009 by campaigning against his “job-killing carbon tax,” had just won a national majority. Now he was unconstrained in pursuing the rapid expansion of fossil fuels, although, of course, he maintained that he was also sincere on climate. In British Columbia, Premier Gordon Campbell, the politician who had implemented North America’s first carbon tax, was gone and his replacement as premier had frozen the tax. National and regional media teemed with industry advertisements and statements by political and corporate elites focused entirely on the economic benefits of fossil fuel expansion. Much of the public seemed passive, overwhelmed by the pro-fossil fuel messaging.

After lengthy discussions with friends and colleagues, I finally agreed with one of my former students, Kevin Washbrook, an effective climate campaigner, that a civil disobedience action challenging the contradictory fossil fuel and climate-sincerity narratives of the Harper government might contribute to its defeat in the 2015 election. Our goal was to increase, even if only by a tiny amount, the number of Canadians suspicious of the government’s climate sincerity, and thus their willingness to vote differently next time. So 13 of us blocked a coal train as a public wake-up action in May 2012.¹⁰ We were arrested and jailed for a few hours.

I explained my actions to the media at the time, and later in an essay in Canada’s premier magazine, *The Walrus*.¹¹ While I had thought a lot about this action in advance, it is difficult in hindsight to see our effort as entirely coherent. I preferred arrest blocking coal, as consumption of this fossil fuel must unequivocally be falling everywhere, as I have explained throughout this book. But this was metallurgical coal, bound for steel factories in east Asia. Even this type of coal should only be used

with carbon capture and storage when making steel, but that's a complicated story for the media to convey. I also wondered if our message about the Harper government's climate insincerity would resonate with anyone.

The government was defeated in 2015, and this occurred in part because younger Canadians turned out in record numbers to vote for the Liberals and other climate-concerned parties. Polls showed that by the time of its defeat, the government was severely distrusted on the climate, a major concern for the 68% of Canadians who voted for the other parties. I cannot say if our action contributed to this changing view, but we got a lot of media attention. Imagine if there had been 100 similar citizen actions during the government's term, or even 1,000.

I hope that this first act of civil disobedience was also my last. But I can't be sure. As the flow chart suggests, our actions as citizens should be conditional, dependent on what is needed and likely most effective at any time. If we can elect climate-sincere governments, civil disobedience may not be necessary. In that regard, I could not bring myself to join others engaged in civil disobedience in 2017 in an effort to stop construction of the TransMountain Pipeline expansion from the Alberta oil sands to the coast at Vancouver. I was more concerned with supporting a government that was quickly implementing the effective climate policies I and others had been demanding for over two decades, especially with its leveraging of our domestic coal plant phase-out with a global multi-country initiative.

If I feel compelled to repeat this act, I think it should focus on vehicles, since we can and must quickly phase out sales of gasoline cars and trucks, following Norway's example. Perhaps chaining myself to the door of a luxury car dealership that sells gasoline vehicles?

For people who criticized me for the audacity of breaking the law, I have some understanding. We can all make excuses for why our particular act of civil disobedience is essential. But I cannot agree that civil disobedience is never an option, especially when it comes to protecting current and future generations from a global disaster that has climate scientists not only alarmed but many themselves opting for civil disobedience. I have sometimes responded to criticism of my arrest by reversing the accusation in asking, "Why are you not engaging in civil action,

including perhaps civil disobedience? You know what I know about the seriousness of this threat and the inaction of our government. Will future generations agree that you did all you could with that knowledge? Or will they say you opted for a comfortable life, even while knowing that your actions could have made a difference?" As Albert Einstein purportedly once said, "Those who have the privilege to know, have the duty to act."

This dilemma on appropriate action reminds me of people in the 1930s, like Adam von Trott in Germany, who recognized early the threat posed by Adolf Hitler and urged fellow citizens to join them in active opposition. Von Trott and other early resisters understood the need to take actions that were judged as unlawful and unpatriotic by many of their contemporaries, but would be seen as justified and courageous by future generations. They also understood that those who did not act bore responsibility for the harm to come. We cannot absolve ourselves from responsibility by downplaying the importance of our actions as individuals. Social and political outcomes are the responsibility of all of us, and therefore of each of us.

The human propensity to delude has for three decades prevented us from effective action on the climate threat. But as more of us are willing to inconvenience ourselves in our actions as responsible citizens, we increase the likelihood of success against this grave threat. And for this we need to understand and overcome the myths that hinder our progress.