CHAPTER 8

We Must Change Our Behavior

The truth that survives is simply the lie that is pleasantest to believe.
H.L. Mencken

How emissions-intensive is your sex life? If you can't answer this question, you're probably not alone. But I know someone who can.

It all started when a grad student of mine (who wishes to remain anonymous) discovered a book offering advice on being a green consumer. One of the sections focused on "greening your sex life." It suggested consumer products that reduce the use of energy and non-renewable resources, as well as cutting down on GHG emissions.

My student was intrigued. Being an engineer, and a skeptic by nature, she wanted some hard numbers to assess these claims, and learn more about her own ecological footprint in the pursuit of tantric pleasure. Soon she was riveting my earnest research group with lists of alternative products for every imaginable and unimaginable pleasure. For some of our young researchers, it was an unexpected educational experience.

You can get into the mood with candles made from beeswax, organic wine in a goatskin, and alluring lingerie produced from hemp, bamboo, or seaweed. Edible underwear may be out of style, but if it's organically produced, it shouldn't be taboo. If whipped cream is your thing, never buy an aerosol-spray canister; hand-whip it instead.

Condoms should be latex, possibly from the sap of a rubber tree on a sustainably managed plantation. Sex toys should be PVC-free. Vibrators should use rechargeable batteries or run on solar power. Lubes and

massage oils should be made from organically based silicon, not petroleum. Feathers should come from real animals: naturally shed, not plucked. And for those who like it a bit rough, there is hemp rope and handcuffs from recycled metal.

Sure, these sustainable, high-quality products cost a bit more, but acquiring them will make you feel good. The edible massage oil is just $16 a bottle. The deluxe eco-rechargeable vibrator goes for only $139. The list of green sex products and activities is endless.

At first blush, it all seemed reasonable: "We must change our behavior and consumption to reduce our environmental impact." But the hypothesis troubled our Ms. Skeptic. Her suspicions were aroused by the sheer volume of devices and consumable products in the modern sex life, green or not. She wanted to see for herself if our shifting preferences of the past five decades, since the sexual revolution in the 1960s, had caused an increase or decrease in energy use and pollution. She wanted to know if a significant effort to green our consumption, in this case related to sexual activity, would truly cause a decrease in energy use and GHG emissions, both directly in the act itself, say the electricity used in vibrators, and especially in the production and delivery of all the devices and products now involved. She wanted to know if 'green consumerism' was a canard when it came to sex, perhaps when it came to everything.

Some people were shocked by the revealing information about American sexual activities in the earlier surveys of Masters and Johnson, Kinsey and Hite. But the shocker for my student was that these earlier authors never collected data on the energy and emissions associated with sexual paraphernalia. To her, this was sacrilege.

As one of our most tenacious researchers, she soon developed her own methodology that combined spot surveys of sexual activities over the years with data on sales of sexual products. She then generated estimates of energy consumption from use rates and of material waste from discard and replacement rates. With these data assembled, she started number crunching.

She estimated that in the wild and natural 1960s, people's sex-related energy and material consumption actually declined. The widespread adoption of the pill undermined sales of condoms, diaphragms, and IUDs. Use of lubes and massage oils was rare compared to today.

According to the surveys, S&M was less common too, which is borne out by the sales data, if it is to be believed. But after that decade, the energy- and emissions-intensity of sex, on a per-person basis, has maintained a steady increase. The ownership of various sexual props, at one time limited to the promiscuous and kinky, has become almost *de rigueur*. Most people have at least some kind of device or liquid in the bedside drawer. For some, it's a full closet.

In her research, my grad student focused on what is involved in making an object and getting it to the consumer – the energy and materials used in production, transport, and delivery. In production, one can calculate the materials and energy required in manufacture. In transport and delivery, energy use depends on weight and size, so again it's possible to find data from comparable products.

She found that energy use for production and delivery of sexual props has grown much faster than the US population; an average American today has many more sexual products and devices than four decades ago. For example, Kinsey found that less than 1% of women in 1953 had a vibrator and Hite put the figure at less than 5% in 1976.[1] Contemporary surveys put the number at 40–55%, with many women having several.

Each of these products and devices takes energy to produce and deliver. The material itself is often produced from petroleum or natural gas, but this 'feedstock' use of energy is tiny compared to the energy consumed for production and transport. The energy required for production of a sexual product is usually a combination of electricity and a fossil fuel like natural gas. The transport of sexual products produces more carbon pollution due to the burning of gasoline and diesel by trains, semis, and local delivery trucks, or ships and planes if imported from overseas.

Does switching to 'green' products change any of this? Not much. With a few devices and liquids as indicators, our intrepid investigator estimated the reduction in energy use and carbon pollution from a widespread shift to greener sexual products and activities. Her results presented a diverse range, depending on the product and activity. But once she had mapped these onto the sales data, the takeaway was unequivocal: the trend to consume more overwhelms even a complete switch to

greener consumption. Per person, we consume a lot more for sex than we did 50 years ago. The energy and emissions impact of almost everyone greening their consumption might offset 5% of this effect.

To her credit, our Ms. Skeptic did distract me from my climate worries. I started worrying about how granting agencies would view our research group if she published her findings.

Greening the consumption side of our sex lives might make us feel good about ourselves. But it's not the path to climate bliss. In fact, across-the-board research on human consumption shows that this truth holds for more than just sex. As we get richer, we consume more. If the economy is dependent on burning of fossil fuels, that greater consumption translates into more GHGs. In this context, changing our consumer choices and behavior can only make a small contribution to the 50–80% emissions reduction scientists say we must achieve by 2050. As I once heard at a conference, "we're not going to buy our way out of this one."

* * *

If you ask a person on the street if behavioral change is necessary to prevent climate change, surveys show that most agree. People can't tell you what behavioral change means. But they agree it must happen, whatever it is.

We hear this refrain from environmentalists, of course, but also from politicians, corporate leaders, celebrities, and the media. In 2006, John Hofmeister, the former President of Shell Oil, said, "We need to change the hearts, minds, values and behaviors of Americans toward a culture of conservation."[2] In 2010, the Natural Resources Defense Council said, "Behavioral change and personal action are critical to any successful effort to curb greenhouse gas pollution and avoid the worst impacts of climate change."[3] And in 2012, Dr. Karen Ehrhardt-Martinez of the Garrison Institute's Climate, Mind and Behavior Program said, "Behavioral approaches offer the promise of large, rapid and relatively inexpensive means of reducing carbon emissions . . . We don't need to change beliefs, we need to change behavior."[4]

When people are pressed to explain what behavioral change might entail, the response is a patchwork. Some talk about being a greener or more ethical consumer. Some talk about changing their lifestyle. Others

talk about consuming less altogether. And some argue that the only way to really consume less is to earn less. Vancouver, where I live, is the birthplace of the Work Less Party, inspired by Conrad Schmidt's book, *Workers of the World Relax*.[5]

Either way, the concept of behavioral change is frustratingly vague. Is it a behavioral change to buy green devices and liquids for sex? Or do we need to buy fewer things for sex? Or stop having sex? (What is the sexual carbon footprint of a monk or a nun?) Or should we make sure that our sex lives don't produce new lives, since the total human population drives our environmental impact? Or, instead of shopping, should we spend more of our time having sex, but without devices except contraceptives? People having sex are not in a shopping mall, at least not usually.

We energy analysts spend a lot of time thinking about this – behavioral change, not sex. We define behavioral change as consciously acting differently and doing so on a regular basis that requires mindfulness, at least initially. Sorting one's garbage for recycling eventually becomes unthinking, automatic. But initially it requires a conscious, daily effort. Busing or biking instead of using the car is a behavioral change since it requires continually acting differently.

Think of the needs and wants that underlie human behavior. We need food, clothing, and shelter. We want security, comfort, and convenience. Many of us want power and status. We seek entertainment and pleasure. We can be quite sedentary, but also quite mobile. Witness the spread of aboriginal peoples throughout America after arriving from Asia 20,000 years ago, and the travel bug of modern people.

Through the millennia, humans have learned how to better exploit the earth's energy and materials to satisfy these needs and wants. And, as we've gotten wealthier, our use of resources has increased dramatically. In the world's poorer countries, people want more electricity and modern fuels because these enable better homes, hospitals, schools, infrastructure, and other key goods and services. But a rising use of energy and materials is still happening in wealthier countries too. Affluence does not appear to satiate all human wants, at least not those of most people. As we get richer, our firms process more energy and materials to provide us with more desirable goods and services. And if firms in other countries can provide these more cheaply, we import them. Thus, we also cause the

energy and materials consumption resulting from the production of these goods and services in far-away places.

With rising wealth, people can satisfy more of their wants. One widespread want is bigger houses. In 1970, the average American single-detached house was 1,500 square feet. In 2010 it was 50% larger. Not everyone prefers a bigger house. But monster homes are now a worldwide phenomenon as some of the newly wealthy emulate the opulent lifestyles of the rich.

And as our wealth rises, our mobility demand increases. With air travel, that increase has been rapid. Figure 8.1 shows the growth of commercial airline passenger travel since 1970 compared to the growth of global Gross Domestic Product (GDP). (For comparison, the data sets have been modified so that both start at 100 in 1971.) Air travel's exponential growth shows no sign of abating, especially as a greater share of global GDP growth occurs in developing countries where more people are reaching income levels that enable increased travel.

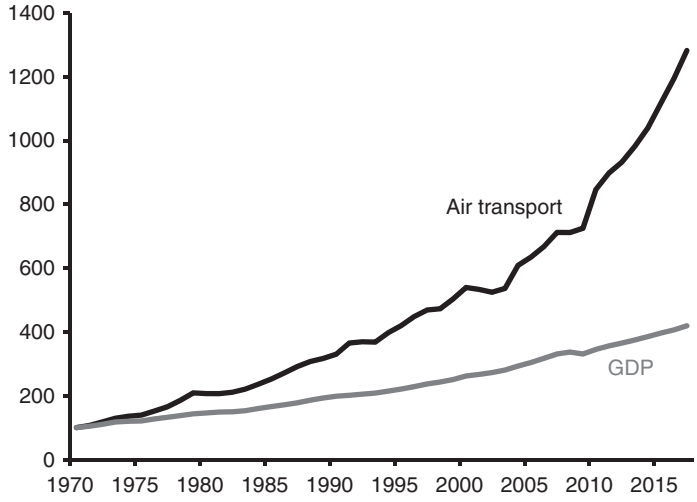

Figure 8.1 World air transport and GDP

In a positive feedback loop, the more we travel, the more our desire and need for travel increases, as we tell friends and neighbors about exotic destinations, meet and marry people from distant places (causing additional travel by family and friends), and develop far-flung business

and professional connections. Rather than a behavioral change, we might best characterize this as a behavioral trend, one of many that leads to more energy use and, in a fossil fuel energy system, more GHG emissions.

In *The Economic Naturalist's Field Guide*, Robert Frank describes how our consumption can be motivated by our wealth relative to the other people in our social context.[6] Simply put, we consume in part to keep up with the Joneses. And if our incomes climb and we enter new social contexts, we invariably find new Joneses to keep up with.

This drive for status has obvious implications for material and energy consumption. But even if status comparison were not a factor, humans are drawn to novelty and this has big implications for energy consumption. If a neighbor, friend, or relative acquires a new gadget, we often think it might benefit us too. So even those who are not particularly status-conscious are drawn in, for reasons that might go all the way back to our emergence as a species. As Bill Rees, the academic who invented 'the ecological footprint,' explained in a 2010 article, humans seem coded for acquisition – throughout human history, acquisition success meant evolutionary success.[7]

Empirical evidence of the energy consumption caused by our acquisitiveness was clearly shown by one of my grad students, Steve Groves, in his 2009 thesis entitled "The Desire to Acquire: Forecasting the Evolution of Household Energy Services."[8] He found that in 1970, the average American house had 12 energy-using devices, excluding the light bulbs. These comprised the furnace or air conditioner, other major appliances, and smaller devices like TV, iron, toaster, vacuum cleaner, and a few radios and alarm clocks. Forty years later, in 2010, the much larger average American house had 48 energy-using devices. To the 1970s list, add many of the following: freezer, ice-dispenser, garburator, coffee maker, cordless and mobile phones, several computers, CD players, consoles and hand-held devices for gaming, multiple TVs and DVD players, mp3 players, blender, bread maker, food processor, wine and/or beer cooler, microwave oven, patio heater, hot tub, leaf blower, high-powered lawn mower, an array of power tools, power washer, and barbecue. Also, dishwashers and air conditioners made the transition from luxury to necessity.

Since the 1970s, regulations and occasional energy price spikes have motivated significant improvements to the energy efficiency of furnaces, air conditioners, and major appliances like fridges, clothes washers, clothes dryers, and stoves. But this reduction has been offset by the growing size of houses packed with these new energy-using devices. As a result, energy use per person has grown significantly among the wealthiest 25% of Americans. This is especially so if one includes all the energy used by firms throughout the world making stuff or providing services for these people, like the aviation fuel for their ski vacation, the energy to produce their ski equipment and clothing, the energy for the hot tub at their ski resort, and, increasingly with climate change, the energy to make snow at their ski resort. And then there's all the stuff we don't see or think about, like internet servers with their skyrocketing energy use.

Layered onto this is a secondary trend: the accelerating rate of turnover of some of these devices. Ten years ago, the average person kept their mobile phone for three years. Today this average is much shorter, as people race to buy the latest upgrade, meaning that energy use in production and transport is rising faster than the number of devices actually in use. Someone once referred to the mounting volume of discarded devices as "the Steve Jobs legacy."

People who call for behavioral change can be vague on what we do that causes GHG emissions, and thus on how behavioral change might reduce these. My research group cannot afford such vagueness, so we keep asking for specifics in order to numerically estimate the effect.

The work of my research group on human mobility illustrates this point. We run computer models that estimate how and at what cost humans can reduce GHG emissions. We frequently hear from environmentalists and public transit advocates that since people use cars to get from point A to point B, public transit in the form of bus, light rail, or rapid transit offers the same mobility service. They note, moreover, that public transit uses less energy and costs less than a car per person-kilometer-traveled (as long as the bus or train has a decent ridership), especially when you consider the cost of a car, its maintenance charges, insurance, and fuel. Once people are educated about this cost advantage, some will shift to transit – or at least that is the assumption.

But this rarely happens. One reason is that person-kilometers-traveled is just one of the values a car provides. Other behavior-determining wants and needs are important, such as comfort, convenience for transporting goods and other people, entertainment, power, and status. We are not effective as researchers, policy advisors, and concerned citizens if we ignore these critical factors when predicting the receptivity of people to the call for behavioral change.

Thus, a key task of my group's research is to undertake surveys asking people under what conditions they would switch from their personal vehicles to public transit. We also compare survey responses to actual behavior to make sure we have designed the questions to prevent respondents giving biased answers because of 'wishful thinking' or 'wanting to please.' From these surveys we've become aware of the extent to which a personal vehicle is much more than a device for delivering person-kilometers-traveled. Other key vehicle attributes include convenience for short trips, privacy for personal conversations, quick flexibility when plans change, ability to move bulky or heavy objects, cost advantage over public transit when transporting several people, avoiding exposure to hot or cold weather when walking to and waiting for the bus, and less direct interactions with people who are rude, ill, or threatening.

At some point, our research findings led me to propose that we no longer refer to a vehicle as a CAR in our computer model. I wanted us to call it a PMD, 'personal mobility device,' to reflect the high value many people place on the convenience of having their own mobility device. I wanted this kept in mind as we assessed policies attempting to lure people on to transit.

As it turns out, my desire to change CAR to PMD opened a can of worms. Our next set of surveys, and those of our colleagues, further assessed human motivations in mobility choices. Before I knew it, one of the researchers in our team altered the PMD acronym to PMSED, a 'personal mobility and status-enhancing device.' I initially protested, but the research showed that car ownership was for many people as much about status as mobility.

It didn't end there. (These are grad students after all.) Soon more surveys led to still more debates about the correct acronym. Quietly, one

of our researchers changed it yet again. The rest of us were left to ponder the meaning of the new acronym, PMSESICD.

We should have guessed. This student was surveying the willingness of young males to pay a substantial premium for excess horsepower combined with an appearance of speed, a muscle car, or strength, a large pick-up. When the acronym's meaning was finally revealed, it seemed obvious and appropriate. In the case of many young males, and some older ones, a personal vehicle is more accurately labeled as a 'personal mobility, status-enhancing, and sexual-insecurity-compensatory device.'

If we want people to change their behavior, we better know why they behave a certain way and exactly how we could motivate them to behave differently. We may have success with some behaviors. But new fads, inventions, and processes can continuously swamp these successes.

One example of these unpredictable developments is the emergence of bitcoins. Bitcoin trading is enabled by what are called 'blockchain technologies.'[9] These require huge amounts of electricity to progress through protocols designed to ensure that bitcoin transactions can be trusted, without involving an overseer, like a government regulator. Figure 8.2 shows the incredibly rapid growth in electricity use by the

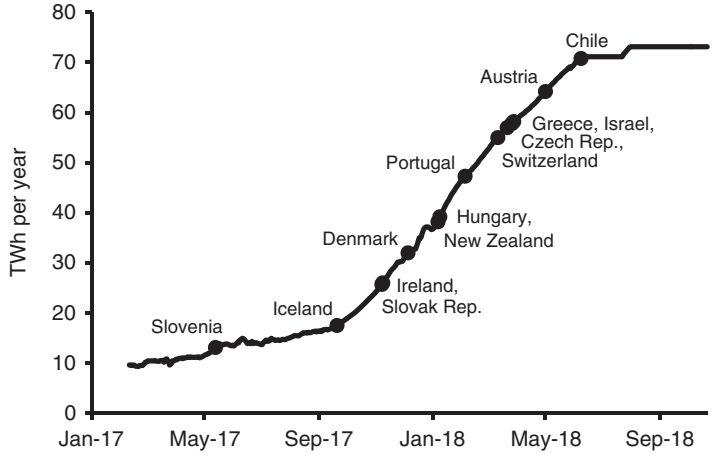

Figure 8.2 Bitcoin electricity consumption

bitcoin industry in just over one year. Between January 2017 and September 2018, bitcoin electricity consumption reached and then surpassed the entire electricity consumption of one modest-sized country after another.

The bitcoin phenomenon was unforeseen 10 years ago. It is impossible to predict the energy-intensive activities that will emerge over the next 10 years. But we can be sure there will be many. Humans love to innovate, and they love novelty. Often that leads to more energy use. If we have not decarbonized our energy system, GHG emissions will rise.

* * *

The next time someone tells you we must change behavior to reduce GHG emissions, ask them how they changed behavior to reduce emissions that were causing acid rain, smog, dispersion of lead, and destruction of the ozone layer. You will get a blank stare. No one changed behavior. Instead, we changed technologies, with considerable success. We did this with the compulsory policies, especially regulations, I described in Chapter 6.

Acid rain was a major problem in the 1970s and 80s, killing forests and lakes, reducing agricultural production, and damaging buildings and infrastructure. It was caused by sulfur and nitrous oxide emissions from burning fossil fuels in power plants, factories, buildings, and vehicles. We needed to change technologies and fuels throughout the economy. And that's what we did. Governments required refineries to remove sulfur from transport fuels. In fact, it required them to dramatically reduce the sulfur content in all fuels, from home heating oil to bunker fuel for ships. In blissful ignorance, we now emit much less sulfur when driving a gasoline vehicle.

Coal-fired electricity plants were another major source of acid emissions. Governments gradually tightened standards, forcing the development of flue-gas-desulfurization. As this technology became commercially available, the US government enacted in 1990 a sulfur emissions cap-and-trade policy that contributed to sulfur emission reduction from power plants.

While acid rain was once a great concern of environmentalists and scientists, today it's rarely mentioned. We adopted regulations and some emission pricing to drive technological changes that dramatically reduced the environmental harm caused by burning fossil fuels in all sectors of the economy. Behavioral change played virtually no role.

This pattern repeats for urban air quality. Today, our cities are not smog-free, by any stretch. But when compared to 1970, urban air quality has improved significantly in industrialized countries. Again, we did not change behavior for this environmental improvement. We simply regulated the fuels and technologies that caused emissions. New regulations required refineries to reformulate fuels and vehicle manufacturers to install catalytic converters and other emission control devices. By 2000, a typical gasoline-fueled car emitted 96% less smog-creating emissions than its 1970 predecessor. Industrial plants in and near urban areas were also regulated for their emissions, leading to the adoption of selective catalytic reduction to reduce nitrous oxides, and the installation of bag-house filters or electrostatic precipitators to capture particulates. In Los Angeles, government instituted a cap-and-trade system for nitrous oxides, which reduced these by 25%. The net consequence of these regulations and some pricing mechanisms is substantially improved air quality in most US cities. Ask a baby boomer what it was like when they were a child, and you'll hear about teary eyes, hazy vision, and labored breathing.

This pattern recurs with other environmental threats. Scientists alert people to the problem. Environmentalists are the first to believe them. Corporations that are implicated as contributing to the problem initially either deny the threat or balk at the cost of addressing it, fearful of government red tape and loss of profits. Eventually, enough public concern prompts politicians to act. They respond with tougher standards, and on rare occasions with policies that change prices. The standards force technological change. The threat is diminished. Afterwards, almost no one can say what technologies and what policies were involved. But if asked, they admit they didn't change their behavior.

Why would anyone think that reducing GHG emissions will be any different? One reason on offer is the magnitude of the problem: "surely a major transformation of the global energy system in just a few decades will require behavioral change." But why assume this? Why not focus on implementing the policies we know are essential, and then see what happens? Getting effective policies adopted is very difficult, but far less difficult than convincing virtually everyone to voluntarily change their behavior. As the compulsory policies are tightened, it may well be that some people will change their behavior. But we should not bank on this. Focus on pricing GHGs or regulating GHG-emitting technologies, and let individuals and industries decide the mix of behavioral and technological change as they respond to these policies.

As public awareness of acid rain and smog grew through the 1970s and 80s, an increasing number of people understood that their vehicles were part of the problem, in some cases a big part. Environmental campaigners talked about the need for people to use their cars less. But few did, as average vehicle use continued to rise. What made the difference was the rising public demands for political action, which eventually forced politicians to enact tighter regulations that forced the necessary technological change. The successful response was political and technological, not personal and behavioral. Of course, there was no explicit decision to forget about behavioral change. But governments quietly acknowledged that to rely on it alone would be insufficient.

With climate change, everyone has had the option over the last three decades of changing their behavior. We know the result. On average, we built larger houses and transported more goods and people – and even produced more emissions for sex. Fortunately, as with the other environmental threats, there are technological options to use less energy, to use zero-emission forms of energy, and to use fossil fuels while capturing the carbon, just as we now capture sulfur and particulates. When we finally do enact policies that compel GHG reduction through regulations or carbon pricing, corporations and individuals will decide on the mix of behavioral and technological change that suits them.

Figure 8.3 Cartoon by Jacob Fox

I have frequently heard people say that we must severely curtail vehicle use to succeed against global warming. But should we bet the future of the planet on this when all we need to do is stop emitting carbon from our mobility devices, be they public transit or PMSESICDs?

As a politician having to deal with all people, not just the environmentally focused, Arnold Schwarzenegger understood this when, as Governor of California, he pushed for GHG reductions. He understood that there was little chance young males would give up their love of powerful vehicles. So he showed car and truck enthusiasts how he'd converted one of his Hummers to biofuel and another to hydrogen. (How many did he have?) When regulations dictate that muscle cars will only run on biofuels and electricity, this is what young males (and some females) will buy. Some might gripe about it. But compare this to

the difficulty of convincing all of them to voluntarily sell their vehicles and take the bus.

In the same vein, I once heard a conference speaker confidently say, "Someday, flying will be viewed with the same disgust associated with lighting a cigarette indoors." Yes, the smoking change was behavioral. But is this a good example? Scientists claim that smoking is directly harmful to nearby non-smokers via second-hand smoke. The smoke from a cigarette and its effect is direct and obvious when a smoker subjects us to this risk – we immediately see it, smell it, and feel it in our lungs. On this basis, health advocates were finally able to get policy-makers to ban indoor smoking, although even that took decades.

In contrast, online carbon counters help us estimate the impacts of our flying behavior, but they don't seem to be having much effect. For one thing, the impact of airplane emissions is not nearly as immediate and obvious as smoking next to someone. Indeed, I note that most of my environmentally aware friends and colleagues fly well above the average in terms of person-miles-traveled. Why? They are wealthier than the average person, they love to see the world, their friends and family are spread around the globe, and many of them (here's the rub) fly frequently to meetings and conferences dedicated to stopping climate change.

As a corporate leader having to deal with all people, not just the environmentally focused, Richard Branson, president of Virgin Airways, has put considerable thought into behavioral change when it comes to flying.

> I think it's impractical to start talking about people not being able to fly. What we need to do is come up with a technological solution to flying, which is to come up with a clean fuel so people can carry on flying but not actually damaging the environment, and that's what we're trying to do.[10]

Branson has always expressed a deep concern for the climate threat and he has backed his words with his wealth, investing millions in the development of biofuels to replace conventional jet fuel. Jet fuel from non-fossil fuel sources is now being produced and its use would dramatically increase if required by regulation, albeit with an increased cost for airline travel.

It can be revealing to monitor our behavioral change efforts. Sometimes our behavioral change reduces energy use or GHG emissions. But sometimes each choice involves a difficult trade-off. A friend of mine provides an example. He once explained to me that he was adopting a greener lifestyle to have less impact on the planet. This included his new-found passion for hot yoga.

When I mentioned this to my grad students, one of them, inspired by our Ms. Skeptic, could not resist. Soon he was browsing websites, calling hot yoga studios, and even visiting a few. Later, with a straight face, he recounted conversations with puzzled staff as they earnestly tried to answer queries about their building's insulation and heating system. Perhaps they assumed the new client had a furnace fetish. But when he asked to see their monthly utility bills, the staff at one studio showed him the door. Amazingly, another studio let him copy their bills. Some companies will do a lot to attract new customers.

According to his notes, the studios he tracked kept their hot yoga rooms at over 38 degrees Celsius (100 degrees F) during the day, with only a moderate reduction at night because the rooms needed to stay hot for early morning sessions. The studios were in older commercial buildings with poor insulation. He estimated the average annual energy consumption of a 7x7 meter (20x20 foot) hot yoga room as equal to 20 average-sized, moderately insulated houses in our climatic zone.

When I next saw my hot yoga friend, he again mentioned how he had changed his behavior to fight climate change. I am sure he is doing many good things, and I want to encourage that. I did not tell him about my grad student's surreptitious research.

* * *

The belief that we must change our behavior to succeed against climate change is a bad-news-good-news story. The bad news is that all but the most extreme behavioral changes (living like a monk in an abbey or like Diego in New Mexico) will have little effect while we still live within an energy system dominated by fossil fuels. The good news is that we don't need behavioral change to reduce GHG emissions. We only need technological change.

Humans aren't going to stop using electricity. So we know with certainty that we need to phase out coal in electricity generation. This is now happening in wealthier countries, in some faster than others, and we need the trend to spread to developing countries. We also need to phase out gasoline and diesel in transportation. Led by jurisdictions such as California and Norway, people in wealthier countries are shifting toward zero-emission vehicles. Even in a developing country like China, people are buying electric vehicles. Other countries may soon emulate China's new policies that accelerate the adoption of low- and zero-emission vehicles.

At the same time, behavioral change should be encouraged. Some people will consciously use less electricity than their neighbors, which reduces the amount of zero-emission electricity needed in the energy transition. Some people will use cars less, instead favoring public transit, cycling, and walking. But, if we are to succeed with the climate-energy challenge, the contribution from technological change will dwarf these efforts at behavioral change, just as our past successes with other pollutants were almost entirely attributable to technological change.

Although we should encourage behavioral change, we must guard against deluding ourselves and others that such efforts are effective. Take the example of our consumption choices. In recent decades corporations have figured out that labeling products as "green" helps sales. So most products now tout their greenness. Even fossil fuel marketers do it, as I explained in Chapter 5. If this labeling leads me to unconsciously assume that my consumption choices are making a difference with GHG emissions, this is bad news for the climate.[11]

Likewise, while the movement for ethical investment should be encouraged, we must not delude ourselves into assuming its effect will be significant. Think about the frequent claims by industries about their "corporate social responsibility" or "triple bottom line" – the idea that an ethical corporation simultaneously pursues profits, societal well-being, and environmental protection. How durable are such initiatives?

Compare the recent histories of British Petroleum and Exxon Mobil. During his 10 years as CEO of BP, from 1997 to 2007, John Browne promoted a socially responsible corporate stance on global warming by

investing in renewable energy and pilot projects to capture and store carbon. With much fanfare, BP rebranded itself as "Beyond Petroleum," an agent of change in the energy transition. It even argued that shareholders would benefit in the long run, although that again begs the question of whether the goal was corporate social responsibility or long-run profits.

In contrast, its competitor, Exxon Mobil, took the opposite strategy, focusing on investments that benefited from the lack of regulation or pricing of GHG emissions. Not surprisingly, Exxon earned higher returns for its shareholders than BP did during Browne's tenure. After his departure, BP's management quietly backed away from his approach, no doubt to the relief of shareholders.

The fossil fuel industry and insincere politicians would like nothing better than to delay compulsory decarbonization policies by claiming that we need behavioral change. We must not play into their hands. Instead, we should prioritize the one behavioral change that can make a big difference: changing our behavior as citizens and voters to more forcefully pursue deep decarbonization policies. Annie Leonard, producer of the documentary, *The Story of Stuff*, put it this way.

> Instead of asking what we as consumers can do, let's ask what we as citizens can do. Our real power to reduce the environmental and health impacts of the energy we use lies not in convincing consumers to make different choices from a limited menu but in engaging as citizens to influence what's on the menu.[12]

Thirty, twenty, and ten years ago, zero-emission vehicles were not on the menu. I pursued behavioral change as best I could, almost always commuting by transit or bike (never buying a parking pass to ensure I would not lose my resolve during miserable weather). But I also had a gasoline car, which was our best option for getting kids to hockey practice and lugging home groceries. Now my partner and I have an electric car. The purchase price of such cars is still out of reach for many people, although we addressed that challenge by sharing the car's cost and use since neither of us drives much (and ours is a Nissan Leaf, not a Tesla!).

What a fantastic feeling to finally have a commercially available technological option for eliminating our vehicle emissions. But that option only materialized because of the compulsory policies I described in Chapter 6. With vehicles, the most important policy was the ZEV mandate California initiated in 1990, that gave vehicle manufacturers deadlines for innovating and then marketing zero-emission and near-zero-emission vehicles – leading to the development of hybrid, plug-in hybrid, electric, and hydrogen-fuel-cell cars. The successful push for climate-energy policies in California helped change the menu for citizens, enabling the kind of technological change that previously addressed smog, acid rain, and other environmental threats. And this is essential because people won't stop using vehicles in the next three decades, yet they must dramatically reduce their GHG emissions in that period.

Fifteen years ago, electric companies in North America were still building coal plants, so clean electricity was rarely on the menu, except where hydropower and nuclear power dominated. As I noted in Chapter 6, the British Columbia government in 2007 was finally convinced to implement a clean electricity standard, which prevented the construction of two coal plants and a natural gas plant. Because of this, the electricity I use in my electric car is zero-emission. Coal-plant phase-out regulations and carbon pricing in Canada, and state renewable portfolio standards and federal regulations in the US are decarbonizing the electricity sector. Various compulsory policies are also decarbonizing the electricity system in most European countries. Our citizen efforts to change climate-energy policy are changing what's on the menu so that now consumers can use near-zero-emission electricity in their homes, including for space and water heating which are the two main household energy uses.

These changes are technological, not behavioral. But this is not to deny the value of also changing our behavior. Drive less and you reduce electricity consumption. Use less hot water and turn off unneeded lighting and you reduce electricity consumption. Fly less and you reduce GHG emissions from the combustion of fossil fuel-derived jet fuel, but perhaps – if our policy efforts succeed – you will one day instead reduce the combustion of bio-jet fuel, produced in sustainable processes. These types of behavioral changes reduce total energy demand, which in turn

reduces the aggregate investment required for the transition to a zero-emission energy system, making that transition easier and faster.

Speaking of what's on the menu, our food system is an important source of GHG emissions. Studies repeatedly confirm that a dramatic reduction in meat consumption would significantly reduce agricultural GHG emissions, while improving human health.[13] In developing countries, meat consumption is rising in step with incomes. But in wealthier countries, it is declining and this trend is accelerating with the growing awareness of delicious and healthy vegetarian recipes and the development of simulated-meat substitutes for those with continued carnivorous cravings. My bet is that agriculture-related GHG emissions will decline significantly over the next two decades on a per capita basis. Unfortunately, aggregate emissions might not fall, as this trend is offset by population growth. Still, this is an important behavioral change that should be championed, even if mostly for its human health benefits. People think of this as a behavioral change, and I accept that. I note, however, that switching from beef burgers to meatless burgers with an identical taste seems more technological than behavioral.

In any case, it's time to stop feeling guilty about ourselves as consumers and start feeling guilty about ourselves as citizens. As consumers, there is little we can do with the guilt in those cases where we have no realistic options to reduce GHGs. As citizens, however, there is a lot we can do. There is a lot we must do. But it won't always be comfortable.

The adoption of transformative climate-energy policy is a Herculean task. If we have sincere politicians, we need to push and support them. They can easily go off course. And, sadly, sincere politicians are rare when it comes to this challenge for reasons I explained in Chapter 4 (a global problem without a global government), Chapter 5 (the political power of incumbent fossil fuel interests), and Chapter 6 (the difficulty of enacting and sustaining effective domestic climate-energy policies). When these factors result again in the election of insincere politicians, we must especially challenge ourselves as citizens. For as Bill McKibben asks, "Planet Earth is miles outside its comfort zone; how many of us will go beyond ours?"[14]

In the final chapter, I explain the reasons why I left my comfort zone in 2012, leading to my arrest with 12 other people for blocking a coal train in Vancouver. For me, this was an enormous but unfortunately essential behavioral change as a citizen – one I and many other citizens may need to repeat before achieving climate success.