Appendix

Your Carbon Footprint

How to Prepare for Climate Change is primarily about *adaptation*: changes we can make to accommodate the new climate and its effects.

But there's another response to the climate crisis: *mitigation*. That means taking steps to *minimize* the worsening of the climate.

At this point, we need to adapt *and* mitigate, hard and fast. The more mitigation humans do, the less we'll have to adapt.

Group Action vs. Solo

It's clear that the bigger the entity, the greater the effect it can have on the climate. What the car industry does, what the United States does, or what China does can have a gigantic effect. But you? As an individual? What possible effect could your actions have?

Some observers even suggest that you take *no* efforts to reduce your carbon output. Why bother? You'll have almost zero effect compared to the planet's gigantic corporate, government, and institutional polluters. After all: The 100 most copiously polluting companies on earth are, together, responsible for *71%* of all greenhouse gases. And you think you'll make a difference by changing your light bulbs?

In one regard, those experts are right: If you were capable of making only one gesture toward solving the carbon problem, you'd be most effective as part of a group. "Organizing groups, or being influential in the groups you're part of, is the most powerful thing you can do. What is your

school doing? What is your workplace doing, your town doing?" says Ben Strauss, CEO of Climate Central.

In Chapter 1, you can find a tidy list of national and international organizations that need your help: Citizens' Climate Lobby, Climate Reality Project, and others. They can guide you in spreading the word, lobbying, making media appearances, joining cleanup operations, writing blog posts, and so on. Many of them have been successful in prodding the government into action.

But the *most* effective thing that you can do for the climate, as part of a group, is to help elect climate-action candidates. Your city, state, or country can make carbon reductions millions of times greater than anything *you* can effect alone.

"The most important thing to do is to vote for politicians who prioritize climate change," says David Wallace-Wells, author of *The Uninhabitable Earth*. "If we tell our leaders that we really care about this as a number one issue, as something that really defines how we want the world to work and how we want our leaders to work for us, policy will begin to follow."

Chapter 1 of *How to Prepare for Climate Change* offers a guide to getting started down this path, too.

In another sense, though, the suggestion that you abandon individual action is dead wrong.

There are three huge reasons why you, as a tiny, noncorporate entity, should attempt to minimize your carbon footprint (the total CO_2, methane, and other greenhouse gases you produce each year):

- **You're adding to a cumulative effect.** Think about how many massive societal shifts have come about through *individual* changes in behavior: Americans' beef consumption has declined over 20% since 2005, because individuals are choosing different entrées. Cancer deaths in the United States are down 29% since 1991, because individuals are smoking less. Deaths by car accident have dropped 40% since the seventies, because individuals are wearing seat belts.

- **You're modeling behavior for others.** What we see other people doing affects what *we* do. It's called the social-norms effect, or behavioral contagion.

  Social cues are especially important when it comes to recognizing emergencies. "People don't spring into action just because they see

smoke; they spring into action because they see others rushing in with water," write Stanford postdoctoral psychology scholars Leor Hackel and Gregg Sparkman.

"If I'm careful about my carbon footprint, and I try to eat very little carbon-intensive food, or I say 'I'm taking the train, I'm not flying,' or I'm busy turning off the lights or putting up solar panels—that influences the people around me," says psychiatrist and climate activist Lise Van Susteren. "You don't even have to mention climate."

- **You'll feel better.** Psychiatrists have long known that feeling helpless is a major contributor to depression. Cultivating a sense that you're *doing* something about your problems—taking some action, no matter how small—gives you a sense of control. And that makes you feel better.

As you dive in, climate-therapy author Leslie Davenport reminds you not to fall victim to *greenwashing*: making token efforts to just feel better, and then stopping there. "Don't say, 'I'm not gonna use plastic straws, and now I can fly to Europe because I feel so much better,' " she says. Do *everything* you can.

All right, expectations set. What *are* the steps you can take to mitigate the climate crisis?

Where It's Coming From

The chart in Figure A-1, from the U.S. EPA, gives you a good idea of how our greenhouse gases break down. (The numbers are for the United States. For the planet as a whole, the agricultural component is much larger.)

It breaks down like this:

- **Transportation (29%).** Here are the emissions from your planes, trains, automobiles, and ships. No surprise: 95% of them burn petroleum as fuel.

- **Electricity (27%).** This category represents the coal, natural gas, and oil needed to generate power. (63% of our energy comes from burning fossil fuels; the rest comes from nonpolluting sources like solar, wind, and nuclear.)

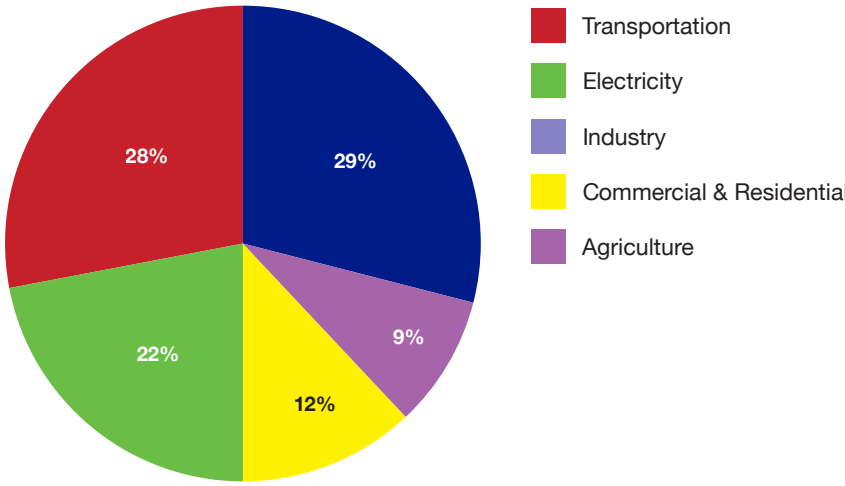

Figure A-1. Here's where all the greenhouse gases are coming from, as of 2017.

- **Industry (22%).** This category is made up of burning fossil fuels right at the factory to provide energy, plus gases that result from processing chemicals, metals, and ore.
- **Commercial & Residential (12%).** This slice means "Buildings." It doesn't include electricity, which is covered above; it's mostly from burning fossil fuels for heat, cooking, and garbage trucks.
- **Agriculture (10%).** Agriculture's big contribution to greenhouse gases isn't carbon dioxide. It's nitrous oxide, which comes from fertilizer and manure processing, and methane, which comes from—yes—cows and sheep belching. Incredibly, animal gases account for *two-thirds* of all agricultural emissions.

Of course, the U.S. carbon footprint includes a lot of stuff you have no control over, like agriculture and manufacturing. Here, however, is a fascinating graph that shows how much impact *individuals* would have, as a group, if they adopted each of 14 behavioral changes worldwide.

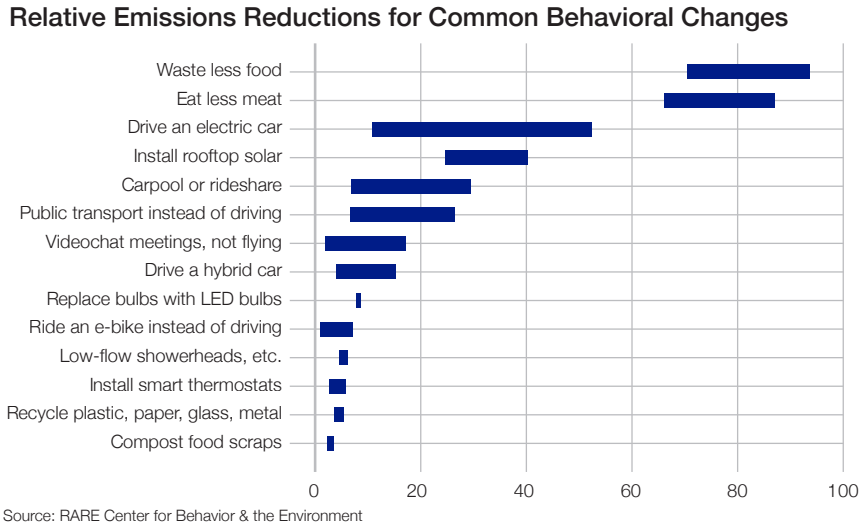

Figure A-2. The ranges of effectiveness shown here reflect varying assumptions about how many people on earth might adopt each of these techniques. Overall, though, this graph gives you a good sense of the relative effectiveness of each behavioral change, expressed in gigatons of carbon dioxide or the equivalent.

Your Carbon Footprint

To begin your own mitigation campaign, it's helpful to know what *your* carbon footprint is. Here's a fun little exercise: Go to carbonfootprint.com. You'll be asked to enter data from things like your electric, gas, and oil bills; flight records for the year; total miles driven; spending on food and drink, furniture, phone, insurance, and so on.

Gases are typically measured in metric tons, each of which is about 2,205 pounds. If you're an average American, you'll discover that you generate something like 20 metric tons of greenhouse gases every year. That's four times the global average. If you're European, where you're likely to have a smaller car, smaller house, and less air conditioning, the average is less than half that.

According to the Deep Decarbonization Pathways Project, everyone on earth needs to bring their footprint down to 1.87 tons a year by 2050 in order to meet the IPCC's 3.8-degree goal.

That won't happen. But by following the suggestions in this appendix, you can probably do a lot better than you are now. As it turns out, the

most damage you probably do to the planet comes in three categories: your transportation, your food, and your home.

Transportation

The single biggest source of carbon emissions in the United States is transportation. It pumps out more CO_2 than power plants, industry, or all the homes in the United States. Chances are, that's your biggest contribution to emissions, too. If you're part of a two-car American family, for example, your tailpipes emit about half of all the carbon your life produces.

You can get better mileage, and therefore lower emissions, by following the usual driving tips: Start and stop gently, keep the tires properly inflated, combine errands, go easy on the A/C, carpool. If you have two cars, prefer the smaller one; drive the SUV or truck only when you have to.

But you can make a much bigger dent by avoiding driving altogether. It's not impossible.

Public Transportation

Gasoline-powered cars and trucks spew out two-thirds of all transportation emissions. As you drive, you pump out almost one pound of CO_2 per mile.

Obviously, public transportation, like subways and buses, is better for the environment than driving. A subway or metro system puts out 76% fewer greenhouse gases per person—in part because they're usually powered by electricity. A typical bus with a quarter of its seats full puts out 33% less.

The government calculates that one driver switching from car to public transport for commuting to work cuts the household's carbon footprint by 8.1%. That's a much bigger drop than you'd get by, for example, replacing 20 light bulbs (1.6%) or insulating your attic (1.2%).

Meanwhile, you're improving street traffic, getting to work more safely, and reclaiming the *time* of your commute. You can watch a video, do email, or sleep.

If public transportation is available to you, and you're interested in reducing your carbon footprint, take it. It's one of the most effective steps you can make.

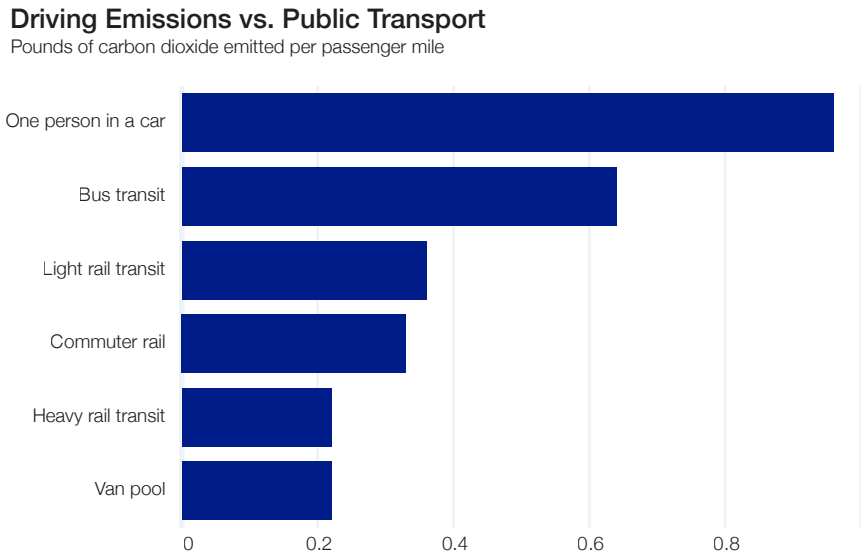

Figure A-3. Driving a gas car is much, much worse than public transport.

Electric Cars

Electric cars are silent and have incredible acceleration. The drivetrain has only 1% as many moving parts as on a gas car, meaning that your maintenance costs are next to nothing. The electricity you'll use to charge them costs about a third of what gasoline does. An electric vehicle (EV) never needs emissions checks, oil changes, or tune-ups; it's got no transmission, spark plugs, fan belts, air filters, timing belts, or cylinder heads.

Oh—and it has no tailpipe, either. An EV produces no emissions as it drives. (Of course, your local power plant produces the electricity you'll use to charge the car, and *it* produces emissions. But with every passing year, more of our grid's power comes from renewable, clean sources. Furthermore, a power plant generates electricity far more efficiently than millions of individual engines built into cars can.)

That's not to say that there are *no* trade-offs involved with owning an electric car. The big one is the time to charge: An EV takes a lot longer to charge than a gas car does to refill.

You recharge an EV, of course, by plugging it in—but there are four different ways to do that:

- **A regular household outlet.** It works, but it's *slow*. We're talking overnight or longer for a full charge. (Keep in mind, of course, that you rarely charge an electric car from zero. More often, you're just topping it off.)

- **A 240-volt (Level 2) outlet.** At home, this is the kind of outlet you'd use for a washer or dryer. Out and about, there are about 70,000 public Level 2 chargers in the United States, in parking lots, garages, shopping centers, and so on. Some are free; at most, you pay for the electricity.

  At these chargers, you get about 20 miles of range per hour of charging. If the car is completely dead when you arrive at a Level 2 charger, it takes maybe five hours to charge fully.

- **A DC fast charger.** About 11,000 of the nation's public chargers are *fast* chargers, so called because they give you about *80* miles of charge per hour. That is, a completely dead car might take three hours to charge fully.

- **A Tesla Supercharger.** A Tesla can use any of the chargers described so far—*and* any of 2,000 Tesla-only Supercharger stations (over 1,000 in the United States), each with spaces for several cars. These stations are generally near restaurants, shopping centers, and cafés, so you have something to do while you're waiting.

  These chargers are *really* fast. Most of them take about 20 minutes to charge a dead battery to 50%, or 75 minutes to 100%.

  The new V3 Supercharger stations, introduced in 2019, do even better. They can charge a Tesla from zero to half full in 11 minutes, or 0 to 100% in 55 minutes. (Every rechargeable battery on earth slows charging when approaching 100% full.)

The other knock on electric cars is that their battery range drops in cold weather. That's partly a feature of lithium-ion batteries—the cold affects phones and laptops, too—and partly because you tend to turn on the heater and seat warmers when it's cold, which draws power from your car's battery. All told, when it's really cold out, an electric car's range can drop a third or more.

To be fair, gas cars' mileage drops in cold weather, too, as much as 22%.

But if you have an EV, you have some battery-warming tricks at your disposal. Keep the car in your garage and plugged in as long as possible, so that the battery isn't as cold as the outside air.

And if you have a Tesla, consider warming up the interior remotely before you drive, using the phone app. As a handy bonus, doing so *also* warms up the battery, minimizing the range loss from the cold.

Used Cars

Once you're judging a car by its cradle-to-grave life-cycle emissions, you can immediately understand why environmentalists recommend buying a *used* car when you need wheels, even if a new model would have somewhat better mileage.

Manufacturing a gas car and transporting it to the dealership pumps out about a quarter of its life-cycle emissions. So if you buy a used car instead of a new one, you're not adding any *new* manufacturing emissions to the air. That used car has already *been* built.

(Of course, this is advice for gas-car aficionados. The math is different for electric and hybrid cars. They pay off their manufacturing carbon debt after a year or two of driving.)

By that same logic, the lowest-carbon lifestyle means hanging onto *everything* as long as you can—clothes, bicycles, mattresses, TVs, computers, phones, furniture. Buying stuff secondhand should give you a rosy glow of doing something meaningful, because buying a new *anything* triggers the manufacture of a replacement somewhere in the world.

Probably China.

Electric Bikes

A car is comfortable and fast, but expensive to own and dirty. Riding your bike is clean and good exercise, but tiring and slowish.

These days, though, there's something in between: an electric bike.

An e-bike looks like a regular bicycle, but there's a nearly invisible motor built into the wheel. It amplifies the power of each pedal stroke you make. With its help, you can accelerate faster, coast easily up hills and into headwinds, and rest occasionally without slowing down.

Legally speaking, an e-bike is still a bicycle, with all of the ease and simplicity that entails. It's not a motorcycle, which requires a driver's license, a

Figure A-4. An electric bike costs between $1,500 and $3,000. For comparison, the average commuter spends $2,600 a year in gas and $3,000 in parking.

registration, a minimum age, a bunch of laws, not to mention noise, gas, and emissions.

Plenty of people, in other words, can get away with an e-bike *instead* of a car, or instead of paying $2.75 a day for bus or subway rides.

What's in it for the planet, of course, is that you're not creating any emissions to speak of. What's in it for *you* is that you don't pay for gas, don't hunt for parking (or pay for it), and you sail through traffic jams.

These things are also *really* fun to ride. You feel a controlled, steady, affectionate boost forward when you pedal, like your dad's hand on your back when you first learned to ride.

An e-bike makes biking cities and suburbs more practical, more desirable, more pleasant. And best of all, an e-bike means that you can bike to work and arrive *not sweaty*.

Plane Travel

If you fly, congratulations: You've just identified your biggest source of carbon.

Cars and planes put out about the same amount of CO_2 per gallon of fuel burned. But planes *also* spew other heat-trapping substances, like water

vapor, black carbon, nitrous oxide, and sulphur oxide. Per passenger-hour flown, planes are as much as 47 times worse than cars, environmentally speaking.

Your average contribution, on a cross-country flight, is 1.6 tons of CO_2, which is like an entire year's commuting in a gas car 15 miles each way.

Airplanes produce 2.5% of all human carbon emissions. But that percentage is rising fast—as the world's population grows, as the Asian middle class rises, and as more electricity on the ground is generated cleanly.

Unfortunately, there aren't many trade-off-free alternatives to flying. Occasionally, though, you may be able to make one of these options work:

- **Drive.** Some trips are short enough that you could *either* drive *or* fly—New York to Boston, Phoenix to Dallas, for example. In that case, the emissions math is complex and fluid, because there are so many variables. What mileage does your car get? How many people will be in it? How many people are in the plane?

  As a general rule, go by this: If you're driving alone, and your car gets under 40 mpg, you're better off flying. (Not included in that calculation: the duration and misery of the trip, your need to do work or sleep in transit, cost, and dealing with TSA.)

- **Amtrak.** The train isn't an option for every trip; riding the Amtrak from LA to New York, for example, takes almost three days, versus 4.5 hours by plane. And that's *if* the Amtrak is running on time.

  But for some trips, especially up and down the East Coast, the train is cheaper than flying, far less stressful, and much more comfortable. And once you've factored in "get to the airport an hour before the flight," getting through security, and waiting for your luggage, the train may actually save you time.

- **Greyhound.** These buses are nicer than they once were, and they've got power and Wi-Fi at every seat. But, you know. They're buses.

- **Video chat.** Yeah, yeah, we know: There's nothing like a firm handshake to seal a business deal.

  But as we learned during the coronavirus pandemic, so many meetings and pitches and conversations do just as well over videoconferencing services like Zoom, WebEx, Google Hangouts, Skype, FaceTime, and so on.

How Not to Fly to Conferences

It's all very well and good to say, "don't fly as much." But what if you *have* to fly? What if it's your job? What if, for example, you're in academia, where you get promotions and tenure based, in part, on how many presentations you've made at conferences?

There are ways around it.

An increasing number of organizations, for example, are permitting speakers to make their presentations remotely, by video chat. The pandemic gave this approach a rather massive boost.

One option is to establish a constellation of local hubs, which attendees can reach without flying. Each hub has its own local keynote speaker and panel discussions, but there are also panel sessions and discussions held, by video, *across* all of the hubs.

At one such conference, organizers calculated that per capita carbon emissions dropped 70% compared to in-person conferences. As a bonus, the number of countries participating rose by 50%. These systems make conferences far more accessible to scholars in less wealthy countries, to everybody's benefit.

For smaller conferences, another approach is to conduct the entire thing virtually. The speakers upload videos of their talks in advance to a conference website. The long-distance "attendees" can watch the talks and then ask questions and interact with the speakers online, in chat rooms. Using this method, the "conference" can last several weeks, generating far more discussion and interaction than a live one, where only a couple of people get to ask the speaker questions after the talk.

University of California at Santa Barbara professor Ken Hiltner has put together several conferences this way—and written a step-by-step article explaining how you can do it, too. It's available at https://hiltner.english.ucsb.edu/index.php/ncnc-guide.

These ideas drastically cut down on flying—and carbon. They also, of course, eliminate the face-to-face, spontaneous hallway conversations that are often the most valuable parts of attending conferences. The closest the organizers can come is to make sure that the chat rooms, social-media channels, and discussion boards are open, available, and flawless in operation.

- **Buy offsets.** If you have to fly, you can, in theory, soften the environmental impact of your flight by buying *carbon offsets,* described below. The option to buy them is built right into most airlines' apps or websites; you'll pay, for example, about $8.50 to offset the carbon from a New York–Los Angeles flight.

Of course, a given flight is still going to take off and pollute even if you're not on board. But the thinking is that if *enough* people find alternatives, the airline will eventually schedule fewer daily flights on that route, and total emissions will drop.

Carbon Offsets

When you buy a carbon offset, you're giving money to projects around the world that remove carbon from the air or prevent it from getting there. Such a project might be building wind farms or solar arrays, paying for a methane-capture system for manure fields or landfills, or planting or rebuilding forests.

The idea is: "Well, OK, my share of that flight was 0.7 tons of carbon dioxide added to the atmosphere. I can pay $9 to a carbon-offset company who will use that money to keep 0.7 tons of CO_2 from getting into the air somewhere else."

Paying to offset your carbon creation is better than nothing, but it's controversial. The critics recoil at the notion that you're paying other people to cut *their* emissions so that you don't have to. It shouldn't be a license for you, the wealthy person, to pollute. It's much better not to pollute in the first place.

("When you cheat on your partner, you add to the heartbreak, pain, and jealousy in the atmosphere," said a parody site a few years ago. "Cheat-neutral offsets your cheating by funding someone else to be faithful and not cheat," which "leaves you with a clear conscience.")

There's another problem, too. How do you know that your payment *actually* reduces emissions somewhere else? Some carbon-offset efforts aren't meaningful, and others are straight-up scams.

To explain how a carbon-offset program could lose its punch, the National Resources Defense Council uses the example of a fund that pays Amazon farmers not to cut down their forests. The program is no good

unless it's verified (somebody checks in on it), enforceable (there's a penalty if the farmer backs out), permanent (the farmer can't just take the money now, and then burn his trees a month later), and *additional* (someone has to prove that the farmer never intended to clear-cut his forest in the first place). Ideally, the project won't be susceptible to "leakage," either (loggers just move down the road to a different forest, resulting in no improvement).

Fortunately, watchdog organizations now confirm all of these aspects of various carbon-offset companies for you, such as Green-e and Gold Standard.

Most airlines let you buy offsets when you buy your flight, either in the app or on their website. In those cases, you can trust that your money will go to validated offset projects.

If you'd rather buy your offsets directly, you can go to a site like atmosfair or Cool Effect and pay for it on the spot. There's also terrapass, which lets you offset your broader carbon footprint—beyond flying.

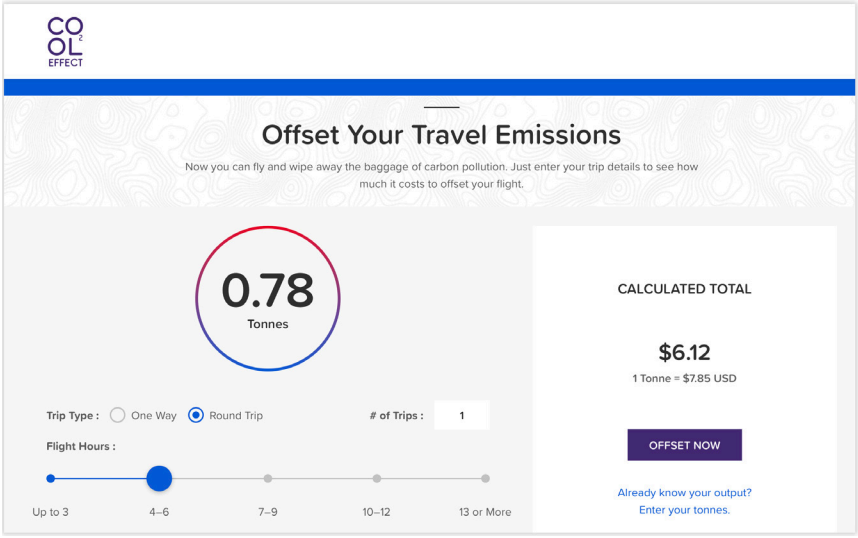

Figure A-5. At CoolEffect.org, you can calculate your flight's carbon emissions and buy offsets that equal them. ("Tonnes" is the British spelling.)

Cruises

The average new American car gets 25 miles per gallon. A cruise ship gets *two one-thousandths* of a mile per gallon. That's 12 feet per gallon.
Mile for mile, a cruise ship is worse than train, car, bus, or even plane. And that's not counting the flights people take to get *to the cruise*.

Yeah. It's bad.

Food

As you know from Chapter 17 of *How to Prepare for Climate Change*, beef is a *huge* problem. Americans eat 222 pounds of meat a year—which produces about the same emissions as your share of 56 flights from New York to London.

Raising meat animals is responsible for 14.5% of *all* human-generated greenhouse gases, and cows are two-thirds of that. If cattle were a country, they'd be the third biggest greenhouse-gas polluter on the planet, right behind China and the United States.

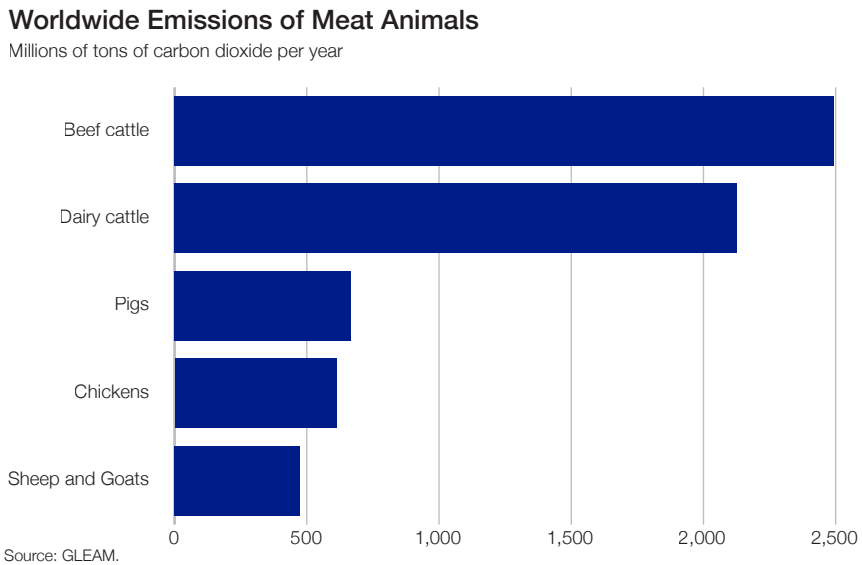

Figure A-6. Cows are by far the worst meat animals for the future of our life on Earth.

They're a perfect storm of gas generation. Consider:

- **Methane.** In their stomachs, cows and sheep ferment the grasses or grains they eat. That process produces enormous amounts of gases, which the animals release as burps and farts. A single cow belches up as much as *12 gallons of gas an hour.*

  Half of the upburped greenhouse gases are carbon dioxide and nitrous oxide, but the rest is *methane*, which is 80 times worse than CO_2 at trapping heat during its first 20 years in the atmosphere. It's awful, awful stuff.

  Chicken, fish, and even pork are far less damaging.

- **Land.** Every cow spends at least two-thirds of its life in grassy pastures: six months hanging out with its mother, then six months eating grass.

  At that point, 95% of U.S. cattle are sent to feed lots, which industry executives call CAFOs—Confined Animal Feeding Operations. There, they eat grain, corn, hormones, and antibiotics (the cows, not the executives).

  The other 5% of U.S. cattle finish out their lives eating grass in pastures. They take longer to grow older, their meat is leaner, and, fans say, they're much happier.

  The point is that *all* cows need a lot of land for most of their lives—and they get it. About 30% of the *entire ice-free land area of the planet* is dedicated to livestock grazing.

  To make more land for cows, we generally burn or cut down forests, which releases millions of tons of CO_2 that the forests had been storing.

  On a per-calorie basis, we need *160 times* more land to raise cows than to grow potatoes, wheat, and rice. And we produce 11 times as much greenhouse gas in the process.

- **Water.** Almost half of all water in the United States is used to raise food animals—mostly cows. To bring you one pound of beef, the agricultural system consumes 2,400 gallons of water. That's 4 times as much water as you'd need for pork, 5 times as much for chicken, and about 100 times as much as you'd need for wheat.

- **Feed.** Producing one pound of beef requires *eight* pounds of soybeans, corn, and so on. That's eight pounds of food that people could have eaten directly.

- **Fertilizer.** Cows and sheep consume staggering quantities of fossil fuels, too. Not by drinking them—by eating corn and grain, which we grow by spreading 188 million tons of chemical fertilizer every year. We make fertilizer in high-temperature tanks, which are heated by—what else?—burning fossil fuels.

  All told, each cow requires burning 284 gallons of oil. There are 1.3 billion cows standing around eating grain at this moment.

- **Life span.** The final problem with red-meat animals is that they spend a *long time* producing greenhouse gases before we kill them and eat them. We slaughter most cattle when they're about 1.5 years old. For comparison, we slaughter pigs when they're only six months old and chickens at six *weeks*.

  In other words, a cow keeps doing its damage to the climate many times longer than its competition. And not just from the 1.5 years of belching. "It also means producing all this food, using all that acreage, the water, the fossil fuel, the fossil-fuel–generated pesticides, all the nitrogen that's used to make these crops," notes nutrition author Sharon Palmer.

The bottom line: The steak or burger that lands on the average American's plate twice a day required 28 times as much land to raise as pigs or chickens, used 11 times more water, and pumped 5 times as much greenhouse gas into the atmosphere.

"Without dietary change, there is just no way we can avoid dangerous levels of climate change," says Oxford food-systems professor Marco Springmann.

Cutting Back

You now know the environmental argument for cutting back on red meat. But that's not the only reason:

- **The financial argument.** In the age of climate change, everything gets more expensive: real estate in safe areas, insurance, medical care, and especially beef.

  "We're going to be moving away from animal foods in general, because they use more land and water," says Diego Rose, professor of nu-

trition, public health, and agriculture at Tulane University. "The worst offender, of course, is cattle. So I would guess the price is going to go up a lot, because it's going to be more expensive to raise. Beef is going to become more of a luxury."

And if, as many experts expect, a national carbon-tax program goes into effect, red-meat prices will be hit extra hard. Developing a diet that's less dependent on red meat *now*, in other words, will start protecting you immediately from the price jacking that's to come.

- **The health argument.** In a classic 24-year Harvard study of 120,000 people, researchers found that every additional daily serving of red meat you eat increases your chances of dying prematurely by 13%.

  You're one Google search away from uncovering similar studies that establish links between beef and heart disease, strokes, breast cancer, colorectal cancer, diabetes, and obesity.

  Being healthy has always been an excellent goal, but in the new era, it's going to be even more essential.

  "We're gonna have to get really fit for climate change," says Nick Nuttall, former director of communications for the UN Framework Convention on Climate Change. "Will you be healthy enough to withstand heat waves, the spread of infections, and the disruptions of the normal food-supply chains?"

  In other words, what you eat will become increasingly important, especially if you're over 50; you are particularly vulnerable to suffering from high temperatures, disease, and pollution.

  "If you're planning for climate change, plan to be super fit," Nuttall says. "Darwin was right."

- **The disease argument.** Every year, one in six Americans—48 million people—get sick from contaminated food; 3,000 of them die. Those numbers are rising, too. The populations of sick-making bacteria like campylobacter, salmonella, and STEC shot up 96% between 2014 and 2017 in the United States, thanks to 15 multistate food-poisoning outbreaks a year.

  Improved testing and detection explains some of those numbers, but climate factors are at play, too. First, the bacteria replicate faster and better in warm weather. Second, runoff water from massive storms washes over animal feces, contaminating the water supply.

As it is, most of the foodborne microbes come to you aboard hunks of meat; when they arrive on fruits and vegetables, it's often because those were grown in a field *next* to meat animals. "An increasing number of outbreaks are associated with the consumption of fruits and vegetables, due to contact with feces from domestic or wild animals at some stage during cultivation or handling," notes the World Health Organization.

Or, as Palmer puts it: "You're a vegetable farmer and your next-door neighbor is a cow farmer. What can you do about that?"

The Adaptation Diet

If you're not a frequent flyer, the single greatest thing you can do for the environment—and your own health—is to eat fewer animals.

But what will you eat for protein?

Pulses.

Pulses are beans, lentils, peas, and chickpeas. They're part of the legume family—plants grown in pods, like beans and peanuts—but include only the dry, edible seeds inside the pods. ("Pulse" comes from the Latin *puls*, meaning "thick soup.")

Palmer notes that pulses are the highest protein source of plant foods. They cost less than beef, they're drought resistant, they don't need a lot of water, and they don't need a lot of pesticides. And they supply their own fertilizer by capturing nitrogen from the air and depositing it into the soil. "Pulses are really wonderful," she says.

You don't have to go cold turkey on hot beef. But the more you replace red meat with plants, the more of those benefits you get. Some is better than none.

As it turns out, there are two avenues for swinging your personal pendulum toward plants without sacrificing any pleasure in eating:

- **Plant-based beef.** The agricultural world—and even Silicon Valley—are paying attention. They know that, as the medical journal *The Lancet* puts it, "intensive meat production is on an unstoppable trajectory comprising the single greatest contributor to climate change. Humanity's dominant diets are not good for us, and they are not good for the planet.

The plant-based burgers from companies like Beyond Meat and Impossible Foods look, cook, feel, smell, and taste astonishingly close to ground beef. And yet they're meatless. Their protein comes from peas, soybeans, beans, and rice. These burgers are environmental home runs.

You can get these burgers at chains like Burger King and White Castle (Impossible Burger), Dunkin', Carl's Jr., and Tim Hortons (Beyond). The Impossible Burger is on the menu in 7,200 U.S. restaurants. Both are sold in grocery stores, too.

- **The protein flip.** Nutritionists and environmentalists, aware that asking American and Chinese eaters to give up meat entirely is a hopeless ambition, offer another strategy that holds more promise: Think of meat as *an* ingredient, and not *the* ingredient.

  "People think, 'What's for dinner? Is it chicken, fish, or beef? They just can't think of a meal without meat at the center of the plate," says Palmer.

  Tulane's Diego Rose believes that moving away from the slab-on-the-plate model is the future. "There are lots of cultural traditions in which meat is part of the dish—almost like a flavoring or seasoning. It's there, it's part of the dish, but it's not the whole dish."

The Dairy Problem

According to the latest science, most dairy products come from cows, too.

And that's really bad news, because cows are methane machines whether we're squeezing milk out of them or chopping them up. Dairy cows brutalize the atmosphere *slightly* less than beef cows, but they're still many times worse than pigs, chicken, or fish.

You can probably imagine dialing back on red meat a little, but dairy is another story. Who would stop giving their children milk? Who would give up cheese? Cream, cream cheese, sour cream? Yogurt? Who would give up mozzarella on our pizzas? Who would give up *ice cream*?

In the United States, there's some good news. Lately, the answer to "Got milk?" is "Not as much as before." Our milk consumption has dropped 22% since 2000.

But we've been making up for it by scarfing down record amounts of cheese, butter, and yogurt. Meanwhile, in China, dairy consumption has more than tripled since 1982. That's why, globally, dairy production is expected to grow about 2% a year over the next decade.

There are all kinds of dairy-product alternatives: oat milk, soy milk, almond milk, hazelnut milk, cashew milk, walnut milk, peanut milk, macadamia milk, coconut milk, rice milk, hemp milk, pea milk, flax milk, banana milk.

These plant-based milks are *much* better for the planet. Producing cow's milk generates three times as many greenhouse gas emissions as even the worst non-cow milk, and requires ten times as much land.

They're catching on, too: Sales shot up 60% from 2012 to 2017. Most of the sales is almond milk.

The dairy industry is freaking out. Its trade group even tried to get the word "milk" banned from use on non-cow products. Federal courts have consistently shot down those lawsuits, though, pointing out that any idiot would know that a carton labeled "almond milk" doesn't contain cow milk. "Under Plaintiffs' logic," wrote one judge, "a reasonable consumer might also believe that veggie bacon contains pork, that flourless chocolate cake contains flour, or that e-books are made out of paper."

If you have any interest in testing the waters—or the milks—you have three factors to consider:

- **Taste.** Nothing tastes exactly like cow milk. But in many milky situations, you won't know the difference, or you may even prefer the taste of the alternative. Banana milk, for example, is a hit in smoothies and baking; pea milk is great in smoothies and shakes; and rice milk doesn't affect the flavor of coffee at all, in *Food and Wine*'s testing.

  The testers raved, in particular, about oat milk: "Very close to real milk, its flavor is a bit reminiscent of how milk tastes after it's had shredded-wheat cereal sit in it for a while. Which is a good thing."

- **Nutrition.** You have to hand cows one thing: Their milk is loaded with protein, calcium, amino acids, vitamin D, iron, potassium, phosphorus, B vitamins, magnesium, zinc, and so on.

  Most plant-based milks are less fattening than cow's milk, have less sugar, and have very little fat, and they have plenty of calcium.

But most cowless milks have almost no protein. Only fortified soy and pea milks have about the same protein as cow milk.

You, the human being old enough to be reading a book about climate change, probably eat plenty of protein. You can safely delve into non-dairy milks.

- **Children.** The big question, though, is children.

  Children's nutrition is a minefield of controversy, so when feeding yours, follow your heart, which should in turn follow the advice of a pediatrician or nutritionist.

  This is what they'll tell you: Children need protein and fat to grow. Cows' milk is an easy, convenient way to deliver them, and most plant-based milks aren't. Cow's milk is usually fortified with vitamin D, too, which isn't found in very many foods.

  That may be why four prodigious scientific armies—the American Academy of Pediatrics, the American Heart Association, the Academy of Nutrition and Dietetics, and the American Academy of Pediatric Dentistry—joined forces in 2019 to issue these recommendations:

  Birth to 12 months: Breast milk or formula. *1 to 2 years old:* Whole milk and water. *2 to 5 years old:* Skim or 1% milk. No plant-based milks.

  Over 5: Kids over five don't *need* to drink milk at all. It's possible to get vitamin D from other fortified foods—cereal and orange juice, for example—and protein and fat from all kinds of sources. But getting all that into your kid without milk takes more planning, effort, and, again, the supervision of a doctor or nutritionist.

  "When choosing a non-dairy milk, make sure it's fortified with calcium and vitamin D," recommends *Parents* magazine. "And look for varieties labeled 'unsweetened.' One brand of 'original' almond milk contains almost two teaspoons of added sugar per cup."

Food Waste

In climate-science circles, you can't talk long about the food problem without hearing this astonishing statistic: In the United States, we throw away 40% of the food we grow.

That's $2.6 trillion of food in the trash every year. About 60% is lost before it ever reaches us; the rest, we throw away after we've bought it. We

buy more than we cook, we cook more than we serve, and we serve more than we eat. All told, an average American family blows $1,800 on uneaten food a year.

The EPA reports that, incredibly, there's more discarded food entering our landfills than plastic, paper, glass, or any other single material.

And what's wrong with that? Only that decomposing food in the landfill releases methane, the greenhouse gas from hell.

We're not just throwing out the food; we're also throwing out all the fertilizer, water, and land that we used to produce it. We're also producing, pointlessly, the thousands of tons of greenhouse gases released in its growing, processing, packaging, shipping, and storing—the equivalent of 37 million cars' worth of emissions every year.

Imagine, if we could snap our fingers and have 40% more food! We wouldn't need genetic engineering, or dietary shifts, or carbon pricing. It's food we've already grown.

The "40-percent wasted" figure came from a 2012 study by the National Resources Defense Council, which now attempts to combat the problem through public-awareness campaigns, partnerships with cities, and federal advocacy efforts. (The NRDC has a great poster image summarizing the issue: A milk carton bearing what you expect to be a "Best if used by" stamp—but it says only, "Best if used.")

The six foods we discard most often *while they're still edible* are coffee, milk, apples, bread, potatoes, and pasta. On Thanksgiving Day, we also trash *200 million pounds* of uneaten turkey.

It doesn't help that nobody has a clue what the "Sell by," "Enjoy by," and "Best if used by" dates mean on food packages. There's no law about what those dates mean—every such proposal gets food-lobbied out of existence in Congress—so they can be whatever the food maker wants; clearly, their interest is in getting you to throw away as much food as possible. Here's a hint, though: *None* of those dates mean "Unsafe to eat by."

The biggest contributor to food waste in cities is restaurants and caterers. But cities oversee schools, grocery stores, hospitals, hotels, and other businesses, all of which throw out massive amounts of uneaten food. Cities make their own rules for trash management, land use, and food regulations, which makes them a key player in the attempt to rein in food waste.

Fortunately, there's considerable reason for optimism. In 2015, the

United Nations and the U.S. EPA both set goals to cut food waste in half by 2030.

Businesses all through the food system have recently committed to reducing wasted food, too. (It's a lot easier to do what's right when it saves you money.) The Consumer Goods Forum, a trade group of 400 companies, has committed to halving food waste by 2025.

If you, the consumer, want to take a stab at cutting down the amount of food you waste, stop by SaveTheFood.com. There, you'll find tips for meal planning, re-using leftovers in new recipes, fixing recipes you've overcooked or oversalted, freezing and storing individual food types, and so on. There's even the cleverly named Guest-imator, which lets you calculate how much food you'll need for each dish when you're prepping for a gathering.

If you have a yard, you should also consider composting your food scraps instead of tossing them into the trash. Trash winds up dumped into landfills, where those scraps decompose and release methane into the air.

Homes

Our homes account for 22% of all the electricity used in the United States—and therefore, 22% of all the emissions from the power-generating industry.

If your home is typical, 36% of your power goes to heating and cooling; 13% is for your hot-water heater; and everything else is for appliances. The beauty of making tweaks to your energy use is, of course, that you're not just reducing your carbon footprint; you're also saving money.

A lot of the usual advice should sound familiar: Make sure your home is well insulated and sealed. Turn off lights when you leave the room. Unplug equipment and appliances when you're not using them (to avoid having them suck down "phantom power"). Live with the thermostat at 68°F (winter) and 76°F (summer). Replace your lights with LED bulbs (which last longer than you'll be in your home, and use only 15% as much power as incandescents). Chapter 3 offers some concrete suggestions on making your home cooler in summer and warmer in winter.

Then there are tips that may not have occurred to you:

- **Turn down your water heater's temperature.** It needs to be 120°F to kill off Legionnaires'-disease bacteria, but anything hotter than that wastes money and power all year long.

- **Turn up your fridge temp.** The government's recommendation is: 0°F for the freezer, 35°F to 38°F for the fridge.

- **Power down the ice maker.** If you're not using the automatic ice maker in your fridge, turn it off and enjoy the 15% energy savings.

- **Watch Netflix through your smart TV, not your game console.** A PlayStation or Xbox uses ten times the power to play streaming movies and shows.

- **Upgrade your major appliances.** A modern fridge uses 40% less electricity than one sold in 2001. If it bears the government's Energy Star logo, it uses another 15% less power than logo-free models. Furthermore, a refrigerator with a top-mounted freezer uses as much as 25% less energy than side- or bottom-freezer models.

- **Drop the temp at night.** If you set your thermostat and forget it, you're wasting a nutty amount of energy. You're heating or cooling your house when there's nobody in it. You may as well leave your car running when it's sitting empty in the garage.

  The beauty of a programmable thermostat is that it can warm or cool the house only when somebody's home. During the workday, or when you're upstairs sleeping, it can save money and energy.

  But only 30% of U.S. thermostats are programmable, and of those, about half never get programmed.

  It's worth getting a programmable model—they start at $25—*and* learning how to program it. You'll save 15% on your heating bill every winter (in an average home, that's $315) and $75 on air conditioning every summer.

- **Switch to a cleaner electricity provider.** In the 16 states that have deregulated their utility industries, you're allowed to choose a source for your electricity. This change means that you can switch to a less expensive energy supplier—or one that uses more renewable power.

  Making this switch doesn't involve any rewiring. Your current local utility will still read your meter, send you bills, and handle your service calls, and you won't experience any interruption in power. What *will* happen, though, is that your local utility will start drawing its power from the provider you choose.

Figure A-7. If you live in a deregulated-power state, you can choose a new electricity provider that's greener, cheaper, or both.

These are the states where you can make this kind of switch: Connecticut, Delaware, Illinois, Maine, Maryland, Massachusetts, Michigan, Montana, New Hampshire, New Jersey, New York, Ohio, Oregon, Pennsylvania, Rhode Island, Texas, and Washington, D.C. Note, however, that states pass or repeal these kinds of laws frequently, so Google "deregulated energy Maine 2021" (or whatever) to confirm your state's current status.

If you're one of the lucky ones, visit a site like www.CompareElectricity.com or PowerSetter.com, enter your zip code, and marvel at the choices arrayed before you. Some probably offer less expensive electricity than what you've been paying; some may offer more renewable electricity; some may offer both. You can click a Select or Choose button right there to make the switch.

- **Run the dishwasher.** The dishwasher uses much less energy than heating the water for handwashing does. Scrape the scraps off each plate, but *don't rinse* before loading them. Your dishwasher is perfectly capable of doing that. Try it!

- **Start a garden.** Everything edible that you can grow saves the world a lot of trucking emissions. See Chapter 4.

- **Wash all your clothes in cold water.** You may have grown up being told to use warm water for white and light-colored clothes, and cold water for darks. But times have changed; modern liquid laundry detergent is designed to work in hot *or* cold water. It's amazing but true: You can use cold water for *all* your laundry. Your clothes will last longer *and* you don't burn fuel to heat all that water.
- **Replant the lawn.** See the end of Chapter 4 for the rationale—and the replacement.
- **Consider solar panels.** Environment? Sure. But also money in your pocket. See Chapter 3.

The Rest of Your Life

Your transportation, your diet, and your home are the Big Three of carbon reduction. But there are thousands of other ways you can tweak your lifestyle to lower your carbon emissions. In general, you've heard them all before: Use less energy, because (in most states) electricity still involves burning fossil fuels. Drive efficiently—tires inflated properly, engine tuned—because burning gasoline releases CO_2. Plant trees with your kids.

You should feel great about joining the fight against plastic, too, because plastic and climate change are deeply entangled. First, plastic requires massive amounts of heat, which comes from burning fossil fuels. Second, seven of the ten largest plastic producers are oil and gas companies. The more plastic we use, the more petroleum they'll extract and heat to give it to us.

And finally, the general rule is: Consume less, because the manufacture and shipping of everything produces emissions.

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