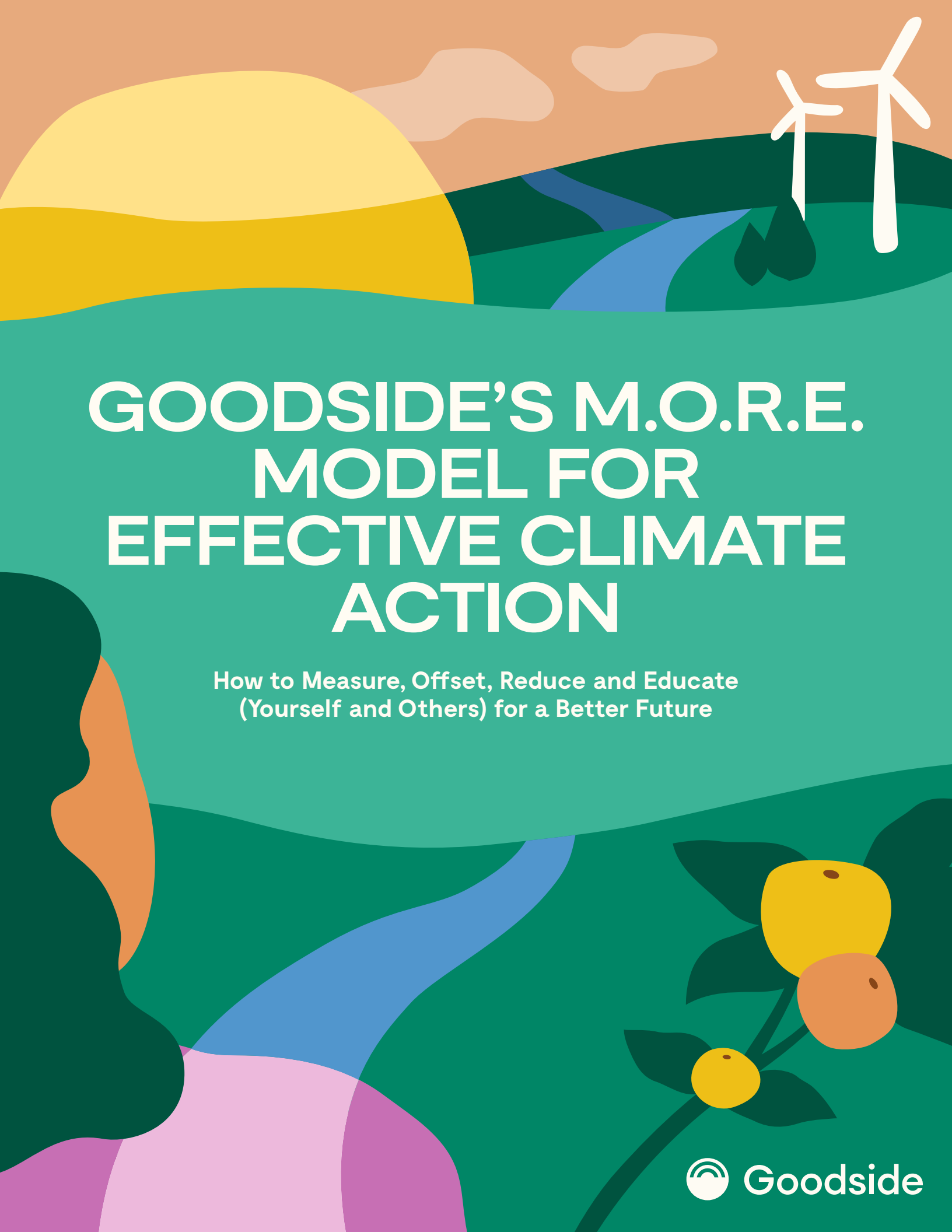


GOODSIDE'S M.O.R.E. MODEL FOR EFFECTIVE CLIMATE ACTION

How to Measure, Offset, Reduce and Educate (Yourself and Others) for a Better Future

Goodside

Introduction

By Amy Valm

If you're reading this, chances are high that you already know a few things about the climate crisis, and understand that global warming and climate change are more than just buzzwords that get casually tossed around when the thermometer spikes.

You're probably aware that climate change is an extremely real threat that keeps sending out urgent messages in the form of melting glaciers, deadly heat waves and increasingly severe tropical storms.

The Earth is basically begging us for our attention and effort. Good thing you're here.

Ever since we discovered fire, humans have been burning things—to stay warm, to cook food, to create ever-more-sophisticated technologies and, in more recent centuries, to get around. All laudable goals, on the face of it. The trouble is, the amount we've burned has gotten to be more than the planet's natural systems can handle, and now that we know that, it's time to take stock—and make some major changes.

The thing is, the consequences are major. And we're on a tight timeline to turn this bus around. If this were "Speed," Keanu would be at his breaking point, very tired and sweaty from non-stop bouts of heroism.

> **“ Fighting climate change needs to be our life's work.**

The good news? We don't have to be all doom and gloom. It is possible to stay upbeat while fighting climate change, and to look forward to the positive changes (and there will be positive changes!) many climate solutions will bring to the world. It's not just about deprivation—we're starting something, too. Building a new future.

Fighting climate change needs to be our life's work. We're not going to fix this overnight. It's a marathon, not a sprint, as they say—and that means we need to train for it. So start with this ebook.

Why we like to think positive

Is it hard to know where to start when the problem seems so vast and your contribution feels insignificant? Definitely. But flip the script and remember that you're one human on a planet of 7.8 billion (and counting) other humans who can all pitch in. Your participation might be just a drop in the ocean, but don't dismiss those small ripples it creates.

Those ripples can form a wave, a wave we can all ride into a better future. Beyond your specific actions, like driving less and eating more plant-based meals, you're inspiring the actions of others. The vegan casserole you brought to the Friendsgiving potluck encouraged your pal Brad to ask for the recipe and include it in his weekly food prep! Your neighbors spotted the mid-century modern teak sideboard you scored on Facebook Marketplace and decided to shop vintage for their own decor upgrade!

It's subtle—so subtle you might not even see it at first. But in every action you take, you can be the change the world needs.

Goodside's MORE model for effective climate action

As we mentioned, it was really important to us that this book actually be fun to read, while delivering the facts you need to know. We've broken it up into four chapters, but you don't need to read them in order—each chapter can stand alone, so start with what you're most interested in.

Here's what you'll find:

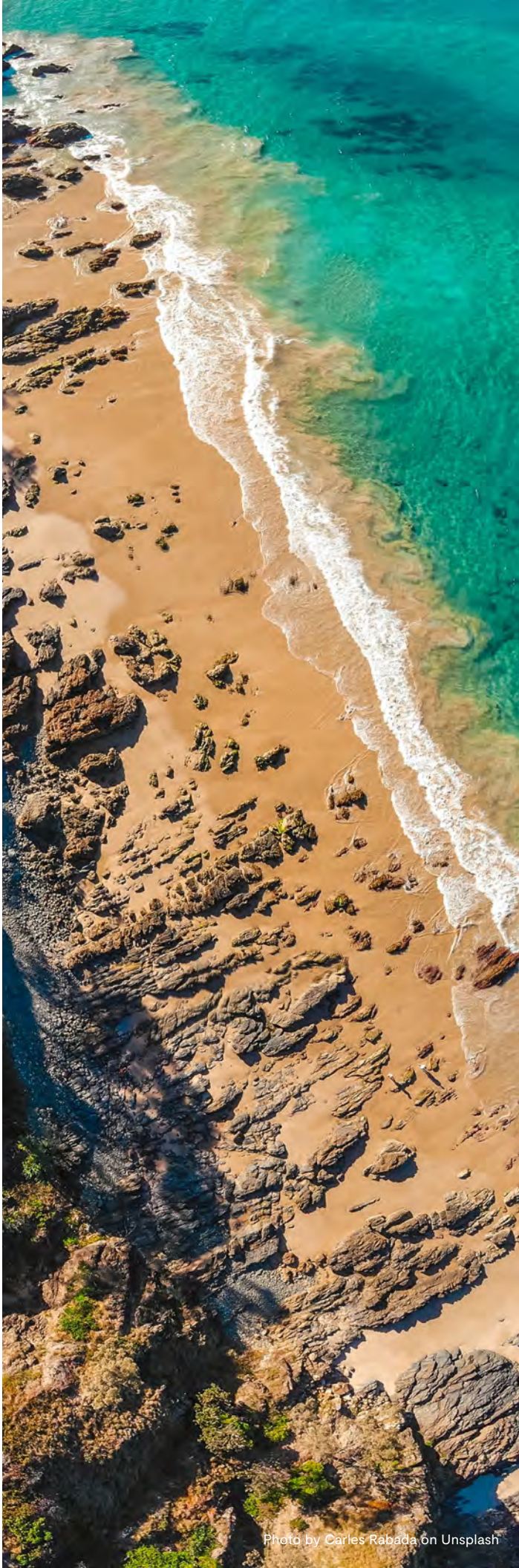


Photo by Carles Rabada on Unsplash

M.O.R.E

Measure

The devil's in the details. This chapter is all about figuring out your carbon footprint: what it is and how to calculate it, plus some eye-opening statistics on emissions by country.

M.O.R.E

Offset

We all create at least *some* carbon, but the good news is, there are effective ways to balance the scales. Enter carbon offsetting and everything you need to know to help yourself—and the companies you support—become more carbon neutral.

Reduce

There's a slew of ways to reduce global carbon emissions, many via shrinking your own personal carbon footprint. This info is to inspire and propel the awesome work you're already doing. Or planning on doing.

Educate

(yourself and others)

The amazing thing about learning is it's never a waste. The topic here is climate change, and our essential guide shines a light (LED, of course) on the nitty-gritty of global warming, the long-term effects of climate change and, good news, possible fixes.

Fighting for the future

Our goal with this book is to arm you with the know-how to easily adopt lifestyle changes, habits and actions that will aid in your efforts against the climate crisis. We spent months researching, writing and revising (and revising again) to reach just the right balance between in-depth and concise. You'll find the information you need to feel educated about climate change, and confident in sparking conversations with family and friends—or answering their questions.

This is an opportunity to develop a new way of thinking and a new way of living. And, as you'll learn through these chapters, it's doable. Making a conscious effort to train yourself into better habits can—no, WILL—have an impact on dozens, maybe hundreds, even thousands of people.

> **"This is an opportunity to develop a new way of thinking and a new way of living.**

Excited to get started? Let's do this.

Table of Contents

CHAPTER 1

Learn Everything You Need to Understand Climate Change

By Lisa Jackson and Lauren Jerome

Ready to learn about climate change? Let's get into it. Read on for all the facts, from the causes of the greenhouse effect and global warming to the consequences of climate change and possible solutions.

Climate Change Is Real and It's Happening—to All of Us. Here Are the Facts

Whether it's articles popping up on your newsfeed or a heated dinner table discussion, there's seemingly endless information to digest about climate change. With so many stories swirling in the news and on Twitter, it can be hard to get a handle on climate change definitions, what's real or "fake" news and how it's all connected. As an environmentally conscious citizen, you've undoubtedly got questions, like what can we do to slow global warming? Is it even possible to reverse climate change at this point?

Our understanding of how the climate works is constantly being refined based on what scientists are learning, but the key points—and what we need to do to change things—are well understood. Here are the current facts as we know them today.

In this chapter:

Photo by Parsing Eye on Unsplash

1.1
Give it to me straight: What is climate change?

Buckle up, because we've got a lot to cover. But before we dive into climate change science, let's first get a handle on the meaning of climate change, the definition of global warming and other must-know terminology.

Consider this your cheat sheet to the main facts:

- → "Climate change" refers to long-term shifts in weather patterns.
- → Yes, the climate has changed naturally over the past 650,000 years, fluctuating between ice ages and warmer periods.
- → But modern-day climate change is *not* a naturally occurring phenomenon. It refers to alterations in weather patterns caused by human activities.
- → "Global warming" is one measure of climate change and refers to a rise in the average global temperature. Human activities such as industrialization, deforestation and intensive agriculture have increased emissions of greenhouse gases (we'll call them GHGs, starting now), causing temperatures to rise.
- → Extreme weather events, rising sea levels and melting polar ice caps are some of the effects of climate change.
- → Although the climate has shifted throughout the Earth's history, this is the first time that climate change has been human-caused and happened so rapidly.
- → Looking at the climate change timeline, scientists report that temperatures are rising faster now than at any other time in history. The average global temperature on Earth has risen a little more than 1.8°F since 1880, and today's atmosphere contains 42 percent more carbon dioxide than it did before the industrial era.
- → The resulting negative effects of climate change, like rising temperatures and sea levels and extreme weather events, have far-reaching social, economic and political implications across every sector of society.
- → Some of the most disturbing data on climate change is that it will not happen gradually—like a line rising steadily on a graph—but rather as a series of "tipping points" that can form a cascade, unleashing a "domino effect" of irreversible consequences.

> **"Today's atmosphere contains 42 percent more carbon dioxide than it did before the industrial era.**

The consensus among experts—people who study climate science for a living—is that climate change is happening, and human activity is causing it.

While a small number of climate change deniers do exist—and they can be noisy—their anti-climate change arguments have been debunked by the scientific community. (More on this below.)

But why is it happening? What is the science behind climate change?

The basic scientific facts about climate change are actually simple, and interesting too. Here are the top three things you need to know:

→ The average global temperature is directly linked to the concentration of greenhouse gases in the atmosphere. (See below for more on GHGs.)

→ The concentration of greenhouse gases has been rising steadily since the Industrial Revolution, and global temperatures are increasing as a result.

→ Carbon dioxide (CO_2) is the most abundant, accounting for about three-quarters of GHGs. Its increased concentration is largely due to burning fossil fuels.

Climate change vs. climate crisis: What's in a word?

If you've ever tried to rope a buttoned-up friend into doing something exciting but risky, you know that you have to use the right words to convince them. The same goes for getting people to care about climate change.

Some media outlets, like the British newspaper *The Guardian*, are revamping style guides "to introduce terms that more accurately describe the environmental crises facing the world." Phrases like "climate emergency" and "climate crisis" may be used instead of "climate change," or "global heating" instead of "global warming."

This new terminology reflects shifting attitudes and attempts to better capture climate change science. You'll note the level of urgency injected into some of the lingo, which also acts as a rallying cry for us all to fight the climate crisis.

Language really does matter, and how words are used can influence the public's reaction.

For starters, scientific language can be very dense and jargony, making it difficult for laypeople to understand. This has prompted the scientific community to "rebrand" climate change concepts.

For example, scientists once used the entirely unrelatable term "inadvertent climate modification" to describe human-caused climate change. This went on until the scientific community came up with two new terms in the 1970s: "global warming" and "climate change." These are simpler, more relatable concepts that resonate with those of us who don't know our way around a lab.

Also, many scientists and activists have criticized what they call "neutral language" for masking the truth about the climate crisis. Take the term "climate change." It's scientifically accurate, yes, but it doesn't exactly get the blood boiling. It also doesn't reveal that this is a full-blown, human-created crisis and not just a shift in weather.

Author and speaker Simon Sinek goes so far as to suggest the term "climate cancer" instead of climate change, and the phrase "save your family" instead of "save the planet." Convincing, right?

What's the difference between climate and weather? And if scientists are saying the planet's getting warmer, why is it still so cold in the winter?

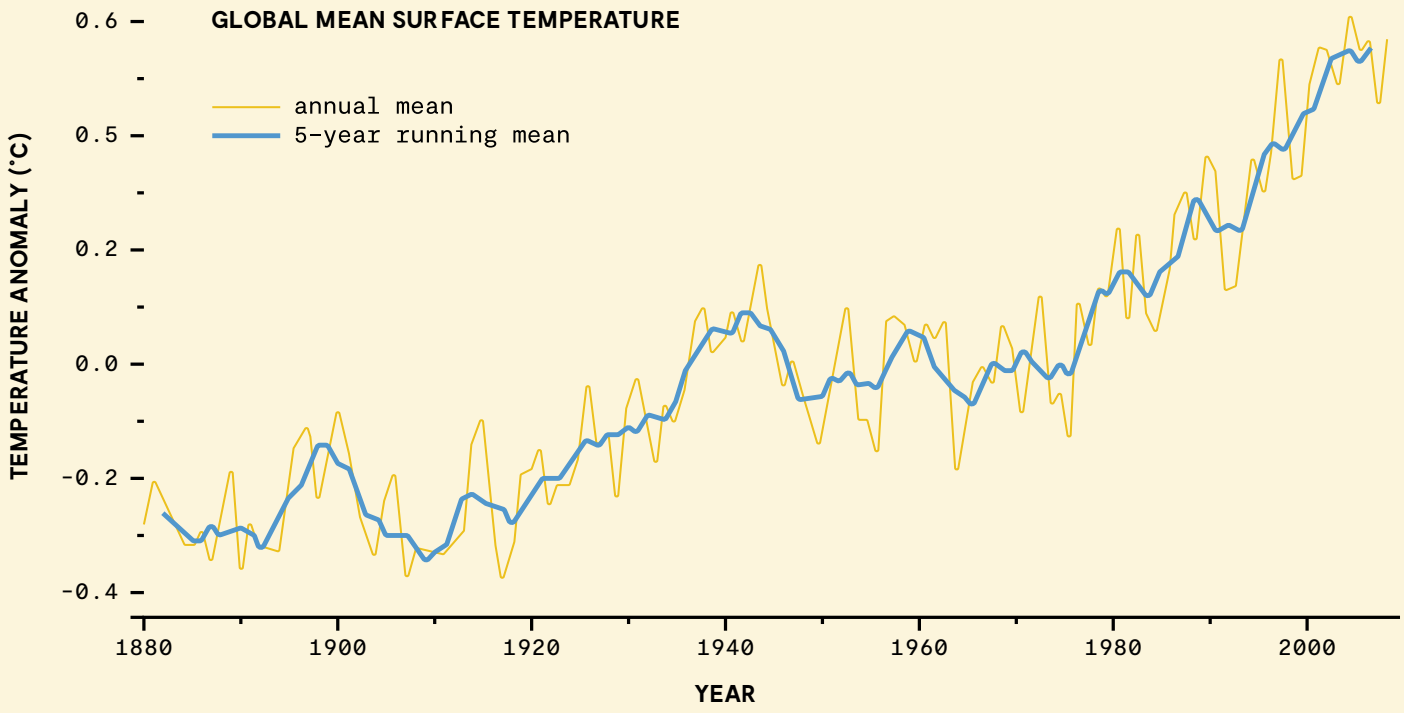
Great question, and a good example of why some people are saying "global heating" instead of "global warming"—if you live in a cold climate, global warming sounds kind of nice, right? Like growing oranges and lemons in your Minnesota backyard? Unfortunately, that's not exactly how it works.

Weather describes short-term occurrences, like a rainy morning or a hot, sunny day.

Climate refers to what the weather looks like in a particular place over a long period of time. For example, a desert region is typically very dry and hot, with temperatures exceeding 104°F in the daytime and receiving less than 9.75 inches of rain per year.

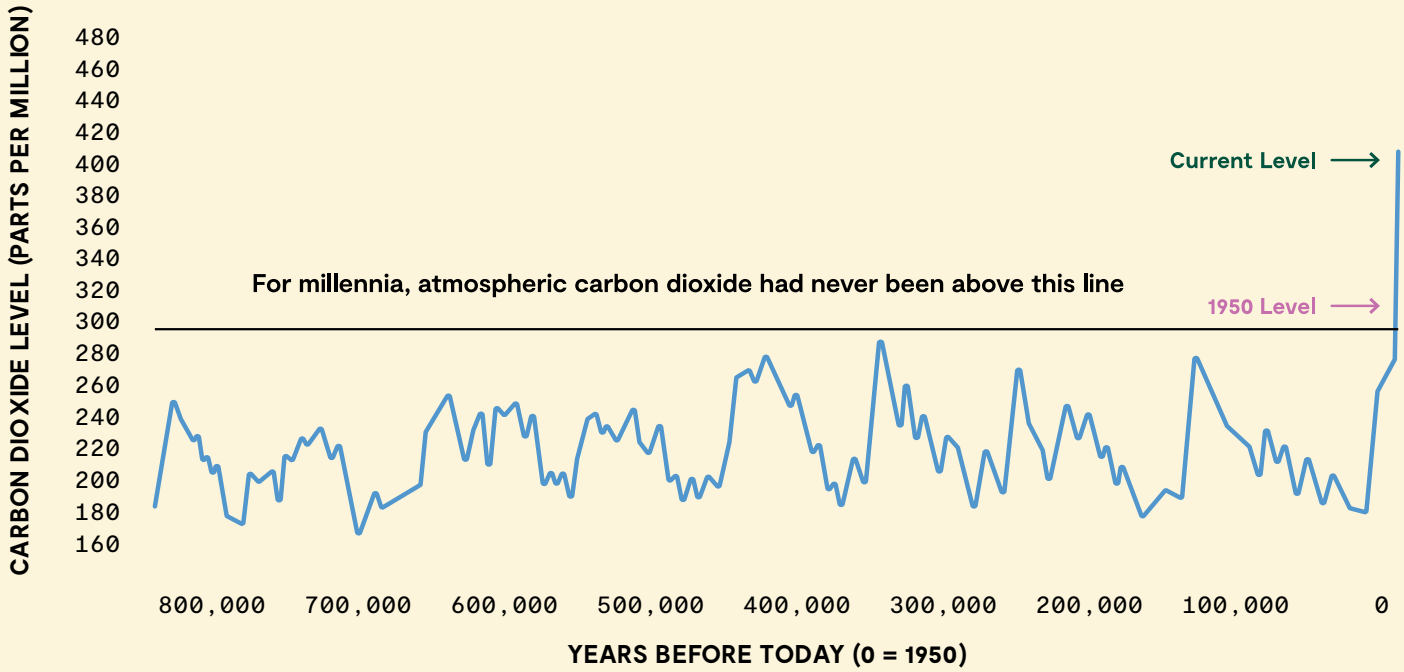
When talking about climate, scientists often look at averages of precipitation, temperature, humidity, sunshine, wind and other weather measures that happen over an extended period (e.g., 30 years) in a specific region.

The bottom line: Climate is what you expect to happen overall, and weather is what you get in the moment.



Despite ups and downs from year to year, global average surface temperature is rising. By the beginning of the 21st century, Earth's temperature was roughly 0.5 degrees Celsius above the long-term (1951–1980) average. (NASA figure adapted from Goddard Institute for Space Studies Surface Temperature Analysis.)

Source



Source

A region's climate can give us a sense of what to expect in general, but it can't predict the weather on a given day.

The other thing to know is that climate scientists deal in averages. They might predict a specific average global temperature rise of 1°F, but that doesn't mean that every day of the whole year will be one degree warmer. So here's what to tell that antagonistic family member when they argue against climate change because it's cold out: You might still get frigid winters, but the number of warm and hot days will push the average temperature higher.

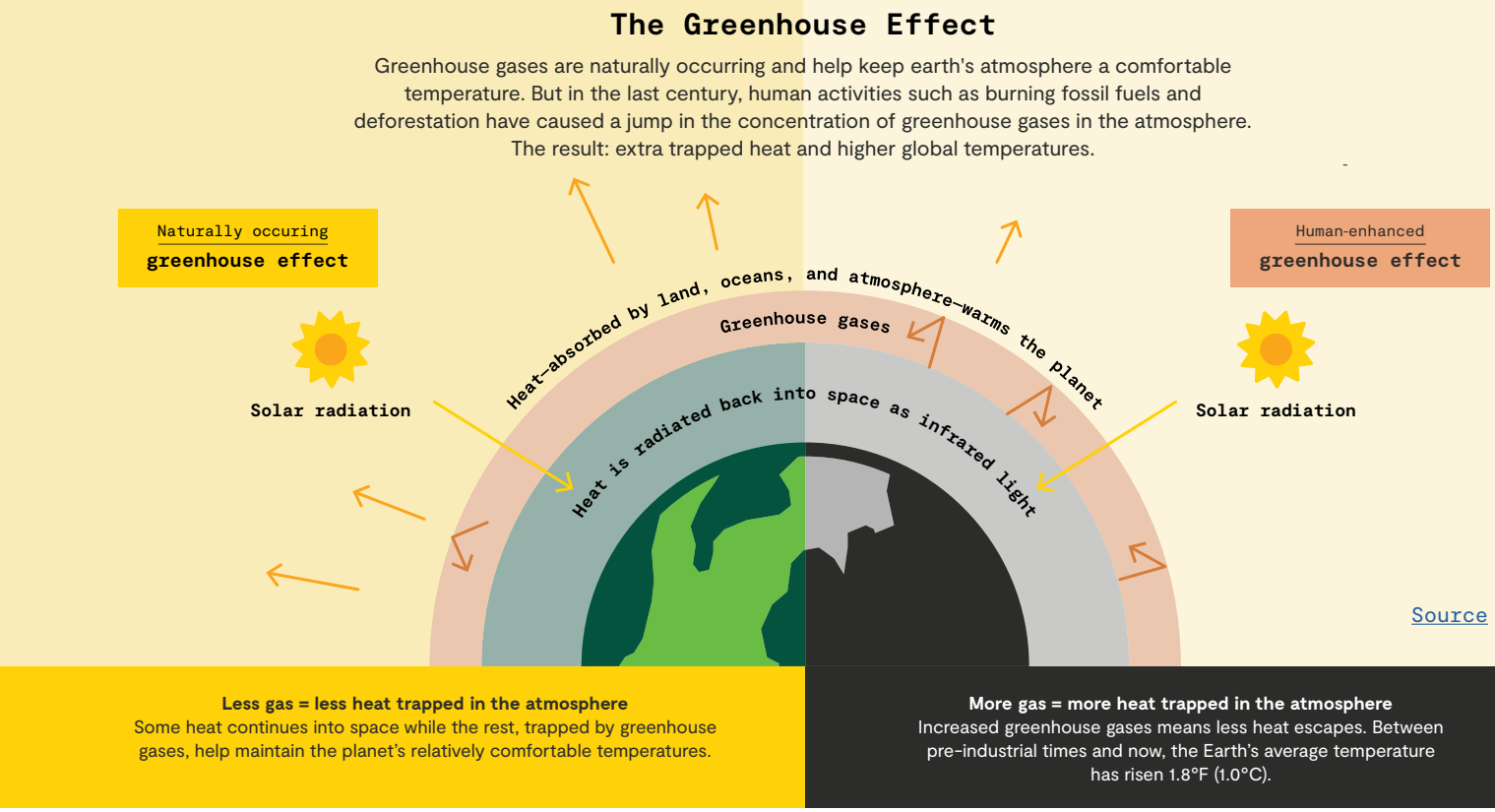
> **"The bottom line: Climate is what you expect to happen overall, and weather is what you get in the moment. A region's climate can give us a sense of what to expect in general, but it can't predict the weather on a given day.**

Global warming vs. climate change: Are they the same thing or not?

Global warming and climate change overlap, but they're not the same thing. To spend a little longer in terminology land, let's look at the difference between the two.

Global warming is the long-term heating of the Earth's climate system due to human activity. It refers specifically to a rise in the average global temperature. Climate change is bigger than that—it includes global warming as well as other shifts in weather patterns, like an increase or decrease in average rainfall.

Since 1880, human activities are estimated to have increased Earth's global average temperature by approximately 1.8°F. This number is currently increasing by 0.36°F per decade. Looking at the global warming timeline, we're expected to reach the 2.7°F mark between 2030 and 2052 if the planet's temperature continues to increase at the current rate. And if we hit that mark? We've got bigger problems than a few summer heatwaves.



The greenhouse effect: a definition for those of you who slept through grade 10 science class

Next on our list of terms that sound less bad than they really are is the greenhouse effect. Again, sounds positive, right? Getting the place a little warmer for all your plant babies?

The truth is, you wouldn't be entirely wrong. The sun's heat is a good thing—it makes life on Earth possible. A small amount of incoming solar radiation gets "trapped" by the gases in our atmosphere. This, right here, is the greenhouse effect.

Like the glass of a greenhouse, these "greenhouse gases" act as a layer of insulation that prevents heat from escaping. Without these heat-trapping gases, our planet would be an icebox.

Unfortunately, like eating an entire cheesecake in one sitting, you really can have too much of a good thing. Human activities have been piling on to the Earth's natural greenhouse effect for a while now. In particular, through burning fossil fuels, we've increased the amount of carbon dioxide and other greenhouse gases in the atmosphere. As a result, the atmosphere is trapping more heat and causing the planet to heat up—fast.

More than CO_2: The gases contributing to the greenhouse effect

Knowing which gases the scientists are talking about is fundamental to understanding the causes of the greenhouse effect. A few specific GHGs are of particular concern because they are tied to human activity. Let's break it down:

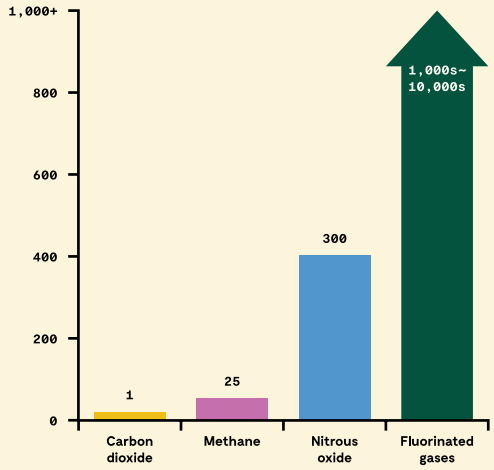
1. Carbon dioxide (CO_2)

If you were wondering which greenhouse gas is most responsible for global warming, you can stop holding your breath—it's carbon dioxide.

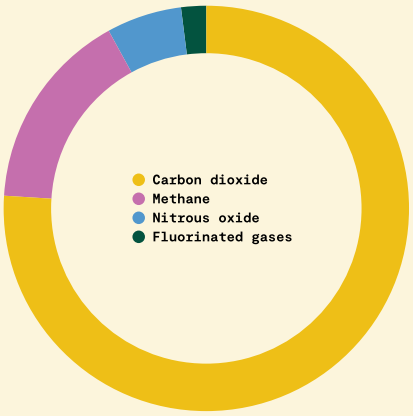
While this greenhouse gas is a natural component of our atmosphere, the issue is one of quantity.

Levels of CO_2 increase through things like burning fuel—like wood, solid waste and fossil fuels—and as a result of certain chemical reactions. The process of making cement, for example, is a massive CO_2 emitter. Carbon dioxide is removed from the atmosphere ("sequestered") during the biological carbon cycle, carbon is absorbed by plants.

How greenhouse gases warm our planet



The global warming potential (GWP) of human-generated greenhouse gases is a measure of how much heat each gas traps in the atmosphere, relative to carbon dioxide.



How much each human-caused greenhouse gas contributes to total emissions around the globe.

Source

Excess CO_2 is one of the biggest contributors to climate change, particularly through the burning of fossil fuels.

2. Methane (CH_4)

Methane is produced naturally whenever vegetation is burned, digested or rotted without the presence of oxygen. Cattle digestion (read: cow burps) is a big contributor, as are out-of-control wildfires.

3. Nitrous oxide (N_2O)

Nitrous oxide is released during agricultural and industrial activities, the burning of fossil fuels and solid waste, and the treatment of wastewater. As a greenhouse gas, it has massive global warming potential—it's up to 298 times more potent than carbon dioxide.

4. Fluorinated gases

Some industrial processes release fluorinated gases (hydrofluorocarbons, perfluorocarbons, sulfur hexafluoride and nitrogen trifluoride), which are synthetic greenhouse gases. Though typically emitted in relatively small quantities, they're extremely potent.

Sulfur hexafluoride (SF_6), for example, has a global warming potential 22,800 times that of CO_2.

But how exactly do greenhouse gases contribute to climate change?

Like a really bad smell, greenhouse gases like to linger—and the stronger they are, the more they affect how much heat is trapped in the atmosphere. The effect of each GHG depends on the following:

→ **Concentration (or abundance)**: The amount of a GHG in the air. Larger emissions of GHGs lead to higher concentrations in the atmosphere.

→ **Duration**: How long the gas stays in the atmosphere. The time frame can range from several years to several millennia.

→ **Potency**: How strongly the gas contributes to heating the earth. Some GHGs have a higher global warming potential.

> **Like a really bad smell, greenhouse gases like to linger—and the stronger they are, the more they affect how much heat is trapped in the atmosphere.**

Break it down for me: What are the main causes of global warming?

TL;DR: Humans are burning too much stuff too quickly.

While the greenhouse effect is a naturally occurring phenomenon, the real problem is the huge amounts of gases that human activities have released into the atmosphere.

For a long, long time, various natural processes have been sequestering and fossilizing carbon underground, keeping it out of the atmosphere. (This is where the name fossil fuels comes from.) Coal, for instance, took millions of years to form, as dead plant matter was buried under rock and dirt and then gradually changed through heat and pressure.

Over time, human communities learned that these carbon deposits in their various forms were potent fuel sources, and started uncovering and burning these forms of carbon to heat their homes and power things like transportation and factories.

Over the past few centuries, and mainly since the early 1900s, human activities have rapidly released massive amounts of CO_2 and other greenhouse gases into the atmosphere.

In fact, the levels of greenhouse gases in the atmosphere have risen to levels not seen in 3 million years. Yes, you heard that correctly. 3. Million. Years. Let that sink in.

Rising temperatures and changes in climate are creating extreme weather events (e.g., hurricanes, flooding and droughts), leading to devastating environmental, social and economic consequences.

Photo by Nik Shuliahin on Unsplash

So, yeah. Burning too much stuff too quickly has a big cost.

> **In fact, the levels of greenhouse gases in the atmosphere have risen to levels not seen in 3 million years.**

1.2
The causes of climate change: Yep, it's us

In short: we humans are the problem. Looking at the climate change science, there's no doubt that human activity is causing modern-day climate change.

Granted, naturally occurring phenomena—like the sun's intensity, volcanic eruptions and shifts in greenhouse gas concentrations—do play a role in climate change. But as NASA says, their "influence is too small or they occur too slowly to explain the rapid warming seen in recent decades."

The Intergovernmental Panel on Climate Change (IPCC)—a group of 1,300 independent scientific experts under the guidance of the United Nations—concluded that there's a greater than 95 percent probability that human activities over the past 50 years have heated the planet.

Evidence overwhelmingly indicates that we've got to own our significant role in climate change, and we've got to do it today.

"The Intergovernmental Panel on Climate Change (IPCC)—a group of 1,300 independent scientific experts under the guidance of the United Nations—concluded that there's a greater than 95 percent probability that human activities over the past 50 years have heated the planet.

Where do GHGs come from?

As we mentioned above, the presence of GHGs in our atmosphere is a natural part of the Earth's climate systems. The issue is one of quantity, and in our quest to develop new ways to heat our homes, feed our families and fuel our lives, we've let things get a little out of hand. (The good news is, humans are pretty clever, and we're already developing even newer ways to build the lives we want, without overheating the planet.)

When it comes to excess GHG emissions created by humans, there are five main sources. Here's an overview.

1. Burning fossil fuels

The majority of greenhouse gas emissions are released from the burning of fossil fuels like oil, gas and coal for things like powering our cars and heating our homes.

SAILING WITH GRETA

To practice what she preaches en route to the 2019 UN Climate Action Summit, activist Greta Thunberg journeyed by solar panel–equipped yacht. Her 15-day trek across the Atlantic, which would create about a ton of CO_2e by plane, was a completely zero-carbon mission.

The 60-foot boat was cozy, to say the least. Accommodations could be likened to camping on the sea, with only thin mattresses, sleeping bags and freeze-dried vegan eats. And in true roughing-it style, there was no toilet—a blue bucket that was emptied overboard after each use did the trick.

When you add it up, according to data from Climate Watch, more than three-quarters of human-made greenhouse gases currently come from our need for energy.

2. Clearing forests and grasslands

Trees and other plants use CO_2 in the air as part of photosynthesis, and store the carbon in their roots, leaves, stems and trunks. When forests are cut down and ancient grasslands are dug up, it means more carbon is released and less is absorbed.

Evidence also indicates that the ongoing destruction of tropical forests is disrupting the movement of water in the atmosphere. This is triggering major changes in precipitation that could lead to drought in agricultural areas of China, India and the U.S. Midwest.

Here, the goal is to leave as much land to nature as possible. Solutions include more climate-friendly farming techniques (and reducing food waste), limiting urban sprawl, and taking the planet's urgent need for carbon sequestration into account in all land use decisions.

3. Animal farms

Agriculture generates an estimated 25 percent of annual GHG emissions when you combine food production and the land-use changes associated with farming, such as clearing vegetation and plowing. Cattle and other livestock also produce significant quantities of methane.

4. Industry

In addition to industry's energy needs, some processes create emissions, such as those needed to create metals like steel or to convert raw materials into resources, like when producing paper. The production of concrete also contributes to CO_2 emissions.

5. Waste disposal

Waste disposal in both homes and businesses contributes to GHG emissions, whether the garbage is being compacted into a landfill, incinerated in a plant or burned in someone's backyard.

Photo by Jakob Cotton on Unsplash

A history of climate change: How did we get here?

Well, it happened slowly, and then very, very quickly. Nailing down when human-caused climate change first began, and how rapidly the Earth has warmed since that date, is key to understanding how much humans have altered the climate.

Recent studies reveal that warming began as early as the 1830s, starting with the tropical oceans and the Arctic. Europe, North America and Asia followed roughly 20 years later, and the Southern hemisphere started showing signs of warming in the early 20th century.

But how did we get here, and when was climate change discovered? The answer involves a quick trip back in time.

While people have been cutting down forests and burning fuel like wood, coal and peat for an incredibly long time, the effects were minor until the onset of the Industrial Revolution in the 1750s. (Picture horse-drawn carriages, stylish gray wigs and towering smoke stacks.) This is when humans began using coal in mass quantities, producing goods in factories and clearing large tracts of land.

First, urban industrial centers emerged in Europe and North America. With the introduction of new technology and machinery, products such as textiles began to be mass produced in factories using steam power. As a result, coal became an essential fuel, needed to both produce and transport these goods.

The early 20th century saw the introduction of fertilizers, chemicals, electricity production and construction materials such as steel and iron. After the First World War, oil became a hot commodity with the growth of cars, airplanes and industrialized warfare.

Aside from the "smoke problem" generated by coal-burning industrial cities, the growing popularity of automobiles also triggered a spike in air pollution. In December 1952, for instance, a fog descended upon London for five days, killing up to 12,000 people. Parliament eventually passed the U.K. Clean Air Act in 1956, effectively reducing the burning of coal and providing an excellent example of how the right government legislation can have significant results.

In the 1930s, British engineer Guy Stewart Callendar suggested that carbon emissions might have a warming effect. His calculations predicting an overall warming of the planet by 3.6°F were met with skepticism. Sound familiar?

> **"In the 1930s, British engineer Guy Stewart Callendar suggested that carbon emissions might have a warming effect. His calculations predicting an overall warming of the planet by 3.6°F were met with skepticism. Sound familiar?**

From 1930 onwards, studies popped up introducing and debating many climate change–related topics, among them global warming and GHGs, ozone layer damage and the inability of oceans to absorb growing carbon emissions. Studies also appeared that warned of potentially catastrophic effects of climate change, such as rising sea levels and the possible collapse of Antarctica's ice sheets.

One famous research project that emerged in 1958 was the "Keeling Curve," a graph that charted the buildup of CO_2 in the atmosphere. Named after Dr. Charles Keeling, a climate change scientist at the Mauna Loa Observatory in Hawaii, the Keeling Curve is now the longest uninterrupted instrumental record of atmospheric CO_2 in the world.

Global temperatures began spiking in the 1980s, with experts pinpointing 1988 as the year that put global warming on the public's radar. It was the hot-test summer on record, and drought and wildfires ripped through the United States. People began to pay more attention to media reports and scientists' warnings about human-induced climate change. By year's end, "The Endangered Earth" had made the cover of Time magazine as "Planet of the Year."

Also that year, the United Nations and the World Meteorological Organization founded the Intergovernmental Panel on Climate Change (IPCC), a committee of experts tasked with giving policymakers regular scientific information about climate change.

1.3
Proof of climate change (or, a guide to the sophisticated ways scientists measure things)

This all feels very abstract when you're reading about it on a screen. But the reason we have so much information about climate change is because climate scientists have been putting in the leg work, digging up ice cores and launching satellites.

What have they learned? Well, in the past 650,000 years, the Earth has gone through seven cycles of glacial advance and retreat. But thanks to a lot of in-depth research, we know that this current warming isn't just another natural cycle. Climate change as we're experiencing it now isn't natural—it's real, and it's definitely human-made.

> **"In the past 650,000 years, the Earth has gone through seven cycles of glacial advance and retreat. But thanks to a lot of in-depth research, we know that this current warming isn't just another natural cycle.**

Let's dig into some more climate change facts.

The rate of global warming (it's faster than it should be)

Sure, Earth's temperature over time does naturally fluctuate due to slight changes in the planet's orbit, impacting how much solar energy gets here.

But—and this is a big but—we're currently experiencing changes within only a few decades that would normally happen over hundreds of thousands of years. It's the intensity of the shift over such a short period of time that is the strongest evidence of global warming.

> **"Since 2014, we've experienced six of the warmest years on record, and 2016 and 2020 have tied as the hottest years yet, according to a NASA analysis.**

The Earth's temperature is rising over time—for real

Human memory can be untrustworthy, so scientists have been measuring and writing down temperatures around the world for a long time so we have evidence of what's happening. The global temperature change so far is an average increase of 1.8°F since the late 19th century. That may not seem like a lot, but consider this: the highest level of temperature increase since 1880 (when modern recordkeeping started) occurred in the past 35 years.

Since 2014, we've experienced six of the warmest years on record, and 2016 and 2020 have tied as the hottest years yet, according to a NASA analysis. The ocean has also warmed significantly, showing an increase of more than 0.6°F since 1969.

Carbon dioxide levels: We broke an 800,000-year-old world record

Everyone wants to be the world's best at something, but this is a top number no one will be proud to see in the Guinness World Records.

Photo by photo sung on Unsplash

We already know that CO_2 (along with other GHGs) is a global heat trapper and plays an integral role in climate change. Historical climate data has been found in mountain glacier and ice core air bubbles in Antarctica and Greenland, showing that carbon dioxide levels today far exceed any from the past 800,000 years. Atmospheric carbon dioxide levels now are about 40 percent higher than they were in the pre-industrial era.

Models of the past half million years or so suggest that CO_2 levels have fluctuated between about 180 and 300 parts per million (ppm). Today, atmospheric CO_2 hovers around 415 ppm. Scientists agree that current levels of greenhouse gases correlate with the record levels of global temperature.

Shrinking ice sheets and disappearing glaciers

Melting glaciers tell the undeniable story of climate change because they're very sensitive to global temperature changes.

Based on historical climate data from aerial and ground photography as well as satellite imagery, it's clear that the Earth's glaciers have retreated at an alarming pace over the past century. Some have completely disappeared. Sad times indeed.

In August 2019, Iceland held a funeral ceremony for its Okjökull glacier, which in 2014 was the country's first to lose its status as a glacier. The plaque they unveiled holds the grim honor of being "the first monument to a glacier lost to climate change anywhere in the world." (That's another world record no one really wants their name next to.)

Satellite data from NASA's Gravity Recovery and Climate Experiment data show that in the past decade, the rate of Antarctica's ice mass loss has tripled. In Greenland from 1993 to 2016, 286 billion tons of ice per year were lost. During the same time frame, Antarctica lost about 127 billion tons each year.

The case of the disappearing Arctic snow

It gets worse. Satellite data is also showing a significant reduction in snow cover in the Arctic, specifically in the spring and summer, a result of global temperatures rising.

This matters because snow may reflect about 80 to 90 percent of incoming solar energy, while snow-free surfaces may reflect only 10 to 20 percent. The effect is compounded when permafrost melts, causing methane and carbon dioxide to be released into the atmosphere.

> **"In August 2019, Iceland held a funeral ceremony for its Okjökull glacier, which in 2014 was the country's first to lose its status as a glacier.**

Rising oceans and acidity levels (or why not to buy waterfront property)

All that water has to go somewhere. So when the earth's ice sheets and glaciers melt, the oceans rise.

Through the 20th century, sea levels rose about six inches in total, an average of about 1/16 inch per year. In the past couple of decades, though, the rate has doubled to more than 1/8 inch per year, and it continues to speed up.

On top of rising sea levels, about 20 to 30 percent of human-induced CO_2 emissions in the atmosphere end up in the ocean, which increases its acidity. This is a major problem because even slight changes in the ocean's acidity levels can seriously harm marine sea life.

Extreme weather events are everywhere

Across the globe, including in the United States, countries keep clocking record levels of heat. Coastal weather events such as hurricanes are becoming more severe. Droughts and wildfires are intensifying in both frequency and size.

The intensity of the recent devastating forest fires in California and Australia, for example, has been attributed to global warming.

Climate science: Why the research is legit

If you're not a climate scientist, it's easy to underestimate how much effort has gone into proving the existence of global warming. The thing is, we're not just talking about a couple of researchers crunching numbers in their ivory towers. The proof of climate change lies in data collected and analyzed over decades, and extensive, comprehensive reporting coming from all around the world.

According to IPCC (the panel made up of more than 1,300 climate scientists from the U.S. and around the world), "Warming of the climate system is unequivocal." They pin the cause of the warming on human activity with a greater than 95 percent probability and predict "profound consequences for the ecosystem and people."

Similarly, the National Climate Assessment (NCA) concluded in their most recent report that our climate has undoubtedly changed faster than ever in the past 50 years. They confidently attribute this change to human activity.

The proportion of climate scientists who agree that global warming trends are the result of human activity is perhaps the most convincing stat of all: a staggering 97 percent. After all, how often do 97 percent of people ever agree on anything?

> **"The proportion of climate scientists who agree global warming trends are the result of human activity is perhaps the most convincing stat of all: a staggering 97 percent.**

Photo by Paweł Czerwiński on Unsplash

1.4
The effects of climate change—and why we need to act now

No matter how you look at it, we're facing some grim realities in the not-so-distant future: climate change droughts, heatwaves, significant changes in weather systems and more intense and frequent natural disasters such as floods, mudslides, forest fires and hurricanes.

With all of that come the forced relocations of climate refugees and a mass destruction of assets, plus insect infestations, destruction of coral reefs, increased air pollution, mass habitat loss and extinctions, and much more.

The bad news: We're blowing past our global warming targets

You know that old tale about the frog in the pot of water that's slowly heating up? Well, we're the frog.

Unsurprisingly, the higher the warming, the more damage to our natural and human systems. But because global warming has been creeping up on us, to many people, it has never felt quite urgent enough

to be our top priority—and we gradually adjust to the changes and feel they are more normal than they really are. And the longer we put off doing anything substantial to stop climate change, the worse it's going to get.

Human activities account for approximately 1.8°F of the global temperature increase since the pre-industrial era, and we're still continuing at a breakneck pace

At the 2015 United Nations Climate Change Conference in Paris, the world agreed to keep the rise in global temperature this century "well below" 2°C (3.6°F) compared to pre-industrial levels.

But we're on track to blow past this critical threshold; in 2018, the UN World Meteorological Organization predicted a rise of 5.4°F to 9°F by 2100, should we continue at the rate we're going.

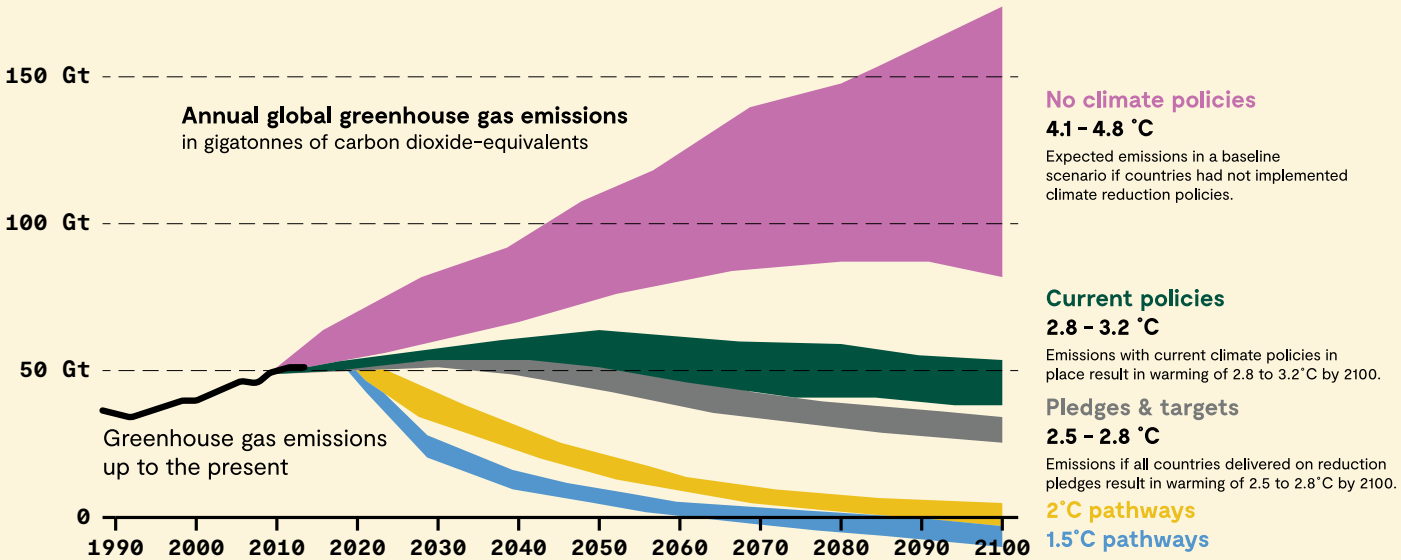
Climate change impacts: How much difference does half a degree make?

Even if we went completely cold turkey on our dependence on fossil fuels, we wouldn't be able to stop global warming entirely. Climate change is already happening. But the good news is, this isn't an all-or-nothing scenario. The lower the temperature rise, the better. But there is debate among scientists and policymakers over where we should set limits.

For instance, the 2018 IPCC report outlined the difference between an increase of 1.5°C and 2°C by 2100. Basically, the more average temperatures increase, the worse all of the projected consequences of global warming will get.

With a two-degree Celsius increase by 2100, for instance, the IPCC predicts that more than 35 percent of the global population will experience severe heat waves at least once every five years, roughly triple the number as under 1.5°C of warming. Fishing yields could decrease by about 3.3 billion pounds and agriculture in some areas could completely collapse. Hundreds of millions more of the world's population could face poverty and other climate-related risks (to their health, food security, water supply, livelihood, human security and economic growth).

GLOBAL GREENHOUSE GAS EMISSIONS AND WARMING SCENARIOS



— Each pathway comes with uncertainty, marked by the shadings from low to high under each scenario.

— Warming refers to the expected global temperature rise by 2100, relative to pre-industrial temperatures.

Source

To be clear, the climate crisis doesn't start at 1.5°C above pre-industrial levels. We're already in it. But when the average global temperature increase surpasses that 1.5-degree mark, climate change projections become significantly worse.

Regardless of warming levels, here are some examples of climate change effects that we can expect.

1. Rising sea levels and ocean acidification

As ice melts, sea levels rise and the proportion of the Earth's surface that is dark (water) versus light (ice) increases. Water absorbs more of the sun's energy than ice, which mostly reflects it, thereby heating up the oceans and accelerating the melting process in a cascade effect.

As oceans get warmer, they also expand in volume, causing sea levels to increase even more.

As sea ice melts and temperatures rise, the Arctic Ocean is becoming more like the Atlantic and Pacific, say scientists—which, among other things, means bigger storms and bigger waves. The community of Tuktoyaktuk in northern Canada, for instance, is on the shore of the Beaufort Sea, where coastal erosion is reaching some two meters per year, and wave heights are expected to increase by some two to three times, reaching one to four meters high by the end of this century, further increasing erosion. The result could be completely losing the town's harbor, which is essential for fishing and other economic activity.

CO_2 in the atmosphere also enters the ocean and makes it more acidic. This acidification will likely cause devastation to many aquatic ecosystems.

Coral and shellfish, for example, are very sensitive to even slight changes in temperature and acidity levels. Warming waters cause the bleaching of coral reefs, and the acidity dissolves the shells of sea creatures and weakens coral structures.

2. Extreme weather conditions

Extreme weather events caused by climate change are already happening: not just rising temperatures and heat waves, but also storms of higher intensity,

including wetter and more frequent hurricanes. Rising sea levels also mean higher coastal inundation and more potential for damage.

Global warming is partly to blame for the devastation caused to Puerto Rico by Hurricane Maria in 2017, for example. Record levels of extreme rainfall hit the country, causing unprecedented flooding and landslides.

3. Mass displacement of climate refugees

As sea levels rise and natural disasters become more frequent, the number of people seeking refuge will inevitably continue to increase.

Kiribati, for example, an island nation in the South Pacific, could be completely submerged in the coming decades due to rising ocean levels—they've already purchased land in Fiji should the population need to evacuate.

Drought, heat waves, agricultural disruption and lack of access to water will force large populations of climate refugees around the world to seek out cooler, more hospitable conditions. **By 2050, hundreds of millions of people may be displaced due to the effects of global warming, according to the International Organization for Migration.**

This isn't a story about some far-off distant future—it's happening now. A 2016 article in the New York Times, for instance, called residents of Isle de Jean Charles, La.—forced to relocate due to the effects of flooding and hurricanes—America's first climate refugees.

Climate change and inequality: The poor are getting hit the hardest

Climate change affects the whole planet, so you might think we're all in this together. And to a certain point, we are. But how much wealth you have—both personally, and as a society—matters, as does your geography.

Countries where a significant proportion of the population depend on natural resources for their livelihood, and those with poor infrastructure and dense, quickly growing populations—plus those who live on coasts and islands—are especially vulnerable to the consequences of climate change.

Lagos, Nigeria, for example, is one of the fastest-growing cities in the world. Located on the western coast of Africa, on the Gulf of Guinea, the city of close to 15 million people is projected to double in population by 2050—an obvious strain on their infrastructure.

> **"Sadly, those who will ultimately suffer the most from the consequences of global warming are those who are the least responsible for its cause.**

Lagos can expect even more hot days and droughts due to global warming, and as rising sea levels continue, seawater may contaminate fresh water and permeate farmlands. Nigeria can expect coastal erosion and a blow to their fishing industry as well.

And consider what the effects of climate change might be in Yemen, which has been in a state of civil war since 2015. The Middle Eastern country is already struggling with mass famine, child malnutrition and casualties, sanitation issues and a lack of potable water. These conditions are likely to be exacerbated by global warming.

Sadly, those who will ultimately suffer the most from the consequences of global warming are those who are the least responsible for its cause.

In light of this painful fact, the concept of climate justice shifts the global warming focus from an environmental phenomenon into the realm of ethics human rights issues and inequalities

Domino effects of global warming: The critical tipping points

Now we get to the part of the disaster movie where all the bad things happen at once.

The effects of global warming don't happen in a vacuum. Each change impacts something else, which impacts something else, and on and on. Within the very long list of climate change projections, climate scientists have identified three potential critical "tipping points."

These tipping points could set off a disastrous domino effect, leading to an irreversible shift in the Earth's temperature and climate systems.

First is the loss of ice sheets, which continues to increase sea levels at alarming rates, triggering a cascade of effects. Second, forest fires and melting permafrost caused by global warming release even more CO_2 into the atmosphere, accelerating global heating.

The third tipping point, and what sounds like a scene straight out of "The Day After Tomorrow," is the shift in the ocean's circulation system, responsible for heat distribution around the globe. Already, the system is experiencing a thousand-year low, believed to be caused by melting ice in Greenland. If this trend continues, the change could set off a collapse to the Amazon rainforest, nearly permanent droughts in Africa's Sahel region, disruption to Asian monsoons and much more.

Effects of global warming in the United States, now and in the future

Sounds rough, right? Well, it is. And while these examples may feel worlds away, the U.S. is going to experience its own climate change problems. In fact, it's already happening.

For example, the Fourth National Climate Assessment (NCA4) predicts an increase in high-temperature extremes, heavy precipitation events, forest fires, high-tide flooding events along the coastline and ocean acidification and warming. On the flipside, they also expect a decline in land and sea ice cover, snowpack and surface soil moisture.

With these climate change issues we can foresee problems for people and industries all around the United States. Here are a few examples.

1. Much higher temperatures

The Northeast will see the highest temperature increase in the contiguous country. The region is also projected to see the highest rise in fatalities due to heat, the highest rate of ocean warming and the highest rising sea levels in the country. (In other words: expect floods.)

The already hot and humid Southeast can bank on up to 100 more "warm nights" by 2100.

2. Intense and dangerous heat in cities

Cities are already experiencing the "urban heat island" effect, whereby heat waves are amped up in urban centers. Dark pavement absorbs heat and releases it slowly, and buildings can cause stagnant air to warm up rather than mixing. Add exhaust from vehicles and buildings plus a lack of tree cover and you get dangerously hot conditions during heat waves, causing power outages and critical or fatal health risks.

These risks are even higher in lower-income urban areas, where there tends to be even less green space and less likelihood of air conditioning.

3. Loss of wages

Among the many costs of climate change, we can expect a decline in wages earned. As anyone experiencing the dog days of summer can tell you, when heat increases, productivity decreases. The NCA estimates that by 2090, we'll see $160 billion in lost wages because of lower productivity caused by increased heat.

4. Climate change effects on agriculture

The Midwest can expect a significant reduction in yields of corn (5 to 25 percent) and soybeans (more than 25 percent) thanks in large part to hotter temperatures. Products made from these crops could, in turn, become harder to find and/or more expensive. (Don't worry, tofu lovers, the bulk of these soybeans are used to feed livestock.)

The Northern Great Plains—responsible for a significant portion of the country's agriculture—will see their winters end earlier and snow levels in the mountains decrease by 25 to 40 percent.

5. Irregular and extreme weather

Hawaii will experience rising sea levels, irregular rainfall, extreme temperatures and weather patterns, drought, flooding and a serious negative impact on wildlife, including seabirds, turtles and seals.

Wildfires and thawing permafrost in Alaska will continue and increase.

The Caribbean will see longer dry seasons and shorter, but more intense, rainy seasons. Puerto Rico may lose more than 3 percent of its total coastal land area and the U.S. Virgin Islands, more than 4 percent.

“ The NCA estimates that by 2090, we'll see $160 billion in lost wages because of lower productivity caused by increased heat.

1.5
Wow, okay. So how do we stop climate change? What are some solutions to global warming?

Let's start with the bad news: there's no “magic bullet” for reversing climate change.

In a 2018 report by the IPCC, leading climate change scientists warned we had only 12 years for global warming to be kept to a maximum of 1.5°C.

Some scientists believe we can't stop climate change, pointing to tipping points and climate change deadlines that may have already been reached or passed. In their opinion, we've already seen irreversible changes in major ecosystems and the Earth's climate system, and we may have hit a climate change “point of no return.”

Others, like the IPCC, advocate for healthy climate solutions to put the world on track to fulfill the Paris Agreement goals of limiting global warming to 1.5°C to 2°C.

But what are these solutions for climate change? Read on.

How to stop global warming: What are some of the policy solutions?

Governments have a lot of power to make changes, Here are some examples of solutions that countries around the world are introducing.

1. Price carbon pollution

Putting a price on carbon incentivizes polluters to either reduce their emissions or pay for polluting practices. There are two main types of carbon pricing:

Photo by Matias Malka on Unsplash

- → **Emissions trading systems (ETS):** Otherwise known as a "cap-and-trade system," this approach sets a limit on total GHG emissions and allows industries with low emissions to sell their allowance to other polluters.
- → **Carbon tax:** This approach sets a tax rate on GHG emissions or on the carbon content of fossil fuels. The bar for emissions isn't defined, but the tax rate is. In some countries such as Canada, the carbon tax that's collected by the government is then redistributed to citizens in the form of a rebate.

With carbon pricing, governments can funnel these funds into climate change mitigation strategies and finding ways to stop global warming.

> **"Great Britain introduced a carbon tax in 2013, which has encouraged electric utilities to phase out coal. This influenced a drop in the country's GHG emissions, which have plummeted to their lowest level since 1890.**

Case in point: Great Britain introduced a carbon tax in 2013, which has encouraged electric utilities to phase out coal. This influenced a drop in the country's GHG emissions, which have plummeted to their lowest level since 1890.

2. Shift to electric

That magic plug in the wall has changed our world, and it's time to depend on it even more. Unlike energy sources like natural gas and oil, electricity can be generated from renewable sources. The more we electrify, the more impact there is when we shift our sources of electricity to clean energy. Plus, will any of us really miss gas-powered leaf blowers?

One huge example is electrifying transportation. **According to a 2019 survey, more than one-third of all prospective car buyers in the U.S. would consider buying a plug-in electric vehicle within the next two years.** IEVs are certainly growing in popularity, and in the case of Tesla, have even achieved a "cool factor."

More than one-quarter of American carbon emissions stem from the transportation sector according to the EPA, so switching vehicles' fuel source from oil (and its derivatives) to electricity could help combat climate change as well.

Today, EVs represent a sliver in the percentage of total vehicle sales, and cost can be a hurdle to getting more of them on the road. The federal tax credit of up to $7,500 helps—especially when combined with any state incentives—but boosting EV sales means expanding incentive programs and making rebates available at the car dealership rather than on annual tax returns.

Global warming prevention relies on government support for active transport (like cycling and walking) and electrifying public transit systems. And consider this: the United States has more than 8 million fleet

vehicles—which includes everything from military and police vehicles to school buses to federal cars. The impact of electrifying the bulk of those vehicles could be massive.

3. Be smart about nuclear power

This might be a shocker to those of us who watched "Chernobyl," but nuclear power is a vital part of climate change prevention. In looking at how we can help climate change, leading environmental organizations such as the Union of Concerned Scientists have recommended safely operating nuclear power plants until other low-carbon energy technologies can be rolled out.

But there's a snag: out of the 60 nuclear power plants operating in the U.S at the end of 2017, more than one-third were either unprofitable or slated to close within the next 10 years.

Something needs to change to keep these plants running, or they risk being replaced by natural gas—a move that could increase the U.S. electric power sector's carbon emissions by an estimated 6 percent by 2035. Experts say a few key things could help keep nuclear energy on the grid, including carbon pricing and subsidies.

4. What about corporations? What's their role in fighting climate change?

Companies have a lot of power to do good, not just in the money they have to spend on solutions, but in the influence they have on others. Some examples:

Transparency and accountability

One of the most important global warming solutions is for corporations to set strict emission reduction targets that support the Paris Agreement or, better yet, the IPCC's most recent 1.5°C goal. Achieving this means tracking their carbon emissions and regularly reporting these numbers to the public with full transparency.

Fortunately, we're going in the right direction. According to CDP (formerly the Carbon Disclosure Project), the number of companies with active emissions targets and those disclosing emissions data is increasing year over year. Check out Chapter 2 for more on what companies are doing about their carbon footprint.

Commitment to carbon reduction

Efforts from corporations to become carbon neutral or even, carbon negative goes a long way, and is becoming increasingly more common. Some of this is coming from improvements in how companies do business in the first place—think of Apple's innovations in using recycled content in its products—and some from carbon offsetting.

Thankfully, we're seeing these kinds of promises from major corporations already. Some of the businesses playing ball are airlines such as Delta, which has pledged to go carbon neutral, and both Microsoft and Ikea, which have declared that they will actively reduce carbon dioxide emissions.

Photo by S. Nou on Unsplash

What about me? What can individuals do to help stop climate change?

What can we do at the individual level to stop global warming? Fortunately, there are a lot of ways we can help fight climate change and reduce our own environmental impact. In fact, there are so many, Chapter 3 is all about specific steps you can take to reduce your carbon footprint.

Individual actions that can have the greatest effect are things like eating less meat and travelling less, especially by air. Take transit, bike, walk or work from home. Make your home sustainable by using energy saving-appliances and low-flow showers and sinks. Buy less stuff! Invest in and support businesses that practice climate consciousness. Educate your friends and family in a shame-free way that gets them onside.

Every little bit helps.

CHAPTER 2

Measure Your Carbon Footprint (How to Do It, and Why It Matters)

By Wing Sze Tang

Turns out you don't need to be a climatologist to calculate your carbon footprint. Here we demystify this concept, bringing it to life with illustrative examples.

What is a carbon footprint, and how can we use it to fight climate change?

"Carbon footprint" is a term you've probably been hearing a lot of lately. But if you're not 100 percent sure what it means, you're in good company.

Recent polls suggest that while most Americans know that climate change is one of the most important issues of our time (some might say *the* most important), many of us are still a bit fuzzy on the specifics—especially when it comes to what we can do on an individual level.

We hear what scientists are saying. Rising levels of human-created greenhouse gases are trapping heat in the atmosphere and causing global warming and other aspects of climate change, like severe wildfires and flooding.

The whole thing is rather daunting, but there really are solutions. And it needs to be a collective effort. The first step? Measuring how big our impact is to start with—aka our carbon footprints.

In this chapter:

2.1
Carbon footprints 101: What they are and how to measure them

Ever been in a performance review at work? Then you've probably heard the term SMART goals. (*Insert audible sigh*, but stay with us.)

The basic concept is that any objective is easier to reach when we make it SMART, aka specific, measurable, attainable, realistic and timely.

Cliché? Definitely. But the thing is, SMART goals work. That's why understanding how to calculate your carbon footprint is the first step in translating a massive global challenge into smaller, more achievable changes we can make right now.

It's true that climate change is a global crisis, and achieving a low-carbon future will take monumental changes from everyone everywhere. But finding ways to take personal action can feel empowering, and the changes you make might influence others around you, too. That "no good deed is too small" inspirational poster you might have seen in script font on Pinterest? It perfectly captures what it means to take individual climate action.

Don't underestimate the ripple effect our small actions can cause: According to political scientist Erica Chenoweth, known for her research on peaceful protest, it takes only about 3.5 percent of a population engaging in action to spark real social change. This theory is known colloquially as the "3.5 percent rule," and we kind of want to embroider it on a sweatshirt.

If you think regulations are taking too long to enact, and you want to do your part for the cause, understanding how to calculate your carbon footprint—and then working to lower it—is a step in the right direction.

Photo by Brian Mann on Unsplash

What is a carbon footprint?

The term "carbon footprint" is a metaphor for the impact our actions have when it comes to global warming.

Basically, a carbon footprint is a way of calculating the GHGs created on behalf of a person, place or thing. You can calculate a carbon footprint for virtually anything: an individual, company, industry or country, for example, or a product, action or lifestyle. The final number reflects all the GHGs that something or someone is responsible for.

Just as an elephant walking down a sandy beach leaves a bigger footprint than the mouse strolling alongside it, someone whose daily activities depend on a lot of energy use will leave a bigger carbon footprint than someone who uses fewer resources. The bigger the footprint, the bigger the contribution to global warming and climate change.

Calculating your own carbon footprint is the first step on the journey from Dumbo to Mickey.

It takes only about 3.5 percent of a population engaging in action to spark real social change. This theory is known colloquially as the "3.5 percent rule."

What about the term "ecological footprint"? How's it different from a carbon footprint?

Well, as any good middle manager knows, you can't get anywhere without a solid set of KPIs. To size up human impact on the planet, ecological footprint and carbon footprint are two common (and overlapping) measurements.

An ecological footprint adds up our impact in global hectares (gha), reflecting how much land you would need to support a certain way of living. (One hectare is 10,000 square meters, equivalent to 2.47 acres.)

Your ecological footprint includes not only your carbon footprint, but other factors too, like how quickly you consume natural resources like plant crops, animal foods and water. If a population's demands exceed supply (aka the region's "biocapacity"), that means its ecological footprint is beyond its means. Spoiler alert: for the average American right now, it is.

"Your ecological footprint includes not only your carbon footprint, but other factors too, like how quickly you consume natural resources like plant crops, animal foods and water.

Why, exactly, are we measuring carbon?

There are lots of greenhouse gases. But carbon dioxide (CO_2) is the most common one, so people use it as a kind of shorthand to talk about all the different gases that can absorb heat energy and trap it in the atmosphere.

These are the heavy hitters:

- → **Carbon dioxide (CO_2)**, which makes up about 76 percent of global GHG emissions
- → **Methane (CH_4)**, which accounts for 16 percent
- → **Nitrous oxide (N_2O)**, which contributes 6 percent (but is still no slouch)

Simple, right? Not quite. Figuring out the total combined impact of these gases isn't as easy as just adding them up, though, since they differ dramatically in how skilled they are at heating up the planet over a certain time frame (usually 100 years). This phenomenon is referred to as their global warming potential, or GWP.

Since we can't compare apples to oranges, a carbon footprint calculator does the hard work for us, transforming all other greenhouse gases into their carbon dioxide equivalent, or CO_2e. That's the amount of CO_2 that would create the same warming.

If you jotted it down, the equation would look like this: [amount of a greenhouse gas] x [the gas's GWP] = CO_2e. Amounts are generally calculated in metric tons, so you'll see a *t* there out front: tCO_2e. (One metric ton is about 2,204.6 pounds.) If you see a footprint measurement without a time frame or other limitation attached, assume it's for a year.

Using this formula, we can calculate that one metric ton of methane = 25 tCO_2e, and one metric ton of nitrous oxide = 298 tCO_2e. Which is astonishing. And also, yeah, we're thankful for the ease of carbon footprint calculators, too.

Okay, but how does a person *actually* calculate their carbon footprint?

Don't worry, there's a handy tool.

The quickest way is to use a carbon footprint calculator like this one, literally designed just for this purpose. A quick Google search will find you countless other options too. They usually start with some easy questions about your lifestyle, like where you live, how much you travel, how much energy you use at home, what you eat and how you shop.

When choosing which carbon footprint calculator to use, make sure it covers your habits thoroughly. Otherwise, you might get an incomplete measure of your carbon emissions. (A "toe print," if you will.)

Think about this. A calculator that estimates transportation-related CO_2 based only on your car usage, without factoring in the flights you take to visit your mom every holiday, wouldn't be giving you the whole picture. And when it comes to the environment, we probably shouldn't be cutting corners.

I've heard about direct and indirect carbon emissions—what's the deal there?

A complete carbon footprint includes both direct and indirect emissions, and the distinction can be confusing. Let's dig in, shall we?

If you're measuring the impact of a product, activity or lifestyle, the direct emissions are the ones immediately connected to it, while indirect emissions are one or more steps removed.

Try this example on. When you're calculating household energy use, like cooking your famous carbonara on the gas stove, that counts toward direct emissions—you're burning the gas right there in

your kitchen. But the electricity powering your shiny, retro-inspired fridge involves indirect emissions, as it was likely made by burning fossil fuel at a power plant.

Both of these *should* count toward your personal carbon footprint. But not all carbon calculators take this into account, so be vigilant.

> **“ When you’re calculating household energy use, like cooking your famous carbonara on the gas stove, that counts toward direct emissions—you’re burning the gas right there in your kitchen.**

Got it. Now, let’s cut to the chase. How much do we need to shrink our footprints?

Let’s start at the end. The ultimate goal is a carbon-neutral planet. That means we balance out our GHG emissions by removing the same amount from the atmosphere, ending up with a net-zero carbon footprint. (Being carbon-negative takes this idea a step further: removing more emissions than we produce.)

Until we get there (cut to the global cheerleading team), the Paris Agreement set the target that nearly the entire world is now striving to reach: cutting emissions enough to ensure that the planet doesn’t get 2°C (3.6°F) hotter than pre-industrial levels.

In fact, the Paris Agreement uses hedging language on this. Climate scientists don’t actually want us to hit that two-degree mark. They would prefer the temperature increase to max out at “well below 2 degrees, maybe even 1.5.”

To reach this 2-degree hard limit, the Deep Decarbonization Pathways Project says **the target for all countries should be to cap energy-related CO_2 emissions at 1.7 tCO_2e per person, as a global average, by 2050.** (This target zeroes in on emissions related to energy production and consumption, since those make up the bulk of all GHGs.)

The bad news is, that’s no easy feat. Even in Sweden, which is considered the leader in climate protection efforts, energy-related CO_2 emissions were about 3.8 metric tons per person in 2016, more than double the target. And in the U.S.? The average American carbon footprint related to the energy sector is around 16 metric tons a year. And if you look at total GHGs for *all* sectors? That number’s closer to 18 tCO_2e per American.

Making the necessary changes requires everyone, from individuals to governments, to do the work. And one super-easy step we can take right now is to figure out our own carbon emissions so we can start making choices to cut back.

Some of the most impactful things the average American can do to reduce their carbon footprint are cutting back on the bacon cheeseburgers, decreasing household energy use (dryers are out, clotheslines are in!) and reducing—or, if you’ve got the chutzpah, eliminating—travel by car and plane.

So think hard: Do you really need to follow Lizzo to Vegas *and* NYC?

> **“ Making the necessary changes requires everyone, from individuals to governments, to do the work. And one super-easy step we can take right now is to figure out our own carbon emissions so we can start making choices to cut back.**

2.2
Global greenhouse gas rankings by country

Unsurprisingly, calculating a country's carbon footprint is complicated. And the results can be both controversial and morally questionable, so the whole thing is a tricky issue to discuss.

But the data definitively shows that we are creating way more greenhouse gases than we should be. (And here in the U.S., sad to say, we're ranking high when we should be aiming low.)

The individual calculation makes sense, but how on Earth do you measure a country's carbon footprint?

With a lot of very complex spreadsheets.

The experts have come up with a number of ways to measure carbon emissions by country, so governments, NGOs, journalists and random data geeks can crunch the numbers and spot trends over time. Here are three commonly used metrics:

Annual output: Total greenhouse gases emitted per year.
Cumulative output: Total historical levels of emissions by country.
Per capita output: Total greenhouse gases emitted per year, divided by total population.

You promised a rankings chart. How do the world's nations stack up against one another in carbon emissions? And what is the U.S. carbon footprint?

“ But the data definitively shows that we are creating way more greenhouse gases than we should be. (And here in the U.S., sad to say, we're ranking high when we should be aiming low.)

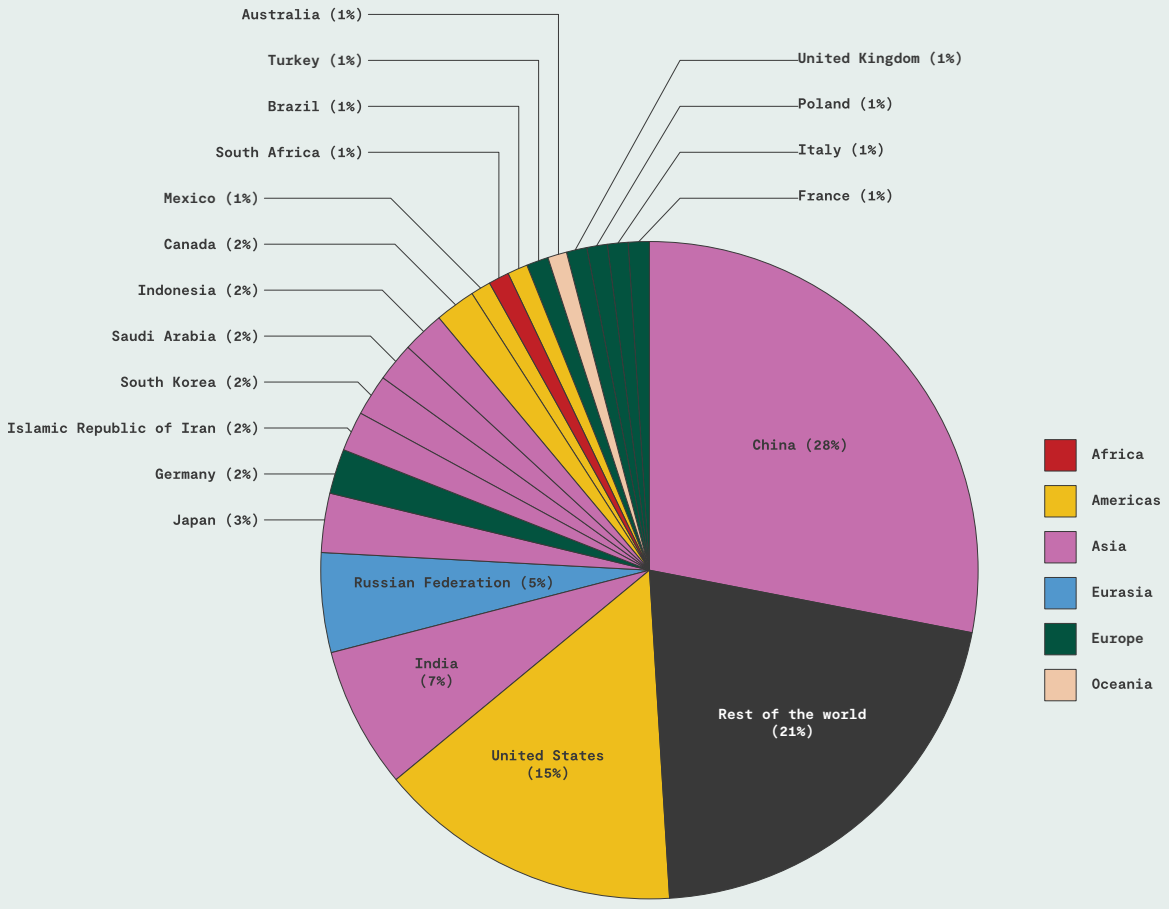
Photo by NASA on Unsplash

Paris Accord Targets by Country

Critically Insufficient	Highly Insufficient	Insufficient	2°C Compatible	1.5°C Paris Agreement Compatible	Role Model
4°C+ World	< 4°C World	< 3°C World	< 2°C World	< 1.5°C World	<< 1.5°C World
Argentina	China	Australia	Bhutan	Morocco	
Russian Federation	Indonesia	Brazil	Costa Rica	The Gambia	
Saudi Arabia	Japan	Canada	Ethiopia		
Turkey	Singapore	Chile	India		
USA	South Africa	EU	Kenya		
Ukraine	South Korea	Kazakhstan	Philippines		
Vietnam	UAE	Mexico			
		New Zealand			
		Norway			
		Peru			
		Switzerland			

Source

Emissions by Country (/Region) Pie Chart (2018)



Source

CO_2 Emissions by Country (2018)

Country	Annual CO_2 emissions (tonnes)	% of world total (36.57 billion t)	Region (Africa, Americas, Asia, Eurasia, Europe, Oceania)
China	10.06 billion t	28%	Asia
USA	5.42 billion t	15%	Americas
India	2.65 billion t	7%	Asia
Russia	1.71 billion t	5%	Eurasia
Japan	1.16 billion t	3%	Asia
Germany	759.00 million t	2%	Europe
Iran	720.41 million t	2%	Asia
South Korea	658.79 million t	2%	Asia
Saudi Arabia	621.30 million t	2%	Asia
Indonesia	614.92 million t	2%	Asia
Canada	568.41 million t	2%	Americas
Mexico	477.32 million t	1%	Americas
South Africa	467.56 million t	1%	Africa
Brazil	457.19 million t	1%	Americas
Turkey	428.18 million t	1%	Europe
Australia	420.22 million t	1%	Oceania
UK	379.04 million t	1%	Europe
Poland	343.54 million t	1%	Europe
Italy	338.03 million t	1%	Europe
France	337.91 million t	1%	Europe
Rest of the world	–	21%	–

Emissions per Capita (2018)

Country	Average Carbon Footprint (per capita)
Qatar	37.97 t
Curaçao	33.63 t
Trinidad and Tobago	31.28 t
Kuwait	23.70 t
United Arab Emirates	21.35 t
New Caledonia	20.56 t
Bahrain	19.80 t
Brunei	18.48 t
Sint Maarten (Dutch part)	18.44 t
Saudi Arabia	18.43 t
Kazakhstan	17.56 t
Australia	16.88 t

Source

So you want to know what country emits the most greenhouse gases? Like many global rankings, the U.S. is at or near the top in every category, except this one doesn't make us beam with pride.

By annual output, the top emitters are:

- → **China:** 27 percent of total global CO_2
- → **The U.S.:** 15 percent
- → **The E.U.*:** 9.8 percent
- → **India:** 6.8 percent
- → **Russia:** 4.7 percent

*The E.U.'s 28 countries are often grouped together since they set environmental targets as one body.

By cumulative output:

- → The U.S. is the biggest contributor by far—it's responsible for 25 percent of total historical CO_2 emissions (from 1751–2017).
- → China takes second place at 12.7 percent, thanks to its rapid industrialization, propelled by manufacturing—and, of course, the fact that more than a billion people live there. Between 1995 and 2015 alone, CO_2 emissions from its manufacturing industry went up by 221 percent

Photo by The New York Public Library on Unsplash

What countries have the highest carbon emissions per capita?

- → In 2017, the biggest CO_2 emitters per capita were, in order: Qatar, Trinidad and Tobago, Kuwait, Brunei, Bahrain and the United Arab Emirates.
- → Out of the top emitters by total output above, the highest on the per capita list is the good ol' U S of A. Our emissions in 2017 were more than 16 metric tons per person. Compare that with China at 6.86, the E.U. at 7.04, India at 1.84 and Russia at 11.31.

THE AIR CONDITIONING CLIMATE SPIRAL

It's a vicious cycle. As the earth heats up from global warming, we use more AC to cool down. And all the power and refrigerants producing that cold air create greenhouse gases that are heating up the world.

There's now nearly one AC unit for every four people on the planet, and along with electric fans, they're responsible for 20 percent of global electricity use. 2050 predictions say they'll be in two-thirds of the world's households, making them as ubiquitous as cellphones are now.

One solution to help lower that projection? Building better, more efficient air conditioning. The technology hasn't really changed since it was invented in 1902. Until we get there (and even once we do), let's do our best to use less of it to slow down the cycle.

→ It's important to note that this metric ranks country emissions on the basis of *production* (which would include fuel and other products for export), because this is the standard accounting method. But an alternative is calculating based on a country's *consumption,* which would better reflect the population's lifestyle and policy choices. Total per capita CO_2 emissions in the U.S. in 2018, for example, were 16.58 tCO_2e for production, and 17.63 tCO_2e for consumption. For China, on the other hand, production is higher than consumption: 6.97 tCO_2e vs. 6.28 tCO_2e.

Interesting. And what country has the smallest carbon footprint?

→ Since it takes a certain amount of money to produce GHGs, it will come as no surprise that the individuals and countries with the lowest carbon footprint are those that have the least.

- In many less affluent countries such as Chad, Niger and the Central African Republic, the average footprint is less than 0.1 tCO_2e per year. That's well under that 1.7 tCO_2e target we're reaching for, though let's keep in mind that we shouldn't be relying on the world's poorest to keep the averages down.
- Among more developed and industrialized countries, the lowest on the list are Sweden and Switzerland, with 4.27 and 4.52 tCO_2e per capita.

Wow. Why do greenhouse gas emissions by country vary so much?

There are a lot of reasons, but it boils down to a combination of having money to burn—and deciding whether to burn it. There's also a bit of luck involved, like the climate you live in and the natural resources you're surrounded by.

Economic inequality is a big factor. The richer the country and the higher its standard of living, the more energy it tends to burn through and the more stuff people tend to buy (and discard).

“ The richer the country and the higher its standard of living, the more energy it tends to burn through and the more stuff people tend to buy (and discard).

Think about the way we live in the U.S.: we drive more, fly more, shop more and air-condition our buildings more than people in most other places. (Plus, those homes and cars tend to be a lot bigger than elsewhere.) Similarly, the more populous the country, the greater the potential for CO_2 emissions.

On the flip side, some countries are able to keep carbon emissions lower—or reduce them—by enacting climate-friendly policies.

Example? Sweden instituted a carbon tax way back in 1991, or when Will Smith was still sitting on his throne as the Prince of Bel-Air. **As a result, carbon emissions decreased and the tax contributed revenue for Sweden's general budgets, which they were able to use to fund other climate-related initiatives.**

Some countries are lucky enough to reap the benefits of endemic natural energy sources that limit their reliance on fossil fuels. Take Iceland, the world's largest green energy producer per capita. As you may have seen on Zac Efron's Netflix series “Down to Earth with Zac Efron,” nearly all of the island's electricity comes from hydropower and geothermal power.

And then there's the realities of winter. It would be a challenge worthy of reality TV to live out the cold months in Alaska (or, for that matter, Sweden) without using some kind of energy to stay warm.

How do we know what is an acceptable carbon footprint per person in each country?

As we previously touched on, 189 countries have signed the Paris Agreement. **That means they've committed to take action—i.e., not just talk—to keep temperatures from hitting that 2-degree average increase.**

Most countries are taking the agreement seriously, at least from the public image POV. China, for example, has pledged that it will reach carbon neutrality by 2060, and that its overall emissions will start going down before 2030.

Unfortunately, some experts, like the ones behind the Climate Action Tracker, believe the environmental commitments set by most countries aren't yet enough to block the literal floodgates of global warming.

> **"The absolutely unfair fact is that while the world's poorest countries have contributed the least to the climate crisis, they are especially vulnerable to the fallout.**

Is it fair to say that everyone has to reduce their carbon footprint? What are the ethical conundrums here?

These are thorny issues. As is the question of which countries should shoulder the biggest burden of cleaning up the environment, cutting consumption and investing in new and upgraded infrastructure. Should this be the nation responsible for the most emissions historically (the U.S.), the current top emitter (China) or the ones cranking out the most CO_2 per capita (oil-producing countries)?

You can't answer this question without bringing up climate justice, a concept that positions climate change as an ethical and political issue as much as an environmental one.

The absolutely unfair fact is that while the world's poorest countries have contributed the least to the climate crisis, they are especially vulnerable to the fallout, which includes everything from land degradation and devastating food shortages to escalating infectious diseases.

Photo by Nicolas J Leclercq on Unsplash

This also goes for the poorest members of relatively affluent countries, who tend to live in areas that are already plagued with pollution and that are at greatest risk of being negatively affected by climate change. **In the U.S., this group disproportionately includes people of color, hence the term environmental racism.**

The less money you have, the less you're able to escape disasters like flooding and fires or to be able to pay for air-conditioning and other things that make life in a hot climate more bearable. Climate change solutions need to take this growing inequality into account.

Photo by Nathan Dumlao on Unsplash

So... is there any good news? What is being done by countries to lower their greenhouse gas emissions?

Well, let's just say there's room for improvement. But because it's important to celebrate the small victories, here are a few noteworthy measures being rolled out.

→ **Morocco** is one of few countries on track to reach Paris Agreement goals. It's achieving this by generating more of its electricity from renewable sources. One example? It's home to the world's largest concentrated solar farm, the Noor-Ouarzazate complex, which creates enough electricity to cover the needs of one million Moroccans.

→ **India** wants to generate 40 percent of its power through renewables like solar by 2030, and it's well on its way to earlier-than-planned success. In the past decade, the government has also doubled its coal tax (a de facto carbon tax) three times, putting that money toward clean energy projects.

→ **Costa Rica** already gets 98 percent of its electricity from renewables, chiefly hydropower. It wants to hit 100 percent by 2021. The country is also turning its attention to reducing emissions from fossil fuels used for transportation. For example, government policy encourages people to choose electric vehicles: not just with financial incentives like tax breaks, but also other attractive perks like better parking.

2.3
Break it down: the U.S. carbon footprint

Close to 80 percent of all U.S. emissions are thought to be directly or indirectly related to household consumption. That includes things like your electricity usage and the gas in your car, plus things you buy like appliances, furniture, gadgets and food.

What you do, use and buy can also generate emissions outside your country. Clothing as a category, for example, accounts for more than 12 percent of U.S. household emissions *overseas*, even though it has no significant domestic footprint. (In other words, if your shirt was manufactured, say, in Bangladesh, its carbon footprint is mostly attributed to that country. Which seems kind of unfair, since demand is coming from elsewhere.)

> **“ Close to 80 percent of all U.S. emissions are thought to be directly or indirectly related to household consumption.**

Which sectors contribute most to carbon emissions in the U.S.?

The United States Environmental Protection Agency (or, to their friends, the EPA) has been crunching the numbers on national GHGs from all human-made sources since 1990. The findings are published every year in the Inventory of U.S. Greenhouse Gas Emissions and Sinks, which we're sure would be a great pick for your bedside table if you're prone to insomnia.

To browse numbers by sector, and see trends over time, you can use the EPA's interactive tool,

the Greenhouse Gas Inventory Data Explorer. For the CliffsNotes, have a look below for a breakdown of greenhouse gas emissions by sector in the U.S., according to EPA data from 2018.

Transportation (28 percent)

More than 90 percent of the fuel we use to get around—by car, truck, plane or diesel-powered train—is still petroleum-based. The largest sources of these emissions are passenger cars and light-duty trucks, including SUVs and minivans.

Electricity (27 percent)

Around 63 percent of U.S. electricity comes from fossil fuels, mostly coal and natural gas; these release GHGs as they burn. In American homes, the biggest electricity hog is making things cooler and heating them up: that means the hot water tank, the furnace and AC, and the fridge, freezer and stove.

And then there's all our power-sucking gadgets and the systems they're connected to. The information and communications technology industry could account for up to 21 percent of global electricity demand by 2030.

Industry (22 percent)

When it comes to the industrial production of goods, burning fossil fuels for power or heat is one of the biggest sources of GHG emissions. And sometimes the production process itself involves emissions, like when petroleum is used to manufacture plastic. (As for the impact of plastic, that's a story for another day.)

> **"The information and communications technology industry could account for up to 21 percent of global electricity demand by 2030.**

Commercial and residential (12 percent)

In this sector, many of the emissions in the U.S. are related to heating and cooking. Burning natural gas is responsible for the majority of GHGs directly emitted, since most of us don't burn any other fuels right in our homes anymore.

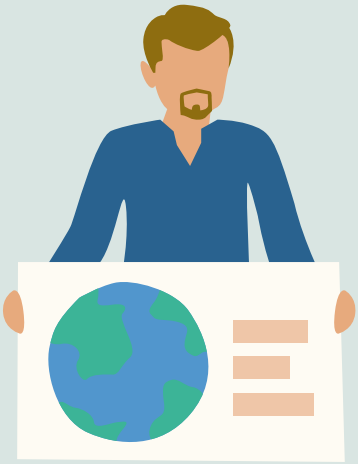
Other sources of GHG emissions include organic waste, wastewater and leaky air conditioning and refrigeration systems.

Agriculture (10 percent)

Livestock, especially cattle, produce and release methane—enough to make up more than 25 percent of agriculture-related emissions in the U.S. Certain farming practices, like using fertilizers, can lead to emissions of nitrous oxide.

Land use and forestry

Since trees and plant matter absorb and store carbon, that category is a "net sink" in the U.S. In fact, this sector offset around 12 percent of GHG emissions in 2018. Score one for the trees!

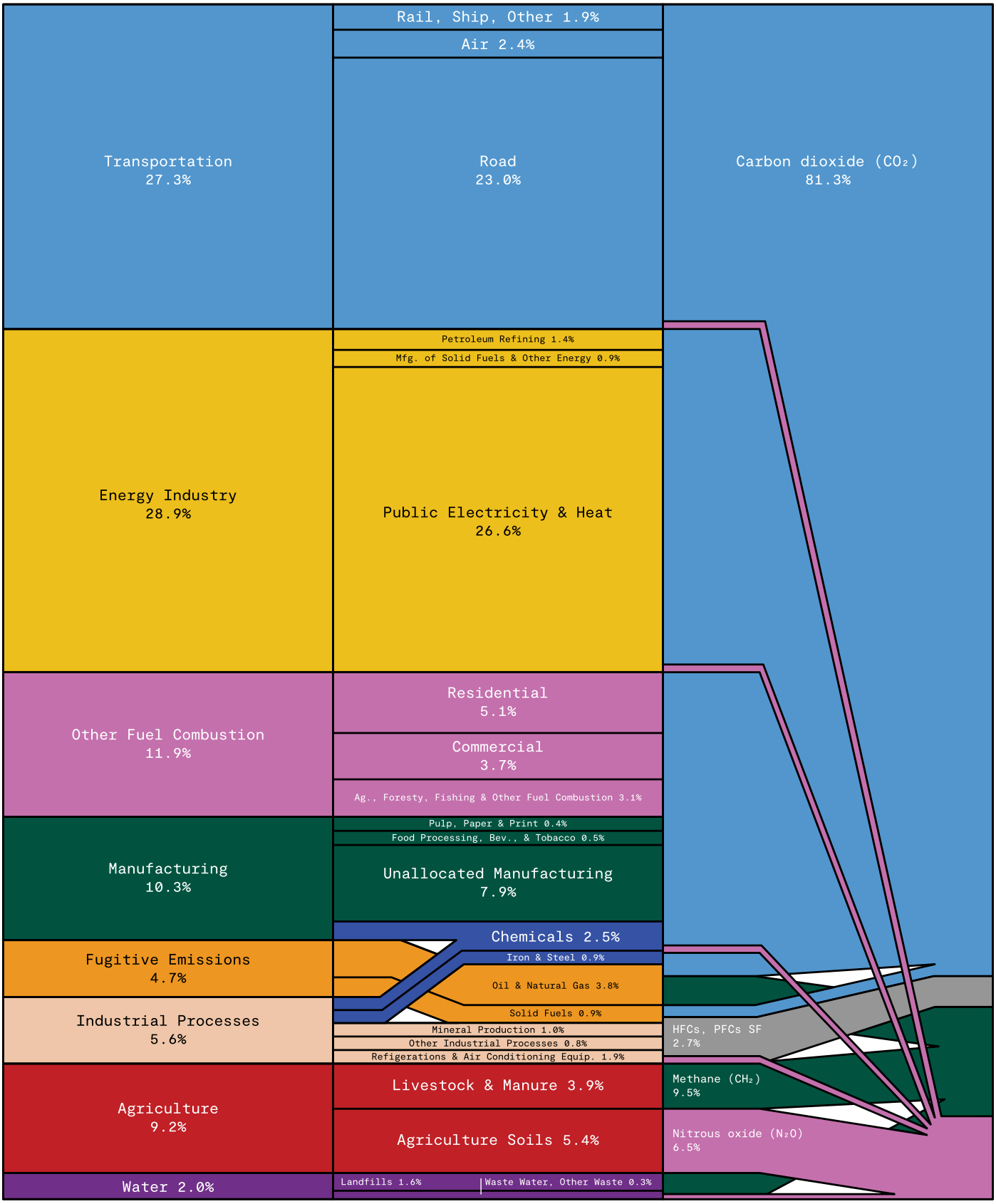


LEO'S CLIMATE CRUSADE

He's famous for his big-screen roles and standing at the bow of the Titanic, but Leo has a leading part as an environmentalist, too. Since the '90s, he's been using his heartthrob status for good, shedding light on climate-related issues and becoming one of the most famous climate action champions in the world.

But it isn't just UN speeches, low-emissions cars and climate-change docs. Among other endeavors, the actor is a big-time investor in plant-based food companies. Since 1998, the Leonardo DiCaprio Foundation has funded more than 200 organizations with climate action and ecosystem protection on their agendas. That's a romance we can get behind.

U.S. Greenhouse Gas Emissions, 2018



Source

2.4
Carbon emissions, and what companies are doing about them

A country's carbon footprint is the sum of the actions of a lot of individuals—and that includes individual companies. The good news? For a number of reasons, more and more businesses are motivated to care about their carbon footprint.

To start with, consumers increasingly value and expect sustainable business practices.

Next, extreme weather caused by climate change is putting companies and their supply chains at risk. And no smart CEO likes that kind of risk.

Plus, businesses are realizing that a carbon-conscious future isn't just about making sacrifices. In fact, it holds huge opportunities for growth and leadership.

Why are companies tracking their corporate carbon footprint? What's in it for them?

Sometimes they just have to: The biggest GHG emitters in the U.S. must report their data annually to the EPA. Other times, companies track their corporate carbon footprint so they can give the details to non-profit organizations such as CDP (formerly the Carbon Disclosure Project), or because they have their own reasons for trying to do better.

CDP shares data on carbon emissions with potential investors. Since sustainability is increasingly crucial, a firm's carbon footprint—assuming it's relatively good—can be seen as a competitive edge.

What are corporations doing with their carbon footprint score?

Just like age, a carbon footprint is, well, just a number. But if companies want their upcoming annual reports to include truly impressive graphs, they have to have a plan. And great news: There are plenty of companies making huge efforts to reduce their carbon footprints.

Luckily, there are lots of options available. They can work toward reducing emissions, or buy offsets to counteract their carbon footprint. They can set internal carbon pricing (more on this concept later). And they can also push their business partners, such as suppliers, to do their own carbon accounting and set emissions targets.

What's being done to lower carbon emissions by industry?

Reducing greenhouse gas emissions begins with spotting the opportunities. And there is plenty of inspiration, if you know where to look. Like these potential measures:

→ **Cut overall energy consumption:** One simple first step is to upgrade to energy-efficient lighting and HVAC equipment. Companies can also consider extensive building overhauls, known as "deep retrofits," which are estimated to save up to 60 percent in energy costs.

→ **Reduce unnecessary business travel:** Transitioning to a remote workforce, for instance, would cut down on car commuting, a significant source of emissions. If one good thing has emerged from the COVID-19 pandemic—at least when it comes to climate change—it's that we've been abruptly thrust into a world where video conferencing is normal.

> **"Reducing greenhouse gas emissions begins with spotting the opportunities. And there is plenty of inspiration, if you know where to look.**

→ **Use renewable energy:** Corporations can commit to getting more electricity from renewable sources like wind or solar power. Apple, for instance, uses 100 percent renewable energy for its operations. It's now working on transitioning its products—including its full supply chain—away from fossil fuels.

→ **Buy carbon offsets:** Both companies and individuals can put money toward GHG-reducing measures (think tree planting, energy-efficiency projects and methane recovery) in order to balance out their emissions.

Who's turning words into action when it comes to reducing corporate carbon emissions?

While no company has a perfect track record, there are lots of examples of positive corporate change when it comes to climate issues. Here are a few highlights.

→ Microsoft intends to be carbon-negative by 2030. Even more ambitiously, by 2050 it aims to remove all the carbon it has emitted since the company was founded. To get this done, the company plans to slash its carbon emissions by more than half by 2030, and will launch a $1-billion fund for climate innovation, aiming to accelerate technology for carbon reduction, capture and removal. Woohoo!

→ Consumer goods giant Unilever plans to achieve net-zero emissions for all products by 2039. It will set up a system to improve supply-chain transparency, with each supplier invoice declaring the carbon footprint of goods and services provided. The company will also invest €1 billion in a climate fund, expected to support projects like reforestation, carbon sequestration and water preservation.

- → Amazon wants to be carbon-neutral by 2040, and it co-founded The Climate Pledge to get other companies to hit that same deadline. It's reducing emissions related to customer shipments by developing more environmentally friendly packaging and delivering packages via zero-emission transportation such as electric trucks. And it intends to power its operations entirely with renewable energy by 2030.
- → Ford Motor Company aims to be carbon-neutral globally by 2050. The car maker plans to run all its manufacturing plants worldwide on 100 percent locally sourced renewable energy by 2035. It will also be launching electric/no-emission versions of some of its most popular vehicles.
- → Never one to be outdone, Apple has pledged to become carbon neutral for both its supply chain and its products by 2030. (The company's global corporate operations are already carbon neutral.) The plan includes low-carbon product design, increased energy efficiency, renewable energy, carbon removal (aka offsetting) and other innovations, like the development of a new, lower-carbon process for smelting aluminum. And also, because we're talking about the future, there's a smart recycling robot called Dave. No joke.

What's all this talk about internal carbon pricing, and why are organizations using it?

It's widely expected that one day, emitting GHGs will come with a cost to corporations, like a government-imposed carbon tax. (This kind of system already exists in some countries.)

To prepare for this future, some companies are setting their own internal carbon pricing. This can be a real fee that's collected, or a "shadow" amount that's strictly theoretical, like Monopoly money.

Here are two examples, along with the business benefits.

- → Microsoft has an internal carbon fee of $5–$10 per metric ton. They funnel the funds into sustainability projects, like the purchase of renewable energy.
- → BHP set a shadow price on its carbon of $24–$80 per metric ton. They've factored this cost into their budgets to help them manage risks and make decisions, including ways to mitigate current emissions.

If I want to shop and invest according to my values, how can I tell the difference between greenwashing and legitimately sustainable companies?

It's not always easy to tell if claims are just greenwashing—a marketing tactic designed to create the illusion that a company is more environmentally friendly than it truly is—but there are some questions to ask while you're digging. How does the company define "sustainable," "carbon-neutral" or "climate-positive," and what's the specific plan to get there? Will it reduce corporate carbon emissions by switching to renewable energy, buying carbon offsets, or both? How will progress be measured and documented? Those companies that are making real change are easily able to explain how they're doing it.

Luckily, you don't (always) need to casually comb through 70-page annual reports to figure this out. There are tools available to help you research just how sustainable a company really is. Good On You is a guide to the clothing industry, for example, and HowGood gives insight into food brands.

Photo by Karolina Grabowska from Pexels

2.5
Now that I know my carbon footprint, what can I do to reduce it?

Real talk: it's not always easy, and our society is built for consumption, not reduction. But no matter the size of your personal carbon footprint, you really can make mindful changes to lower it. Here are just a few ideas to start.

- → Considering going vegan or vegetarian, at least part-time. One study estimates that eliminating meat and dairy would reduce our footprints from food by two-thirds. We know, steak is tasty, and cheese is delicious. So don't think it's a question of all or nothing. **Even eating less red meat (especially beef and lamb) and more plants will still make a difference.** Meatless Monday is a really delicious challenge to take on. Honest.
- → When you can, trade car rides for bikes, buses, trains or your own two feet. The next time you're in the market for a vehicle, consider if an electric or hybrid might be your next ride.
- → Reduce your overall home energy use. Make sure the heat or AC isn't cranked too high, improve insulation and switch to energy-efficient appliances when the time comes for replacements. (And listen to your thrifty grandfather: turn the lights off when you're not in the room!)
- → When it comes to clothing and other consumer goods, we could all stand to be more considerate about purchases. Buying less, shopping vintage or secondhand and choosing quality things we'll want to keep for years are all steps in the right direction.

> **"It's not always easy, and our society is built for consumption, not reduction. But no matter the size of your personal carbon footprint, you really can make mindful changes to lower it.**

Up for more? You got it. Head on over to Chapter 3 for our guide to reducing your carbon footprint with 26 ways to get started today.

CHAPTER 3

Reduce Your Carbon Footprint: 26 Ways to Live More Sustainably

By Rebecca Gao

We can't all be Greta, but anyone can help reduce global carbon emissions by lowering their carbon footprint. Here are 26 tried-and-true ways to do your part.

26 ways to reduce your carbon footprint

Environmentalists have long been branded as granola-eating treehuggers who care more about the planet than about people. But whether you look at that as a good thing or a bad thing (granola is pretty delicious, and who doesn't like a tree?), it's not exactly accurate.

The biggest reason climate change is a problem for humans is—well, because it's a problem for humans. Global warming will affect (and is affecting) plants, animals and fungi too, but overall, the planet will keep going long after people are gone.

But if we want life here to be comfortable, we need to do something serious about climate change—right now.

That's where carbon footprints come in, and why it's important that we all work to shrink our shoe size, so to speak. Some of the actions are easy, some a little harder, but think of it as a collective challenge we'll look back on fondly, like that mud race you did with your college roomies in a fit of fitness optimism.

Reducing our global carbon footprint is going to take concerted effort from governments, companies and individuals across the planet. And the best way to get started is in your own backyard—plus your kitchen, garage and bathroom.

Read on to learn more about carbon footprints and global warming and to find out what lifestyle changes are the most effective ways to reduce your greenhouse gas emissions and lower your impact.

In this chapter:

Photo by Dustan Woodhouse on Unsplash

3.1
What is a carbon footprint, and how do I measure it?

Before we dive in, let's run through a quick refresher on carbon footprints (you can always jog your memory with a re-read of Chapter 2). In basic terms, **your carbon footprint is a representation of the total amount of climate-changing greenhouse gases you produce as you make your way through your daily life.**

You know when someone won't leave your party, even after you've turned up the lights and started doing the dishes? That's a lingerer. Greenhouse gases do the same thing, but in the atmosphere, and they invite solar energy along for the ride.

Where do these GHGs come from? Basically, everything we do, from turning on the blender for our post-workout power smoothie to driving off to a lakeside getaway at the end of a tough week, uses energy and other resources that create emissions of various gases. The bulk of these emissions come from burning fossil fuels (that's the gas in your car), land use changes like deforestation (to grow the cattle feed so you can get your whey protein) and generating electricity (which is often fossil fuels again).

> **"Everything we do, from turning on the blender for our post-workout power smoothie to driving off to a lakeside getaway at the end of a tough week, uses energy and other resources that create emissions of various gases.**

And despite the name, a carbon footprint is about more than just carbon. It includes all your other GHG emissions, like methane and nitrous oxide. Carbon footprint calculators will do the math (so you don't have to) and convert everything into the carbon dioxide equivalent, which is abbreviated as CO_2e.

Information overload? Let's take three deep breaths before we carry on. And don't worry, we promise not to quiz you at the end.

How much do we need to reduce our carbon footprints?

Honestly? A lot. For Americans, that number is about 90 percent.

The United Nations' Intergovernmental Panel on Climate Change (IPCC) has said that if we don't act now, we'll be facing the severe effects of a warming planet as early as 2040. One example? 50 million people around the world, including here in the U.S., will be exposed to the effects of increased

Paris Agreement on Climate Change (COP21)

KEEP GLOBAL TEMPERATURE RISE

Well below 2°C **With aspiration to 1.5°C**

ALL COUNTRIES TO REPORT REGULARLY on their emissions and efforts to reduce them → New transparency and accounting system in place

EVERY 5 YEARS **REVIEW EACH COUNTRY'S CONTRIBUTIONS** to GHG emissions cuts so that they can be scaled up

Developed countries to provide **$100BN** climate finance per year **until 2025**

coastal flooding. (That's bland scientific language for everything from "frequent basement floods" to "islands completely disappearing.")

Remember the 2016 Paris Agreement? It was an international pact to find climate change solutions and aimed to limit the rise in global average temperatures to under 2°C (3.6°F) above pre-industrial levels—and ideally, under 1.5°C (2.7°F).

How does that affect you? The Deep Decarbonization Pathways Project says the target for all countries should be to cap energy-related CO_2 emissions at 1.7 tCO_2e per person, as a global average, by 2050. Currently, the U.S. carbon footprint related to energy is around 16 tCO_2e per capita. That means Americans need to cut their emissions by almost 90 percent.

> **"Currently, the U.S. carbon footprint related to energy is around 16 tCO_2e per capita. That means Americans need to cut their emissions by almost 90 percent.**

Achieving this goal, and the Paris Agreement targets, will require a herculean effort and commitment from all of us. And a big part of that is how we live our daily lives. By lowering your personal carbon footprint, you won't just be reducing the amount of greenhouse gases in the atmosphere. You'll also be contributing to a positive ripple effect, normalizing a more sustainable way of living and helping to change prevailing attitudes.

Ready to get started? Here are 26 ways you can be part of the solution.

Photo by Cameron Casey from Pexels

> **“ By lowering your personal carbon footprint, you won’t just be reducing the amount of greenhouse gases in the atmosphere. You’ll also be contributing to a positive ripple effect, normalizing a more sustainable way of living and helping to change prevailing attitudes.**

3.2
Cut back on the gas guzzling

It turns out that we *really* like the convenience of vehicles. And since most of them use internal combustion engines, transportation is the largest source of carbon emissions in the U.S., accounting for about 28 percent of all GHG emissions.

The reality is, we all have to get around, and we shouldn’t feel personally guilty for the way our society is structured. Many of us need our cars for commutes, trains for business conferences and planes to visit family and friends.

But that doesn’t mean we can’t change things for the better. If we ask ourselves, “Is this necessary?” it’s easy to discover winning solutions. Can that business meeting happen over Zoom? Maybe you can carpool or opt for transit sometimes. Or maybe the next time

Photo by Roxanne Desgagnés on Unsplash

> **“ Cars alone account for about half of the carbon footprint of a typical two-vehicle American family.**

you move, you can pick a walkable neighbourhood so you don’t need a car at all.

Cars alone account for about half of the carbon footprint of a typical two-vehicle American family. Here’s the kicker: transportation’s carbon footprint is so outsized not just because we drive a lot, but because Americans have been buying larger vehicles (which use more gas per mile) and flying more.

Your transportation choices make a big impact. Try these simple tips to reduce your transportation carbon footprint. Hey, it’ll save you money, too.

1. Spend less time in your car

It’s easier said than done, but living car-free can significantly reduce your carbon footprint. In fact, going without your car for a year could cut more than 15 percent of your emissions. Walking, biking (both A+ for your health) and taking public transit are alternatives that reduce your carbon footprint while getting you where you need to go.

If ditching your car entirely sounds too drastic (it’s okay, we can only do our best), you could opt to reduce the amount you drive. Working from home even just once a week, for example, will reduce your commuting footprint by 20 percent.

When you do have to commute to work, carpooling will drive down emissions. Combining errands to make fewer trips will also help reduce fuel usage, and walking to your neighborhood market for essentials is a nice way to support local while curbing GHGs.

2. Choose a fuel-efficient vehicle (but don't upgrade too fast)

If you do need a car for your day-to-day activities, **driving a fuel-efficient vehicle (one that gets more miles per gallon) will greatly knock down your emissions.**

Choose a smaller car or a hybrid or electric vehicle when it comes time to upgrade. Some small cars run 50 miles per gallon, whereas pickup trucks might run in the high 20s. Added bonus: you'll seriously save on gas.

One key point, though: New cars generate anywhere from 6 to 35 tCO_2e during the manufacturing process, depending on the type of car and materials needed, which counteracts the fuel-efficient benefits of switching in the first place. That's major, especially considering the average American's carbon footprint is about 18 tCO_2e per year.

So while driving an electric car or a hybrid can help cut down on emissions in the long run, there's no need to rush to upgrade to something new, no matter how shiny it is. The production of vehicles is actually hugely carbon intensive and may take away the gains from opting for an energy-efficient model.

If you are buying a new car, look for a SmartWay-certified vehicle—this government program run by the EPA certifies the lowest emitting cars each year. Thankfully, it's really that simple.

> **"So while driving an electric car or a hybrid can help cut down on emissions in the long run, there's no need to rush to upgrade to something new, no matter how shiny it is.**

3. Make your ride more fuel-efficient

It's not just what you drive that matters, but also *how* you drive. Welcome to Fuel-Efficient Driving School 101: You can save gas by accelerating and braking gradually, subduing your inner speed demon mileage usually decreases when you go faster than 50 miles per hour) and using cruise control, especially on long hauls. And don't be that person who leaves the car idling while chatting with neighbors.

If you're packing cargo, use a hitch-mounted rack (the kind that attaches to the back of your car) instead of roof-top boxes to make your car more aerodynamic. Ask any F1 car designer; aerodynamics save on fuel, big time.

Don't snooze on maintenance, either. Servicing your car regularly can help keep it running efficiently. Simple things like checking and adjusting tire pressure and upgrading motor oil can increase fuel efficiency. Tending to a more serious problem, like a faulty oxygen sensor—which measures the composition of your car's exhaust and helps calculate how much fuel to use—can improve mileage by as much as 40 percent.

4. Fly mindfully

We're sorry to say it, world travelers, but despite how fun and easy it is to jet to a new place, those flights are a major contributor to your carbon footprint. Huge.

But that doesn't mean you can't take a vacation or see the world. Just be more mindful. Take longer and fewer trips, and fewer flights overall—like, maybe once you're in Europe, you get from city to city by train instead of discount air.

Consider this when booking a ticket: An economy-class return flight from Los Angeles to Sydney emits about 3.36 tCO_2e per passenger. That's more than

> **“ An economy-class return flight from Los Angeles to Sydney emits about 3.36 tCO_2e per passenger. That’s more than 20 percent of the average American’s annual carbon footprint (and more than double our target footprint).**

20 percent of the average American’s annual carbon footprint (and more than our target footprint). And that’s just one trip. Since each metric ton of CO_2 emitted leads to about 3 square meters (32.3 square feet) of Arctic ice loss, it’s safe to estimate that one surf vacation down under could mean the loss of about 10 square meters of Arctic ice—that’s more than 100 square feet.

Until planes can fly without fossil fuels, skipping air travel—or at least flying less—is a hugely effective way to pare down your travel carbon footprint. And when you do need to fly, look into carbon offsetting—more on that in Chapter 4. You can use a flight carbon calculator app or website (we like carbonfootprint.com) to do the math on your emissions.

5. Economy > business class

Business class is certainly more glamorous, but it does pose a tricky ethical dilemma. Here’s why: The more people on a flight, the smaller the airplane’s carbon footprint is per person. In other words, your carbon footprint when flying has a lot to do with the size of the seat you choose. And business class is usually between two or three times as energy intensive as economy, with first class as much as four times as bad.

> **“ One surf vacation down under could mean the loss of about 10 square meters of Arctic ice—that’s more than 100 square feet.**

PLANET-FRIENDLY PLANT FOODS

Faux meat is processed, but it’s still sustainable: imitation beef products like Impossible Burger and Beyond Burger create about 5 percent of the emissions of real meat.

An even more planet-friendly pick? The carbon footprint of legumes like peas and lentils is less than 3 percent that of beef, making them the official winner among protein-rich foods from the climate’s POV.

In the end, while the relative healthfulness of processed meat substitutes is up for debate, when it comes to global warming, that plant-based burger patty or “neatball” is the better option, whether it was made in a factory or your own kitchen.

Photo by Karolina Grabowska from Pexels

Photo by Lisa Fotios from Pexels

3.3
Eat your way to a healthier planet

Here's an easier one you can practice every day. According to a University of Oxford study, the food supply chain is responsible for about a quarter of all worldwide GHG emissions. That's a farm-to-table calculation: everything from preparing the soil to turning potatoes into chips to shipping those chips to your local convenience store.

> **“ In the U.S., food waste generates the equivalent of 37 million cars' worth of GHG emissions annually.**

Food production is carbon-intensive because of things like land use (e.g., deforestation to make way for farm land) and the energy needed for harvesting, processing and transportation.

Then, even after the food is in your fridge, it still plays a role in your carbon footprint: in the U.S., food waste generates the equivalent of 37 million cars' worth of GHG emissions annually. So think of that doggie bag (in a BYO container if you're super keen) as a major win in the battle for good.

There are a slew of ways to reduce your food carbon footprint. Here are a few of our easy-to-adopt tips.

6. More bean burritos, fewer beef burgers

Sorry, carnivores, but an extremely effective way to reduce your carbon footprint is to cut back on the amount of animal products you eat, especially lamb and beef.

How much impact does food have?

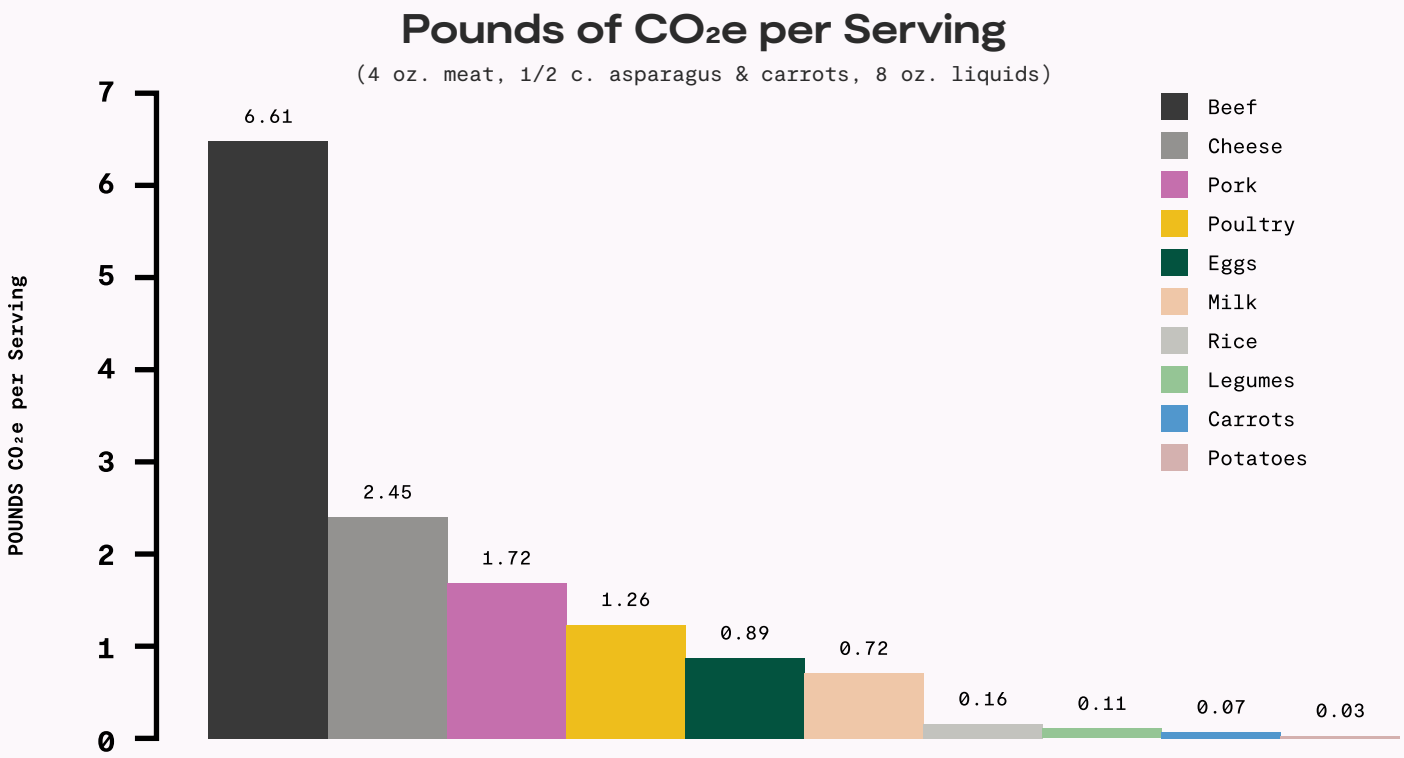
Proportion of total greenhouse gas emissions from food

A quarter of global emissions come from **food**

More than half of food emissions come from **animal products**

Half of all farmed animal emissions come from **beef and lamb**

Source



Source

Photo by Dylan de Jonge on Unsplash

Meat and dairy products account for more than half of food's carbon footprint. Does that mean you *have* to become a card-carrying vegan? Nope. Just being mindful of your consumption is meaningful.

And, it's easier than ever. Vegan and plant-based options are everywhere nowadays. You don't have to go cold turkey, but try adopting one or two meatless meals a week to start.

Let's look at meat's large-and-in-charge carbon footprint a bit closer: Livestock uses twice as much land as crops like grains and vegetables, which leads to deforestation and the loss of biodiversity to make room for farmland. Livestock—mainly cattle—also produce methane c/o their stomachs, which are designed to digest coarse plants, but not without side effects.

Methane is a greenhouse gas roughly 25 times more potent than carbon dioxide, meaning that beef's carbon footprint is one of the biggest for farmed animals. (Sadly for those who love everything creamy

and melty, cheese and other dairy products have a big carbon footprint, too. Because, you know, they also mostly come from cows.)

Let's look at some numbers. A kilogram of peas (that's 2.2 pounds) produces about 0.9 kilograms of CO_2e. A kilogram of beef? SIXTY kilograms of CO_2e. That means that the carbon footprint of beef is more than 60 times bigger than the carbon footprint of peas. In fact, beef's carbon footprint is so large that even swapping it for the less carbon-intensive chicken could reduce your meal's carbon footprint by almost 90 percent.

7. Fresh from the farm

This one feels good and is, conveniently, very delicious. Land use accounts for the bulk of your food's carbon footprint. But another way to reduce your diet's impact is to choose products that are locally produced, like from the farmers' market. You can sometimes shop locally at grocery stores, too.

This is most important when it comes to products imported by air. Transporting food by plane versus truck produces almost six times the carbon emissions per mile—and keep in mind it often travels a lot more miles.

Quick tip: Some foods that are commonly transported by plane to the U.S. include asparagus, green beans and berries. The only way to know for sure is to ask, so make friends with your local greengrocer or produce manager. Skipping flown-in strawberries in winter in favour of locally grown apples is the kind of small swap that can make a big difference.

> **"Americans waste about 40 percent of the food they buy, throwing out about 1.3 billion tons of food per year.**

8. Wasted food is a wasted opportunity

Your dad was on to something when he told you to eat everything on your plate. Turns out he was being an environmentalist before it was cool.

Did you know that Americans waste about 40 percent of the food they buy, throwing out about 1.3 billion tons of food per year? Yes, 400 out of every 1,000 calories produced are never ingested. In other words, keeping in mind some of this waste is in restaurants, industry and transportation, we chuck about a pound of food per day per person, 100 percent wasting the emissions used to grow, produce, transport and buy that food—and adding to our carbon footprint. Yikes.

Thankfully, there are loads of simple solutions to reduce your food waste.

- → Take stock of your fridge regularly, especially before shopping, so you don't buy multiples.
- → Shop more often, and buy less each trip. By picking up what you need every few days, you can solve a lot of waste from produce spoiling before you could get to it because you didn't know on Sunday that you'd be craving pizza on Wednesday.
- → Plan out your meals to manage your pantry and cut down on food spoiling.
- → Freeze leftovers to extend the life of your food.
- → Hack your leftovers: instead of tossing them, look out for recipes that use leftovers creatively or repurpose your dinner surplus for lunch tomorrow. When in doubt, add sriracha.
- → Don't forget to ask for a doggie bag for restaurant leftovers. Future you will thank you once lunchtime rolls around.

9. Composting rules

Let's face it, it's tricky to tick all the boxes, and expiration dates can creep up quickly. Don't sweat too much if that well-intended spring mix ends up languishing a bit too long in the crisper. Home composting is your best option to dispose of those droopy greens. In 2017, Americans recovered about 27 million tons of wasted food through composting—that's a massive 165 pounds per person, or close to half a pound per person per day.

Organic waste in landfills generates methane as it decomposes. In fact, food waste in landfills is the

Photo by Soo Ann Woon from Pexels

third-largest source of human-related methane emissions in the country. Composting not only significantly reduces these emissions, but also turns your food waste into stable soil carbon that can be used as fertilizer.

New to composting? First read up on the EPA's guidelines for home composting. (It's a quick read, honest.) Then, figure out what compost method works best for you. Installing a backyard compost bin is a good way to start and make some fertilizer to use in your garden. There are tons of other options to pick from, too, including some indoor-friendly versions that use worms as waste-eating, fertilizer-making helpers.

If you don't feel up to starting your own composting system, or don't have the space, see if your city or region has a composting system you could participate in. You can also look into private composting services in your area. And if nothing's available? Well, sign yourself up to become your local composting advocate.

“ Composting not only significantly reduces these emissions, but also turns your food waste into stable soil carbon that can be used as fertilizer.

10. Cultivate your green thumb

Growing your own vegetables, herbs and fruit is a fun and effective way to reduce your carbon footprint while also prepping for end times. (We're all going to need a skill, right?) Not only are you eating more fresh produce, you're also reducing the amount you need to buy, which cuts down the overall carbon footprint of your diet. It doesn't get more local than fresh parsley or tomatoes from your own backyard, balcony or windowsill.

Don't have garden space? Volunteer at a community vegetable garden to reap the benefits of growing local.

Photo by Breno Assis on Unsplash

3.4
Sustainability starts at home

Your home's size, how it's built and the energy and water you use all contribute to your personal emissions. Buildings and their construction account for a massive 36 percent of global energy use. And in order to meet Paris Agreement targets, we need to reduce the amount of energy we use in our homes by about 30 percent before 2030.

> **"In order to meet Paris Agreement targets, we need to reduce the amount of energy we use in our homes by about 30 percent before 2030.**

The good news? It's totally doable. Here's a few tips for reducing your carbon footprint at your home sweet home.

11. Downsize your digs

No, you don't need to resort to hobbit-style living, but opting to live in a smaller house—or better yet, an apartment or condo—can help reduce your carbon footprint in multiple ways. To start with, people who live in smaller homes use less energy for heating and cooling. But they also tend to buy fewer things and generate less garbage.

12. Join the energy efficiency train

On average, an American home uses 25 percent of its energy on heating, 13 percent on water heating and 11 percent on cooling. The remaining half is spent mainly on appliances.

Consider investing in a home energy audit, which will show you where your weak points are. Proper insulation with sustainable building materials (like fiberglass and cellulose) can reduce your home's carbon footprint. Installing a cool roof, made of reflective material that redirects light away from your house, is another way to reduce your energy consumption.

> **“ Installing a cool roof, made of reflective material that redirects light away from your house, is another way to reduce your energy consumption.**

Little things make a difference too, like cleaning or replacing HVAC filters every three months, as a dirty filter will waste energy, making your system work harder than it has to. If you use central heating, blocking drafts and sealing windows will help keep the warmth in during wintertime. And in summer, do what Grandma did and close the blinds to keep the sun's heat out.

13. Check your appliances

Energy-efficient appliances will also help reduce your home's carbon footprint. Look for the Energy Star certification to ensure you're getting a credible product. (You could be eligible for rebates and tax credits, too. Type your zip code into Energy Star's website to find programs in your state or local area.)

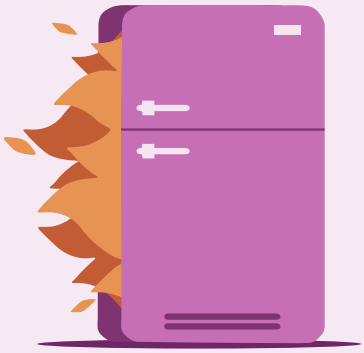
The number of appliances also makes a difference. Do you really need that second fridge in the garage for your yearly holiday leftover overflow, or could it be discarded (responsibly) to lower your household energy use?

14. Little changes, big impact

Installing a programmable or smart thermostat, which will automatically regulate temperatures, is an easy way to reduce your home's carbon emissions and make your home more energy efficient. Also check your settings: Could you leave your house a little warmer in summer and a little cooler in winter to save energy?

Using energy-efficient lighting like LEDs is another quick fix. LEDs last 25 times longer and use 75 percent less energy than other bulbs. And the quality is way better than it used to be.

And guess what? You can actually buy clean energy. Give your utility company a ring, ask how they source the electricity they supply and see if you can opt in for “green pricing” to pay just a little bit more to use alternative energy sources.



THE HEAT FROM YOUR FRIDGE

Fridges and freezers are a triumph of innovation, giving us luxuries like blueberries in the winter and ice cream all year round. But in the process of keeping things chill, they're heating up the planet in an alarming way.

Refrigerants emit greenhouse gases during their entire life cycle, and especially when they're disposed of improperly. They also damage the ozone layer, which helps protect the planet from solar radiation.

Thankfully, updated regulations mean new models are less harmful. If you're getting rid of an old fridge or freezer, be sure to do it responsibly. And if you're in the market for an upgrade, consider buying as small a fridge as possible and picking an Energy Star certified model.

Photo by andré spilborghs on Unsplash

15. Make laundry cool again

Your laundry room is a literal hotspot where you can make easy but impactful changes.

Bet you didn't know that approximately 75 percent of the total energy used during a single load of laundry comes from heating the water. Switching to a cold-water wash will get your clothes just as clean and reduce your carbon footprint in the process.

It's v. European, but skipping the dryer will help, too: if every American line-dried their clothes for just half a year, it would save more than 3 percent of the country's total residential CO_2 emissions.

16. Run less water down the drain

Water usage affects your carbon footprint in a couple of ways: not just from heating the water, but from the infrastructure and energy required to treat it and transport it to your home.

There are many ways to conserve water, like taking showers instead of baths. And the shorter the shower, the better. According to the EPA, a full bathtub requires about 70 gallons (or about 932 cups, if you must know) of water, while a five-minute shower uses a maximum of 25. On top of spending less time in there, use a low-flow shower head to increase efficiency. And when you need new appliances, faucet heads or toilets, look for water-efficient products.

If you're a gardener, installing a rain barrel is a fun and easy way to save water, too. You can use the water collected in your garden instead of taking it from the tap.

17. Get rid of your lawn

A garden isn't just a means of reducing the carbon footprint of your food: it can also help make for an energy-efficient home.

Lawns are on the hook for nearly 3 trillion gallons of water annually, plus 20 million gallons of gas from mowing and 70 million pounds of pesticides. Replacing your lawn with drought-tolerant plants, or other climate-efficient landscaping, can reduce your water consumption by up to 75 percent—and save you a ton of effort, so you can enjoy lounging on your patio with an iced coffee on Saturday mornings watching the bees pollinate your flowers while your neighbors sweat it with the yard work.

> **"Replacing your lawn with drought-tolerant plants, or other climate-efficient landscaping, can reduce your water consumption by up to 75 percent—and save you a ton of effort.**

The trick for cutting down on both water and labor is to choose climate-appropriate plants that will thrive with the amount of sun and rain your locale naturally gets. In drier parts of the country, that might mean installing native plants that don't need a ton of water or replacing grassy lawns with rocks and soils that don't need water at all.

Do some Googling to find out what's the most climate-efficient landscaping in your region, or look into hiring an eco-friendly landscaper who's already an expert in this stuff.

18. Get your house naturally cool with shady trees

For that full-on house-in-the-country vibe, plant shrubs and trees around your house. On top of looking good, they're nature's insulation.

A deciduous tree on the south or west side of your home, for instance, will help shield it from the sun in the summer, reducing cooling costs, then let in that light and heat in the winter. And a row of evergreens on the north side of your house will help block the icy winter winds blowing down from Canada.

3.5
Shop less, save more (carbon)

Everything you buy increases your carbon footprint, from that sweet new vinyl release to that kitchen tool that only does one thing. Buying anything new means that resources had to be extracted and processed, then the product had to be made and packaged, then delivered to you or a store. All of that emits GHGs.

Reducing your product carbon footprint means re-evaluating how much you're buying, who you're buying from, how you shop, how long you use the product for and what you do when you're done with it.

But the most important factor that will reduce your impact is simply to buy less, and buy less often. Downloading a carbon calculator app can help you determine your carbon footprint based on your purchases.

19. Buy less (or nothing at all)

Buying less is step numero uno. Everything you purchase has a carbon footprint, so the less you buy, the better. Think in Marie Kondo terms *before* you make a purchase. Does this item spark joy?

Ask yourself if you *really* need it, or if there's someone you can borrow from, or something you

Photo by Krisztina Papp on Unsplash

can use instead that's almost as good. You can also look into renting items like tools, small appliances or special-occasion outfits. Don't forget, opting out from shopping is a learned skill that takes practice.

Start with clothing. We have a habit of buying a multitude of outfits and then not using them to their full potential, especially if we're among the many Americans who shop for fun, not because we necessarily need new clothes. According to a study by Chalmers University of Technology, in countries like the United States, garments are rarely put on until they're worn out. This is partly because most "affordable" clothing isn't designed to last. Better to morph into a serious fashionista who makes *investment* purchases.

20. Keep your purchases grounded

Just like with food and travel, a product's carbon footprint turns huge the moment it steps on a plane.

By buying from local makers and manufacturers, you often reduce the carbon emissions associated with that purchase. You'll also be bolstering your local economy, and who doesn't love that?

> **"Buying anything new means that resources had to be extracted and processed, then the product had to be made and packaged, then delivered to you or a store. All of that emits GHGs.**

21. Shop online (but be mindful of shipping)

A study from MIT found that shopping online often has a smaller carbon footprint than buying in person. That's because shipping companies tend to use highly efficient delivery systems. Plus, online shopping could result in there being fewer vehicles on the road than, say, if everyone drove to the mall.

But that doesn't mean online shopping gets you off the hook for emissions. You can make specific choices to keep the footprint as low as possible: slower shipping, bulk ordering and avoiding returns.

> **"Shipping's carbon footprint gets bigger when you pick faster shipping options, like next-day or express.**

Shipping's carbon footprint gets bigger when you pick faster shipping options, like next-day or express. When shippers prioritize speed over efficiency, it leads to packages being less consolidated, trucks going out half-empty, more packaging waste and more vehicles on the road to fulfill orders as fast as

Photo by David Ballew on Unsplash

possible. And rushed packages are often delivered on planes, which have a much larger carbon footprint than surface transportation.

That carbon footprint gets bigger again when you make multiple small orders. Try waiting until you have a longer list before ordering. If it's available, choose the option to get everything shipped at once rather than each item as it's ready, so companies can consolidate your delivery.

Also, remember that online returns impact your carbon footprint, too. In totally shocking news, many returned goods are actually thrown out rather than going back into stores, so the pants that just didn't fit right might never get worn, even if you do send them back. Doing detailed research and looking at size charts and product reviews before buying, rather than impulse-shopping, can help.

22. Shop vintage, sustainable and high quality

Sifting secondhand isn't everyone's love language, but buying vintage or used helps save both money and the environment—and there is often lots to choose from. It can be especially worthwhile when shopping for kids, who are prone to growing out of their outfits before they've worn them out. Vintage stores and sites like Depop, ThredUp and Etsy offer curated collections if the hunt is too overwhelming.

Before you feel too proud for donating piles of unwanted clothing, note that secondhand shops are only able to resell up to 20 percent of the clothes they get. The overstock goes to textile recyclers or into landfills, which release GHGs like CO_2 and methane as the product decomposes. Often, unwanted garments from the U.S. end up in other regions like in Africa, where the influx of used clothing has had hugely detrimental effects on local textile businesses due to reduced demand.

> **"Before you feel too proud for donating piles of unwanted clothing, note that secondhand charities are only able to resell up to 20 percent of the clothes they get.**

When more people shop vintage, the life cycle of those jeans, dresses and shoes is extended, and fewer new items are purchased. It doesn't hurt that vintage is cool, and there's nothing quite like the feeling of scoring something that you absolutely love (and no one else has)

When you do need to buy something new, shop from companies with a mandate to produce sustainably, and look for products made from sustainable, longer-lasting materials. Natural fibers like wool and linen aren't just durable, they're also biodegradable, unlike synthetics like polyester and spandex. Also think long-term when it comes to color and style; how long is that mustard sweater really going to be on-trend?

Doing research on products that last a lifetime, either from customer reviews or from a forum like r/buyitforlife on Reddit, can narrow down which products will really stand the test of time.

The longer you own and use something, the less frequently you'll need to purchase something new. When you buy better-quality, you also have room to resell if you decide that piece no longer serves you.

23. Upcycle and repurpose

If you can't resell your gently used items and you're up for a satisfying creative project, upcycle or repurpose them. It takes some extra effort, but it will save your stuff from the landfill and give you good reason not to buy something new.

Photo by Karina Tess on Unsplash

A ripped bed sheet could become a drop cloth for kids' painting projects (or even smocks if you're handy with scissors and a sewing machine), lamps can be made fresh again with an upgraded shade, and obviously you need to keep something useful in that cute bear-shaped honey jar.

Learning to fix things rather than replacing them can also make a big difference. Nowadays, there are plenty of tutorials online to help you do so. Plus, many communities have repair clinics for electronics, appliances, clothes and other goods. Check out websites like ifixit.com to find tips and tricks on fixing and upcycling your damaged goods.

24. Plastic's not so fantastic

From the planet's POV, plastic poses a lot of problems. It lives in the environment for hundreds, if not thousands, of years. Plastics don't decompose; they turn into tiny particles known as microplastics

Photo by Anna Shvets on Pexels

that we (and other animals) ingest. And plastic is more ubiquitous than you might think: consider the lining of a takeaway coffee cup, for instance, or the stretchy fabric in your favorite bathing suit. Both are, pretty much, made of plastic.

Avoiding plastic in favor of alternative materials is one way to make a difference. As always, it's best to buy items that you'll use for a long time or, in the case of packaged food, that can be recycled efficiently. **Above all, use what you have rather than buying new, even in the name of sustainability.**

Skipping disposable and single-use products and picking reusables instead is another way to reduce: think water bottles, reusable shopping bags and travel mugs. It all takes practice, but keep cloth bags on you for when you shop, tote a travel mug to your local coffee spot and call ahead for takeout and let them know you'll be bringing your own containers.

Also, consider whether you need that plastic item at all. The bananas you pick up at the store for your breakfast smoothies already come in nature's packaging. They don't need a produce bag to go into your shopping cart.

Keep an eye out for low- or no-packaging products, like buying the loose lemons instead of the ones in mesh bags. Shopping in the bulk section can reduce your plastic use, too, since there's less, little or no packaging. In some stores, you can even bring your own containers. (Buying in bulk can also help you reduce food waste, as you can buy only what you need, rather than a large container of an ingredient you might not use regularly.)

> **“ Plastic is more ubiquitous than you might think: consider the lining of a takeaway coffee cup, for instance, or the stretchy fabric in your favorite bathing suit.**

25. Digital carbon footprints are a thing

The future is bright, and going digital-only to forgo things like paper printouts or DVDs is a low-waste option. But remember that all that energy that goes into running devices and storing information still contributes to your carbon footprint.

In the U.S., 2 percent of the country's electricity is used to power data centers. Unplugging devices that aren't in use and installing advanced power strips will reduce the amount of "vampire loads" (energy that is wasted on electronics not in use) and lower the amount of electricity used overall.

As for data storage, it's easy to forget about digital clutter when it's out of sight, out of mind. But those gigabytes of saved "thanks!" emails and bathroom selfie outtakes add up to a lot of energy usage and server infrastructure. (One study calculated that if every adult in the U.K. sent one less thank-you email each day, they would save more than 16,000 tCO_2e per year—the equivalent of 81,152 flights from London to Madrid.) Think of it as extra incentive to just delete everything in your out-of-control inbox.

> **“ Gigabytes of saved "thanks!" emails and bathroom selfie outtakes add up to a lot of energy usage and server infrastructure.**

Boost your influencer game

Want to be a trendsetter? Your behavior, and your influence on those around you, can be another way to reduce your carbon footprint.

26. Be the change you want to see

Letting others know what you're learning about climate change can help reduce emissions simply because of increased awareness. Discussing the changes you're making with friends and family might inspire them to think more about reducing their own carbon footprints.

Starting or joining a committee at work is another good way to contribute, as is volunteering with local environmental organizations. And to make yourself extra popular, find a couple of super-delicious go-to plant-based recipes to bring to get-togethers and office parties. They won't believe it's vegan!

The carbon footprints of the future

Perhaps the most controversial among the many ways we can reduce our carbon footprints is the idea of having fewer children. For some, this is accompanied by the question of whether it's ethical at all to bring a child into a world facing what they perceive as imminent catastrophe.

The idea makes a certain amount of sense—more people means more stuff, and more stuff means more GHGs—but alongside being very taboo, the question of whether we should be recommending that people procreate less is subject to a lot of debate.

Conclusions are murky. Predicting the future when there are countless variables is far from an exact science. But it's safe to conclude that while fewer people overall is probably better for the climate crisis, the most pressing issues are to eliminate our dependence on fossil fuels, and to shift government policy toward a carbon-neutral future.

Consider carbon offsetting

Unless you can hold your breath for a *really* long time, you're going to create at least some carbon emissions during your time on this planet. So after doing all that's possible to reduce your carbon footprint—still the best thing you can do to lessen your impact on the Earth—the next step is to consider offsetting your emissions.

> **"Unless you can hold your breath for a *really* long time, you're going to create at least some carbon emissions during your time on this planet.**

That means financially supporting green projects and initiatives to counteract the carbon emissions you've created. Though reducing your carbon footprint is still the best thing you can do to live more sustainably, offsetting is the only current way to be entirely carbon neutral. (See Chapter 4 for more.)

When we know better, we do better. And knowing where to start can be the biggest challenge, especially with a challenge as big as climate change. But now that you've learned all about reducing your carbon footprint, you've got the power to make a difference. From your breakfast menu to your renovation plans to the way you get to work, you can start living your best sustainable life today.

CHAPTER 4

Offset Your Carbon Emissions (Yes, It Really Makes a Difference)

By Alyssa Schwartz

They're a lesser-known tool in our fight against climate change, but carbon offsets have the potential to do a world of good. Here's why.

Do carbon offsets really make a difference? (Spoiler alert: yes.)

Your sushi delivery. That new desk for your home office. A wine country getaway. Much of what we eat, buy and do in this modern world generates carbon dioxide and other greenhouse gases that contribute to climate change.

We know reduce, reuse and recycle as the main pillars of sustainability, but there's another important way to lessen your environmental impact. Meet carbon offsets.

In this chapter:

Photo by Pixabay on Pexels

4.1
What are carbon offsets, anyway?

In the fight against climate change, reducing carbon emissions is our best battle strategy. But the fact is, the essentials of life—like, eating food and living in a building—mean we can't help but produce greenhouse gases. And the realities of modern living (that's the cars, the planes and the factories) produce a lot of emissions that are impossible to erase overnight.

Put simply, carbon offsets are a means of balancing out the impact of the greenhouse gases you're responsible for by creating an equivalent reduction elsewhere. It's kind of like sleeping in after a late night out, or having a salad for dinner when you did three rounds at the lunch buffet.

There's a huge variety of carbon offset projects, but they all have a few things in common. They use nature (think trees or wild grasslands) or technology (like alternative power sources) to reduce or sequester greenhouse gas emissions. And they need money to get the job done.

> **"And the realities of modern living (that's the cars, the planes and the factories) produce a lot of emissions that are impossible to erase overnight.**

Bonus: carbon offsets do more than just balance out emissions. Buying carbon offsets means supporting initiatives that promote sustainability, the proliferation of green energy instead of fossil fuels and other positive environmental and social changes. It's more than just a passive way to become carbon

neutral. Joining team carbon offset means you're actually taking action to help make the world a greener place.

Photo by @felipepelaquim on Unsplash

A brief history of carbon offsetting

You've probably been hearing more about carbon offsets in the past few years, but the concept isn't exactly new. It dates back to the 1997 Kyoto Protocol, a global agreement that gave countries emissions targets.

Among (many) other things, the Kyoto Protocol allowed those countries that produced less than their allowed volume of greenhouse gases to sell their excess allowance to those that were over target.

This tool birthed the idea of "carbon markets," where carbon offsets could be bought, sold or traded. Doing this allowed individuals, businesses, even cities or countries to measure their output and then buy carbon offsets to balance out the effects of their actions.

(Side note: they're called *carbon* offsets because carbon dioxide is the most common greenhouse gas. But when you hear about carbon emissions and carbon offsetting, assume that people also mean other greenhouse gases like methane and nitrous oxide.)

Though the carbon market is complicated and sometimes a bit disorganized, reputable carbon offset programs have significant oversight, including requirements for third-party stamps of approval.

This vetting can come from any of several organizations. In 2003, for instance, the World Wildlife Federation and a group of other non-governmental organizations established the Gold Standard registry, a database that tracks, standardizes and certifies carbon-reduction projects. And in 2006, the International Organization for Standardization developed consistent rules for measuring and validating carbon offsets (more on this below).

In the years since, carbon offsets have gone from niche to near-ubiquitous, and there is an increasing number of places where you can buy offsets, from airline websites to eco-friendly clothing retailers. That's both good news and bad.

Taking steps to become carbon neutral has become easy and accessible. The catch is that it can be difficult to know exactly what you're buying, and whether your carbon offsets will have the impact you're aiming for. But don't despair—that's why we're here.

What do carbon offsets actually do?

Right off the bat: Carbon offsets don't actually reduce your carbon footprint. Instead, they balance out the emissions you generate with projects that reduce the amount of emissions in the atmosphere.

There's a wide array of projects you can buy into to offset your carbon emissions. You might be helping to fund a social initiative that maintains coastal mangrove forests, or contributing toward a wind power project aiming to reduce a region's reliance on coal.

The first step is to determine your greenhouse gas output using a carbon offset calculator. (For comparison's sake, the average American carbon footprint is around 18 tCO_2e.) You might work this out for a certain activity like a ski vacation, for a specific purchase like that sweet new Tesla in your garage, or for your day-to-day lifestyle overall. Then, you buy the equivalent amount in carbon offsets, effectively making your activity—or your whole life—carbon neutral.

Photo by CHUTTERSNAP on Unsplash

Are carbon offsets the same thing as carbon taxes?

This is a common misconception. They're both necessary in our efforts to fight climate change, but their mechanics differ quite a bit.

Carbon taxes are run by governments. They're charged when you buy fossil fuels (like coal or gasoline).

Carbon taxes have a double purpose, though—they're not just a money grab. They make it more costly to generate greenhouse gases (bad), and the proceeds help make it cheaper to use sustainable, environmentally friendly energy (good).

With offsets, you are funding a specific project that reduces the amount of carbon dioxide and other greenhouse gases in the atmosphere.

How do I know how much carbon to offset?

Let's start with the bad news. Much of what you do and consume generates greenhouse gases, and the more you use, the bigger your carbon footprint. Long, hot, steamy showers feel great, but they're not exactly sustainable. Same with buying a new outfit you only wear once, or that weekly three-hour road trip to hit the beach in the summer.

The first step with carbon offsetting is to figure out the amount of greenhouse gases you generate. Whether it's your total carbon footprint or the emissions from specific activities like that recent flight to Honolulu, a carbon footprint calculator will do the math. Flip back to Chapter 2 for more on how carbon footprints work.

That's the easy part. Finding the best way to offset those greenhouse gases is where it gets slightly more complicated.

Photo by Ave Calvar Martinez from Pexels

4.2
What kinds of carbon offset projects can you invest in?

Carbon offset projects exist all over the world. And good news for shopaholics: there's huge variety in the price of offsets, the types of projects you can fund with your offset purchase, and even the traceability and credibility of sellers. That means it's easy to find a project you can feel good about contributing to, and even connected to on a personal level.

There are many ways to categorize carbon offset projects, and as of yet industry insiders haven't come up with a consistent system. But to help you get a handle on the terminology, we've broken things down into six major categories.

1. Energy efficiency

It's simple: the less fuel we burn, the fewer emissions end up in the atmosphere. So some energy-efficiency offset projects are designed to reduce how much fuel people need to use. Examples include distributing fuel-efficient stoves or replacing incandescent lighting with LED.

In Madagascar, where diesel is a common source of electricity, one smart initiative has replaced more than half a million incandescent light bulbs. The switch to energy-efficient bulbs is expected to reduce emissions by 52,000 tCO_2e over seven years.

Photo by Solarimo GmbH from Pexels

2. Renewable energy

You're likely up to speed on this one already. Renewable energy projects develop and promote sources of energy like solar, hydro and wind power. They have huge benefits, as building this kind of infrastructure reduces future carbon emissions from the old-school electricity generation (i.e., coal) it replaces.

One example is a wind power development in Turkey that's saving 66,000 tCO_2e per year as it replaces less sustainable power sources. That's enough to power 7,616 American homes for a year.

A cool thing to know about renewable energy is that it's actually become a less common type of carbon offset project. Not because it doesn't work, but because clean power is now profitable enough that it doesn't need the funding from offset programs. That's all thanks to early investment from believers like you.

3. Methane abatement and capture

Methane gas is shockingly potent (and we don't just mean the smell). Emitted by farm animals, landfills and other waste generators, it's estimated to be 25 times more potent than carbon dioxide at warming the Earth. Methane abatement projects contain and convert this gas, keeping it out of the atmosphere so it can't contribute to the greenhouse effect.

One project in China, for instance, is recovering methane from a landfill and converting it into electricity, which both reduces methane emissions and lessens the need to produce electricity by burning fossil fuels. Now that's a win-win.

The estimated result over 10 years will be a greenhouse gas reduction of approximately 420,000 tCO_2e. That's equivalent to the annual carbon footprint of about 25,000 average Americans.

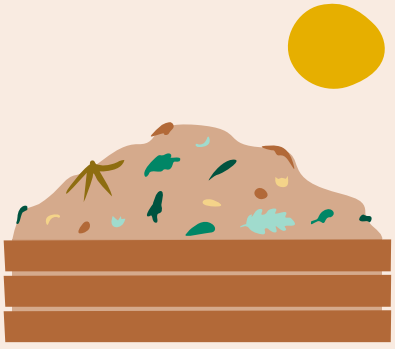
4. Industrial gases and pollutants

In the quest to develop new technologies, we haven't always been on top of the negative side effects. And it turns out many industrial processes use or produce harmful greenhouse gases. Offset projects in this area work to capture and destroy these gases, or to upgrade how things work so the super-harmful gases are no longer emitted at all.

Some of these projects are extremely niche—yet very effective. For example, one automotive parts manufacturer working in the U.S. and Canada has historically used sulfur hexafluoride (SF_6)—which, if you didn't know, is a greenhouse gas with a global warming potential 22,800 times that of CO_2—in its casting process. By using a new gas instead, they aim to reduce emissions by 196,000 tCO_2e. That's like taking more than 42,000 cars off the road for a year.

5. Reforestation and nature preservation

These projects are probably the first thing that springs to mind when you hear about carbon offsetting. They reduce greenhouse gases by protecting and proliferating carbon-sequestering greenery. This means forests, yes, but also grasslands and even giant seaweed. (And if you didn't know,



WHY COMPOSTING > LANDFILLS

Landfills aren't just malodorous eyesores that supply garbage to the ocean. All that trash is contributing to climate change, too: globally, it released a massive 800 million tCO_2e in 2010 alone.

Specifically, organic waste in landfills (read: orange peels, yard waste and well-intentioned bunches of kale) produces methane, a potent greenhouse gas. Projects to capture and use this gas are in progress. But the biggest opportunity is simply to reduce our waste and to compost what we do discard rather than sending it to the dump. With both strategies in place, this is one climate change problem where a solution is in sight.

scientists say nature-based solutions are a hugely potent low-cost tool to help limit global warming.)

Look at Colombia, for example. A project there is reforesting more than 400 acres of degraded grazing land with native and endangered tree species, and protecting an additonal 108 acres of forest. Not only is this initiative a win for conservation, it's creating permanent jobs.

6. Fuel switching

Like slipping lentils into your pasta sauce in place of ground beef, these are projects that substitute cleaner fuels for those that create more carbon emissions.

One example in India has distributed 60,000 solar water heaters, reducing electricity use and saving 150,000 tCO_2e per year. That's the equivalent of driving from Miami to Anchorage and back about 37,500 times.

Offsets with benefits

Another thing to keep in mind: many carbon offset projects support social and sustainability goals in other ways, too.

Take the Kenyan Energy Efficient Stove Project, which supplies brick stoves to households in rural Kenya.

The new stoves made possible by carbon offsets cut the amount of firewood needed for cooking in half, which is helping to lower the global carbon footprint.

But in addition to reducing the amount of carbon that traditional stoves generate, the reduced demand for firewood means local forests have a chance to recover, *and* locals have more time to put toward economic development, jobs and education.

Photo by Ommy Jay on Unsplash

Photo by Narcisa Aciko from Pexels

4.3
Which carbon offset programs can you trust?

Most people are averse to following hard-and-fast rules, but when it comes to carbon offsets, having stringent standards works for the greater good.

Why? Well, in a perfect world, it would be nice to fund projects that you could personally oversee, giving you the confidence that your money was being put to good use. Since that's virtually impossible from a time, energy and location perspective, we must accept a world where there's a common set of standards for projects to follow (if they want to be approved by certification boards).

Even still, vetting carbon offset providers would require sourcing and digesting so much information that you'd feel like quitting before you'd even started.

The shortcut to choosing legit carbon offsetting projects is to outsource the leg work to a trusted third-party organization like the three listed below. They crunch the numbers and check the facts before handing out an official seal of approval to projects that make the grade.

On top of that, the latter two offer browsing and shopping tools, so you can review and even fund projects right from their websites. Just pick your favorite and go.

1. The Verified Carbon Standard, or VCS, is a rigorous set of rules and regulations upon which Verified Carbon Units (VCUs) are established. Each VCU represents one metric ton of CO_2e that is reduced or removed as the result of carbon offsetting, and each must be confirmed and entered to the Verra Registry. And fun fact: the CEO of the Verra carbon program says they always try to build in social benefits to their offset projects to help create an even bigger impact.
2. The Gold Standard is another recognized body that certifies emission reduction projects, with a registry and marketplace of offset products measured in Gold Standard Verified Emission Reductions (VERs), each of which represents one metric ton of emissions.
3. The United Nations carbon offset platform Carbon Neutral Now was launched in 2015. It includes projects in developing countries that have been verified by its Clean Development Mechanism program.

As you come across carbon offset projects, consider accreditation from these groups to be proof that the offsets you're buying are reliable.

Carbon Offset Programs				
Company	**Description**	**Founded**	**Headquartered**	**Fun fact**
VERRA	Verra is a global leader helping to tackle the world's most intractable environmental and social challenges by developing and managing standards that help the private sector, countries, and civil society achieve ambitious sustainable development and climate action goals.	2005	Washington, DC	The CEO of the Verra carbon program says they always try to build in social benefits to their offset projects to help create an even bigger impact.
	The United Nations carbon offset platform Carbon Neutral Now features UNFCCC certified projects that reduce, avoid or remove greenhouse gas emissions from the atmosphere. It includes projects in developing countries that have been verified by its Clean Development Mechanism program.	2015	New York, NY	In 2020, the platform reached the 2 Million CERs Milestone. (CERs are emission reductions units emanating from projects located in developing countries under UN Climate Change's Clean Development Mechanism (CDM).)
Gold Standard®	Another recognized body that certifies emission reduction projects, with a registry and marketplace of offset products measured in Gold Standard Verified Emission Reductions (VERs), each of which represents one metric ton of emissions.	2003	Geneva, Switzerland	Gold Standard was established by WWF and other international NGOs to ensure projects that reduced carbon emissions featured the highest levels of environmental integrity and also contributed to sustainable development.

Go your own way: How to evaluate carbon offset projects

Let's say you want to do your own research anyway, or you want to know how these groups assess carbon offset initiatives, and what makes a project worthy of your hard-earned assets. Your first question might be, "What's the difference between planting a tree and seeding a renewable energy corp, anyway?"

While there are many projects that reduce carbon dioxide in the environment in meaningful and traceable ways, there are also those that would exist despite the outside funding. Plus—sad to say—as in any industry, there are scammers trying to capitalize, literally, on people's good intentions.

Digging into how carbon offset projects are evaluated can help you get a sense of the impact that one initiative might have over another. Here are some of the criteria experts use to evaluate them.

Additionality: Is it really new?

Would the reduction in greenhouse gas emissions have happened even without the carbon offset project?

The goal of carbon offsetting is to create new or additional reductions in greenhouse gases that would not otherwise exist. It's important to find initiatives that aren't part of the regular course of business. Instead, look for those that are additional: they contribute to reductions in greenhouse gases beyond what's legally required, or they couldn't be implemented without the funds generated through offsetting.

> **"The goal of carbon offsetting is to create new or additional reductions in greenhouse gases that would not otherwise exist.**

Quantification: Can we measure it?

Can the results of the initiative be turned into a fancy yet meaningful graph based on actual reduction numbers? If it's all buzzwords and no math, the project isn't quantifiable and won't be approved.

Photo by Pixabay from Pexels

Unique ownership: Is it truly yours?

Imagine you went to pick up the pizza you ordered for dinner (a veggie-lovers' one, of course) and it was gone—they'd sold it a second time to someone else. A similar thing sometimes happens on the shady side of the carbon offset world.

Let's say a clean energy project is responsible for a total 100,000 tCO_2e reduction in emissions. That means they can only sell offsets that add up to 100,000 tCO_2e. If they try to sell more, that's violating the unique ownership rule. That's why in the non-shady world, carbon offset projects are registered, and then all the offsets get retired once they've been sold.

Leakage: Does the project have negative effects elsewhere?

What we're trying to do is reduce carbon emissions overall, across the whole wide world. It doesn't help things if a carbon offset project in one place results in an increase in emissions elsewhere.

One example that's easy to understand is logging. Let's say one region or country decides to protect a certain forest, and lumber output goes down. That's great—until the timber companies just go elsewhere to cut down the same amount of wood. A feel-good story in one place becomes a total downer somewhere else, and ultimately, there's no benefit for the planet as a whole.

A quality carbon offset project will take leakage into account in its calculations and define plans to avoid it.

Verification: Are they doing what they say they're doing?

Sadly, we can't just trust what people write in their reports. So to make sure carbon offset projects are doing what they say they are, you want them to be verifiable by independent and credible third parties.

Permanence: Are the reductions for good?

Greenhouse gases stay in the atmosphere for a long, long time. A project that reduces emissions for only a few years—or even, you know, just a century or two—isn't offsetting, it's just delaying.

Forestry projects, for instance, aren't helping matters if the trees are just going to be cut down 20 years from now. Permanence means the offsets are more or less forever. Which is what we're going for, right?

“ Greenhouse gases stay in the atmosphere for a long, long time. A project that reduces emissions for only a few years—or even, you know, just a century or two—isn't offsetting, it's just delaying.

NATURE'S CARBON SINKS

Nature-based solutions could provide a third of the GHG reductions we need to succeed in limiting global warming, and it's all thanks to the power of plants. During photosynthesis, they take in CO_2 from the air and use the carbon to make food and build up their bodies and root systems.

As long as those plants are alive, most of the carbon stays there—which is why long-living trees are such a powerful carbon-storage tool. When they die, some of the carbon is released during decomposition, but much of it remains in the soil.

That's why shifts in agriculture like the no-till movement, and conservation methods that leave natural spaces intact, are so important in the fight against climate change. Undisturbed soil is carbon-rich soil—which means less carbon in the atmosphere.

Photo by Lukasz Szmigiel on Unsplash

4.4
Who should be buying carbon offsets?

Since the idea of carbon offsetting was drawn up, it's become easier and more accessible to support projects to neutralize your carbon footprint. Companies, and even governments, use offsets, too. Here's what carbon offsetting looks like in action.

Carbon neutrality for individuals

We don't know for sure (yet!) how many individuals are buying carbon offsets, or even know they exist. But consumer attitudes suggest the appeal is real, and increasing.

One in seven people would choose a lower-carbon form of transportation even if it were more expensive or less convenient, says a global study by Ipsos conducted on behalf of the World Economic Forum. Here in the U.S., 12 percent of respondents in a 2018 Ipsos study said they had purchased carbon offsets, and more than half were interested in doing so to offset future activities. That's something.

There's a celebrity element to the growing trend, too. Like when Prince Harry and Meghan Markle visited Sir Elton John in Nice in 2019. The singer, bless his carbon-busting heart, offset the couple's private flight to France. Eco-loving posterboy Leonardo DiCaprio also buys carbon offsets to counter his jetsetting lifestyle.

If you're rolling your eyes at the idea of offsetting the extremely big carbon footprint of the rich and famous, we get it. It does emphasize the fact that the most effective way to go carbon neutral is to start by reducing your footprint—for example, by ditching the private jet. But these high-profile examples can also

inspire people to explore ways of offsetting smaller, everyday activities. And that's where regular folks can make a real difference.

> **"If you're rolling your eyes at the idea of offsetting the extremely big carbon footprint of the rich and famous, we get it. It does emphasize the fact that the most effective way to go carbon neutral is to start by reducing your footprint—for example, by ditching the private jet.**

Corporate carbon offsetting

In addition to purchasing carbon offsets yourself, you can also help neutralize some of your carbon footprint by being a discerning shopper. More and more companies are signing up for carbon offsetting with the goal of significantly decreasing their carbon footprints—and yours as a consumer.

L'Oréal, for example, has committed to making all of its sites carbon neutral by 2025. Some of the reductions are coming from using renewable energy and improving energy efficiency for all its plants and distribution centers. But the cosmetics powerhouse has also invested in renewable natural gas development, a technology that captures and cleans landfill gases so they can be converted into usable energy. It also set itself a "zero deforestation" target for the end of 2020.

And then there's Allbirds. As you might expect, the shoe company knows a lot about footprints. Allbirds publishes extensive details about the carbon impact of its products, highlighting the importance of transparency. Its website includes details on how it measures its carbon footprint as well as the steps it is taking to first reduce emissions and then offset.

Many energy companies are making moves to reduce their carbon footprints, too, through mechanisms like investing in wind farms and developing solar energy and other renewable fuel sources.

Seeking out and supporting brands going carbon neutral is an effective way to let corporations know that you care about their environmental practices. Supporting these companies also means you'll have a lower footprint to offset yourself.

> **"Seeking out and supporting brands going carbon neutral is an effective way to let corporations know that you care about their environmental practices.**

Carbon neutral cities, states and countries

Governments of all levels are working to achieve carbon neutrality through a mix of their own reductions and offsets.

For example, 10 years ago, the Canadian province of British Columbia became the first province, state or territory in North America to achieve carbon neutrality for its public sector organizations. In any given year, the province has between 13 and 25 offset projects on the go to mitigate the emissions they cannot reduce, including projects like electrification, forest conservation and landfill gas collection.

Photo by Yaroslav Shuraev from Pexels

Also in Canada, the town of Eden Mills, Ontario, is at least three-quarters of the way to achieving its goal of becoming the first carbon-neutral community in North America. Efforts have included an energy-efficiency overhaul of the town's community hall and carbon sequestration from planting new greenery.

Across the U.S. and the world, numerous towns and cities also have ambitions to become carbon neutral.

At the country level, just two nations so far have achieved carbon-neutral status: Bhutan and Suriname. Runners-up? The more than 110 countries worldwide who've pledged to hit net-zero carbon emissions by 2050.

Companies + Carbon Neutrality

allbirds **2019 - already neutral!** through purchasing offsets. They are now striving for zero emissions through use of renewable energy and natural materials.	klean kanteen **2020 - already neutral!** achieved through measurement, reduction, creation of its own renewable energy and offsets.	patagonia **2025 target** Focus on becoming net zero, not producing emissions in their operations and supply chain.	Microsoft **2012 - already neutral!** (+ plans to offset all its historical emissions since its founding in 1975, by 2030)
Aiming for carbon neutrality for its supply chain and products by 2030.	ChicoBag **Currently Climate Neutral** Certified, the company is focused on reducing the impact of their supply chain while they offset the impact of their operations.	**2007 - already neutral!** Has maintained carbon neutrality through its operations as well as retroactively offset its impact since its founding in 1998.	lyft **2018 - already neutral!** All Lyft rides are carbon neutral through the purchasing of carbon offsets directly related to the number of kilometers driven by their drivers.
pela **2019 - already neutral!** Pela is dedicated to sustainability through reduction of energy, water usage and waste generated in its operation. In 2019 Pela purchased over 1M tons of carbon offsets making them carbon neutral.	Reformation **2015 - already neutral!** Is now striving to become climate neutral, extending to zero net anthropogenic greenhouse gas emissions (i.e. including emissions beyond carbon dioxide).	L'ORÉAL **2025 target** L'Oréal is pursuing a transition to a low carbon business model by reducing the emissions from its plants and distribution centers as well as achieving carbon neutrality for all its industrial premises and administrative offices by 2025.	**Goal to make their internal processes carbon neutral by 2050.** + large investments in electric mobility.

4.5
How effective are carbon offsets as a climate solution?

After all this, you might be wondering: Can carbon offsets really save the planet? And are there any reasons to be skeptical?

Are there any downsides to carbon offsetting?

Well, in a perfect world, no. But here's the thing. Buying carbon offsets won't actually erase the greenhouse gases you're creating. The best way to reduce your carbon footprint and make a difference in the fight against climate change is to actually decrease the volume of emissions you produce.

Another caveat: with so many carbon offset projects on the market, it's extra important to make sure your offset dollars are working for good. (Even the Vatican fell for a fraudulent scam.) Sticking to accredited organizations like the Verified Carbon Standard and the Gold Standard is one way you can make offsetting choices that are legit.

Plus, because carbon offsets offer an easy way to mitigate (and, tbh, feel better about) your carbon footprint, critics worry that the very idea may encourage people to slack off on the reduction front.

Our stance? It's basically impossible to live a carbon-neutral existence in this day and age, and carbon offsetting is a very effective way to help create the change we want to see in the world. That doesn't mean we're off the hook on reducing our carbon footprints. But we are supporting projects that will help make the future less scary.

> **“ It's basically impossible to live a carbon-neutral existence in this day and age, and carbon offsetting is a very effective way to help create the change we want to see in the world.**

Photo by Gustavo Fring from Pexels

The bottom line: Why carbon offsets are part of the solution

The problem of climate change can seem overwhelming when you look at the numbers. America's carbon footprint, for instance, is so supersized, we need to be reducing it by a massive 90 percent to hit Paris Agreement targets to limit global warming. And other developed countries have a similarly large mountain to scale.

> **“ America's carbon footprint, for instance, is so supersized, we need to be reducing it by a massive 90 percent to hit Paris Agreement targets to limit global warming.**

The good news is, there are so many easy wins in sight to get our emissions down. Shifting to a work-from-home schedule, wearing last year's winter coat instead of buying a new one, hanging your towels on the clothesline to dry, ordering in tofu and vegetable fried rice instead of your usual ginger beef... all of these are totally doable steps that make a huge difference when they all add up.

But even that is likely not enough. And that's where offsets show up to save the day. Whether it's funding new industrial technologies or paying farmers to let some of their land stay wild, carbon offset projects are an essential component of our collective effort to fight climate change. Because you're not just buying them to balance out your own behavior—you're helping to build a greener future.

Contributors

Introduction
By Amy Valm

Amy Valm is a writer and editor who probably makes the same jokes as your dad. She has been a pretty big fan of the planet since the ’80s.

Chapter 1 — Learn
Learn Everything You Need to Understand Climate Change
By Lisa Jackson and Lauren Jerome

Lisa Jackson and Lauren Jerome are journalists who cover everything from personal finance and sustainable living to food, travel and tourism. When not making plans to build a net-zero cottage or sampling the latest local brews, they're busy creating content at Westdale Creative.

Chapter 2 — Measure
Measure Your Carbon Footprint (How to Do It, and Why It Matters)
By Wing Sze Tang

Wing Sze Tang is a freelance journalist, with bylines in many lifestyle publications, including FASHION, FLARE, The Kit and enRoute. When not writing, she likes running long distances—her preferred form of carbon-free travel.

Chapter 3 — Reduce
Reduce Your Carbon Footprint: 26 Ways to Live More Sustainably
By Rebecca Gao

Rebecca Gao is a Toronto-based journalist with bylines in Reader’s Digest, Vice and more. In her spare time, she can be found baking (or at least trying to). Read more of her work at rebeccagao.ca.

Chapter 4 — Offset
Offset Your Carbon Emissions (Yes, It Really Makes a Difference)
By Alyssa Schwartz

Alyssa Schwartz is an award-winning writer who has contributed to Vogue.com, Food + Wine and many others.

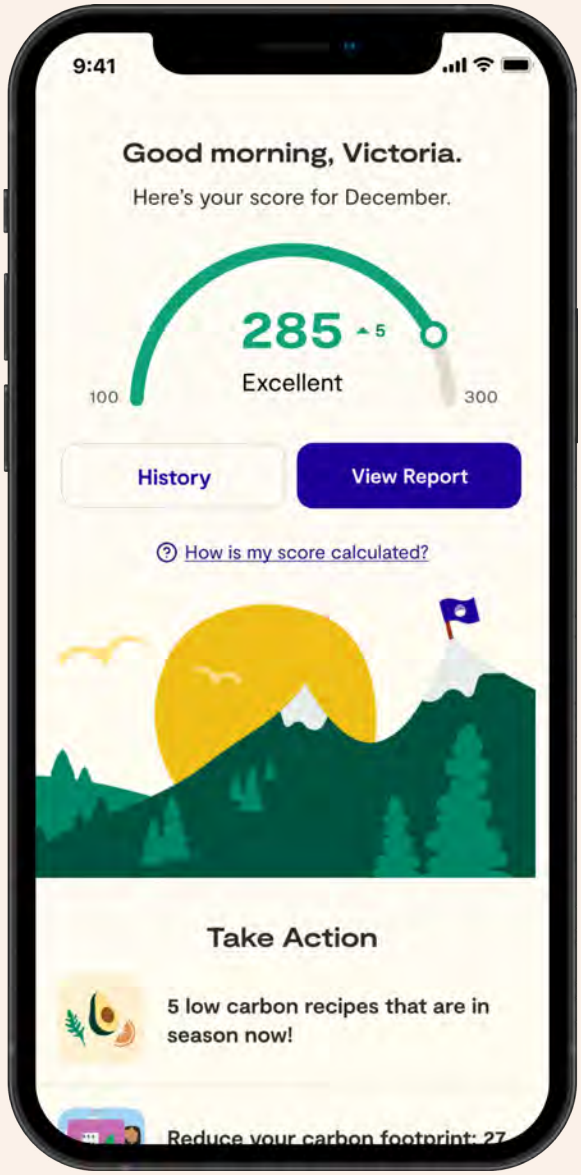
Editor
Kat Tancock

Kat Tancock is founding partner at custom content agency Tavanberg [tavanberg.com]. An evangelist for sustainable textiles, she once turned a thrifted sweater into a cozy crocheted blanket, and is learning to mend the holes in her socks.

About Goodside

Goodside is on a mission to facilitate real and lasting action against the climate crisis by building tools to help individuals measure, reduce and offset their impact on the planet.

Goodside is a company from RBC Ventures Inc., a subsidiary of the Royal Bank of Canada (RBC). RBC Ventures goes beyond banking by building new ventures, acquiring growing firms, making investments and partnering with organizations that share our vision to solve problems and make lives better.



This eBook offers general information only and is not intended as legal, financial or other professional advice. A professional advisor should be consulted regarding your specific situation. While the information presented is believed to be factual and current, its accuracy is not guaranteed and it should not be regarded as a complete analysis of the subjects discussed. All expressions of opinion reflect the judgment of the author(s) as of the date of publication and are subject to change. No endorsement of any third parties or their advice, opinions, information, products or services is expressly given or implied by Royal Bank of Canada or its affiliates.

Together for the Planet

Goodside