Real Life Hacks to Cut Your Carbon Footprint (Plus: A Personal Emissions Calculator)

Many of the actions we take in our daily lives contribute to global warming. When we start a car, we've made a decision to change the Earth's climate. This is also true when we eat lunch, book a flight, do the laundry, turn on the television, or flush the toilet. But the fossil fuels we consume tend to be hidden from our immediate experience, making them easy to take for granted.

Over the past few years I've been working to systematically reduce my impact. I didn't set out to save the world; my reductions are a billion times too small for that. Instead, I'm motivated to avoid harming others, human and nonhuman, and it has become clear that burning fossil fuel does, in fact, harm others. I was also curious to see what life without all the fossil fuel would be like. It turns out that I like it better.

I collected my utility bills, pooled my receipts and estimated the annual greenhouse gas emissions produced by my actions across several categories. I used these estimates to guide my reductions. In the process, I gained a numerical clarity that has allowed me to transform a daunting task into something tractable, and—dare I say it—fun.

Why didn't I just use an online CO_2 calculator? Most ask questions about my house and my lifestyle and spit out a report. This approach didn't connect my emissions to my daily decisions in a transparent and actionable way. On the other hand, a few hours of research clearly linked my actions to the fuel and the fuel to my emissions in a way that made sense to me.

Here are the steps I took to track my impact:

Cars

Tracking your annual emissions from driving is simple. For each vehicle, estimate the miles you drove in the year and divide by the vehicle's miles per gallon. This gives gallons of fuel burned. Then divide by the average number of people in the vehicle. Add up the results from all vehicles, but don't sweat the small stuff.

Burning a gallon of gasoline adds 8.8 kg of CO_2 to the atmosphere. However, fuel requires energy to extract, refine, and distribute. These "upstream" CO_2 emissions currently add a 28 percent overhead, bringing the total emissions per gallon of gasoline to 11.3 kg of CO_2, and 12.1 kg of CO_2 for diesel. [1] It's worth

noting that upstream emissions are increasing over time as oil corporations reach for sources, like tar sands and deep offshore deposits, that are more difficult to tap.

The average person in the United States emits around 5,000 kg of CO_2 per year from driving. [2] By comparison, the average Kenyan emits 300 kg of CO_2 in a year for everything.

I drive a 1984 Mercedes diesel that I converted to run on waste veggie oil from local restaurants. This is a hobby of mine, and my relationship with the old car channels Han Solo's pride in the crappy, but awesome, Millennium Falcon. I know there's not enough veggie oil for everyone to do this—electric cars are more scalable—but driving on veggie oil has given me unique insight into the connections between fuel, food, and transportation. For example, if I were to stop growing food in my 1/20th acre yard and instead grew only soybeans for fuel, a successful crop could move the car a mere 20 to 30 miles.

Biking, on the other hand, offers an easy way to make a big dent. As a kid in the Chicago suburbs, when I wanted to go somewhere I rode my bike. To reduce my driving emissions as an adult, I got back in the saddle. This has been so good for me, for so many reasons, that I'd bike regardless of global warming. Making biking my primary transportation mode reduced my annual emissions by 1,000 kg of CO_2. Switching from fossil fuel to veggie oil fuel reduced my emissions by another 800 kg of CO_2 per year.

Planes

To estimate plane emissions, tally the number of miles you flew over the year, coach and first-class separately. Each mile in coach emits 0.3 kg of CO_2, while each mile in first class emits more than twice that. [3] The average person in the United States emits about 1,000 kg of CO_2 per year from flying, but frequent flyers emit far more. [4]

Jet fuel combustion at altitude has additional short-lived climate impacts: Oxides of nitrogen create ozone, another greenhouse gas; and aerosols create contrails and cirrus clouds that trap outgoing infrared radiation. These effects enhance warming over CO_2 alone, likely by a factor of 2 or 3.

Eliminating commercial flights from my life reduced my annual CO_2 emissions (excluding these additional effects) by 15,000 kg of CO_2 per year. [5] Before I quit flying, I typically flew 50,000 miles in a year—normal for an academic, but far more than the national average. In the United States, some people fly a lot

while others barely fly at all.

Natural Gas

Natural gas produces CO2 when burned, but it also leaks into the air at every step in its life cycle; and methane is a much more powerful greenhouse gas than CO2. However, methane breaks down into CO2 after only a decade or two, whereas CO2 persists far longer. Comparing methane to CO2 therefore requires picking a time horizon: Over 20 years, warming from a tonne of leaked methane is equivalent to warming from 105 tonnes of CO2; but over 100 years, warming from that methane is equivalent to warming from 33 tonnes of CO2. [6]

Most analyses take methane to be only 25 times more powerful than CO2 (they use a 100 year time horizon and older estimates of methane's impact). This downplays methane's role in global warming. I'll instead use the average value of the 20 and 100 year time horizons, assigning 1 kg of methane a climate impact of 65 kg of CO2-equivalent (CO2-eq.).

To track your emissions from natural gas, consult your utility bill to find your household's total annual usage (convert this to therms if necessary [7]). Divide this by the number of people in your household, and multiply by 11 kg of CO2-eq. per therm. [8]

The average person in the U.S. emits 1,800 kg of CO2-eq. per year from residential natural gas.

When I first moved into my house, the five pilot lights were emitting a whopping 1,600 kg of CO2-eq. per year. Eliminating two stovetop pilot lights reduced these emissions by 600 kg of CO2-eq., and adjusting down the remaining three (oven, space heater, and water heater) resulted in an additional 300 kg of CO2-eq. reduction.

Even after this careful tuning, the average pilot light in my house emits 140 kg of CO2-eq. per year.

We also switched from the gas-powered clothes dryer to a clothesline. This eliminated about 200 kg of CO2-eq. from natural gas (and 100 kg of CO2-eq. from electricity, as measured by a Kill A Watt meter).

A solar hot water heater would reduce my share of our household emissions by about 200 kg of CO2-eq. per year.

Electricity

Electricity emissions depend on how the electricity is generated. If 100 percent of your electricity is from renewable sources, then you have essentially no residential electricity emissions. The rest of us can use a U.S. average conversion factor of 0.8 kg of CO2-eq. per kilowatt-hour (kWh) of produced electricity. [9]

Add up your annual household electricity usage in kWh (from your utility bills), divide by the number of people in your household, and multiply by the conversion factor.

We must reduce global emissions now, not later.

The typical American emits 3,500 kg of CO2-eq. per year from residential electricity use. [10] Partly because we heat and cook with natural gas, we use much less electricity than the national average. We're careful to turn off lights and appliances we're not using, which has reduced our bills by 15 percent, but otherwise we use electricity freely. My share of our household emissions comes to 300 kg of CO2-eq. per year.

Rooftop solar makes sense for the typical household, but at low levels of usage it's not cost-effective. Therefore, I've decided to lobby for something called Community Choice Aggregation instead. In California and six other states, communities are able to band together to form a sort of alternative electric utility, allowing them to choose exactly how their electricity is generated. The existing utility company is required by law to deliver the electricity to residents and can charge a fair delivery fee. California's Marin and Sonoma counties have already formed successful CCAs, which provide cleaner electricity at lower cost.

Food

Per capita emissions from food production in the United States depend on diet. Typical meat, vegetarian, and vegan diets emit roughly 3,000, 1,500, and 1,000 kg of CO2-eq. per year, respectively. These numbers include the fact that a third of food produced in the United States is wasted, but they understate the impact of methane (as discussed above) and therefore might be on the low side.

Although I stopped eating meat primarily to avoid harming animals, vegetarianism reduced my emissions by about 1,500 kg of CO2-eq. per year. I personally prefer it, as well. I also began growing food, trading surplus fruit with neighbors, and saving food from the waste stream. Most of my food now comes from these sources. I estimate that freeganism reduces my food emissions by an

additional 1,000 kg of CO2-eq. per year.

Waste

Organic materials—mainly food waste, yard waste, and paper—decompose anaerobically (without exposure to oxygen) in the landfill to produce methane. This decomposition generates a surprising 1,300 kg of CO2-eq. per person annually. [11]

Sewage treatment plants generate an additional 150 kg of CO2-eq. per person annually. [12] If you have a yard, you can safely compost your food waste, yard waste, and human waste aerobically—using microorganisms that require oxygen—eliminating most of these emissions. [13] As a bonus, this creates excellent, hygienic fertilizer for the garden. We'll leave this rich and loamy subject for another time, though.

Stuff

A detailed estimate of emissions produced by buying new goods would be extraordinarily complicated. A simple but approximate rule of thumb is that each dollar spent on new stuff adds 0.5 kg of CO2-eq. including manufacturing, packaging and shipping. To test this relationship, consider a Prius. A detailed study found that manufacturing a new Prius emits 9,000 kg of CO2-eq. At a cost of $24,000, the per-dollar emissions are 0.4 kg of CO2-eq., verifying the rule of thumb. Avoiding new stuff, of course, avoids these emissions.

The average annual emissions from new stuff in the United States is something like 2,000 kg of CO2-eq. per person. My wife and I both prefer not having much stuff; our four-person household typically spends $4,000 per year on goods (clothes, books, hardware, stuff from Target, etc.). My portion of these emissions is roughly 500 kg of CO2-eq.

Emissions from long-lived items such as houses and cars are trickier. We could divide such emissions by the item's lifetime to get a sense of the annualized emissions. For example, building a modest house produces maybe 80,000 kg of CO2-eq. Our bungalow was built in 1926, and if it lasts another 60 years (and there's no reason it couldn't), it could be thought of as roughly another 100 kg of CO2-eq. per year for each of the four people in my family.

However, distributing emissions from houses and cars in this simplistic way isn't quite right, because it doesn't distinguish between buying new versus used. Attribution for such multi-year purchases should be weighed strongly towards

the earliest years.

The Big Picture

I realize that the few tonnes of greenhouse gas I no longer emit are a drop in the still-growing ocean of emissions from billions of humans, most of whom won't reduce voluntarily. And we must reduce global emissions now, not later. That's why we also need sensible policies such as a national carbon fee and dividend, which would provide a clear financial incentive to reduce across all sectors.

But although my individual changes aren't enough to reverse global warming, the process has been extremely worthwhile. I now live life at a more relaxed speed, I'm healthier, I eat better, I need less money, and I'm more connected to place and community.

There's also a deep connection between individual change and collective change. As we change ourselves, we collectively tell a new story with our lives and inspire each other toward further change. This certainly contributes to broader systemic change far more than doing nothing. And over time, the changes of many individuals become collective change.

[Personal Emissions Calculator]

References

1. Note that fuel oil is just diesel. You can estimate your fuel oil emissions by multiplying the number of gallons you burned by 12.1 kg CO_2 and dividing by the number of people in your home.

2. Per capita vehicle miles of travel in 2013 was 9,400 miles, and the average fuel economy of cars on the road in 2013 was 21.6 miles per gallon.

3. The mean of IPCC's estimates of the European average emission rate (which is weighted toward short haul) and the rate for a 747 with 70 percent occupancy average over a 7,500-mile trip (long haul) is 0.30 kg of CO_2 per coach passenger mile. However, the mean of the EPA's estimates for long and short flights is 0.21 kg of CO_2 per coach passenger mile. I average the IPCC and EPA estimates and then factor in upstream emissions of 21 percent.

4. Domestic and international carriers at all airports tallied 1,180,036,002,000 revenue passenger miles in 2015. U.S. population in 2015: 321 million.

5. Note that this includes the 21 percent upstream factor for producing the jet fuel. The article "How Far Can We Get Without Flying?" did not include upstream emissions.

6. Note that these estimates of methane's global warming impact have large error bars. Note also that the article "How Far Can We Get Without Flying?" used a methane global warming potential of 105.

7. One therm is the energy equivalent of burning 98 cubic feet (2.8 cubic meters) of natural gas.

8. This includes natural gas leaked during extraction, refining, and distribution. Burning one therm of natural gas releases 5.3 kg of CO_2; when we add the EPA's estimate of 15 percent upstream CO_2 emissions, this increases to 6.1 kg of CO_2. We then add 5 kg of CO_2-eq. for methane leakage, which we take to be 4 percent of the natural gas (which is 80 percent methane).

9. I took the amounts of natural gas and coal used in 2014 to generate electricity in the United States, converted them to CO_2-eq. (using an emission factor for coal accounting for upstream emissions and the emission factor for natural gas, derived in note [8]), and divided by total electricity generated in 2014.

10. In 2014, the average household used 11,000 kWh. There are 2.5 people per U.S. household.

11. In 2014, landfills in the United States generated 6.6 million tonnes of methane.

12. In 2000, producing the electricity to run U.S. sewage treatment plants emitted 15.5 megatonnes of CO_2-eq. Public waste water treatment plants in the United States emitted an additional 35 megatonnes CO_2-eq. from methane.

13. Note that 2/3 of food waste occurs during production and distribution. Because of this, individuals can't eliminate the full 1,300 kg CO_2-eq. per year by residential composting.

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