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Zero by 2050: Understanding the Challenge Before Us

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If you've been following climate news you've likely heard that we need to get to net zero emissions by midcentury to avoid the worst impacts of climate change. But how was 0 by 2050 chosen as the goal, and how close are we to reaching it? Since climate science and math can get a bit complicated, this post covers the basics behind the "0x50" target and what it means for the US. Comprehending the scale of the challenge before us is the first step to addressing it.

The Basics of Global Warming Targets

In the Paris Agreement, *the* international agreement on climate change, almost every country pledged to stay "well below" 2°C and to "pursue efforts to limit the temperature increase even further to 1.5°C." We are already above 1°C of global warming. Without getting bogged down in the details, let's all agree that for our children and grandchildren's sake we should try to keep the planet to 1.5°C. While every bit of warming has harmful impacts, 1.5°C is certainly better than 2°C or higher. We know that emitting CO₂ leads to higher concentrations of CO₂ in the atmosphere, which causes global warming.

Keeping an Eye on the Concentration of Carbon Dioxide

So how much carbon dioxide is too much? One way to answer this is by measuring the concentration of CO₂ in the atmosphere. With an atmospheric concentration of 450 parts per million (ppm), we have an estimated 50% chance of keeping global average temperature from rising 2°C above pre-industrial levels by 2100. And we really should be aiming to stay below 1.5°C, meaning we should aim for closer to 420 ppm. ¹



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For comparison, pre-industrial (1850-1900) concentrations of CO₂ were 280 ppm. We passed the historic 400 ppm mark in 2016. At current rates of emissions, we will hit a terrifying 500 ppm within 50 years. ²

Comparing with the Past

Very important to note is the rate at which atmospheric CO₂ concentrations are increasing compared to historical records. According to NOAA, the current rate of increase for CO₂ concentrations is about 2.1 ppm per year, compared to about 0.7 ppm in the 70s. Perhaps more telling: “today’s rate of increase is more than 100 times faster than the increase that occurred when the last ice age ended.”³ This is mainly due to the burning of fossil fuels since the industrial revolution. Yes, it’s our own doing.

The last time levels of CO₂ were as high as 300 to 400 ppm was 3 million years ago, during the mid-Pliocene. Temperature was 2°C to 3°C above pre-industrial temperatures and sea levels were 15-25 meters higher.⁴ The last time levels were consistently higher than 400 ppm was 16 million years ago, during the Miocene. This warming period was caused by massive and prolonged volcanic activity, over hundreds of thousands of years⁵ -- meaning atmospheric CO₂ concentrations were increasing at a significantly slower rate than we are causing at present day, giving the earth and the plants and animals living on it more time to play catch up.

Let’s Talk Carbon Budgets

The second way to think about CO₂ levels is in terms of how much CO₂ we can emit to stay below a temperature threshold. This is frequently referred to as our carbon budget, with the most common temperature thresholds being an increase of 1.5°C or 2°C.

The United Nations Intergovernmental Panel on Climate Change (IPCC) provides updated carbon budgets in its reports, the most recent of which being the “Special Report on Global Warming of 1.5°C.” In this report, the IPCC estimates that to have a 50% chance of staying below 1.5°C, after January 1, 2018 the world can not emit more than an additional 580 gigatons of carbon dioxide (GtCO₂).⁶ For a “likely” (66%) chance of staying below 1.5°C, we need to emit less than 420 GtCO₂.⁷

In all of the scenarios modeled out by the IPCC that keep our global warming below 1.5°C, it is critical that CO₂ emissions are reduced to net zero by 2050

So let's say our goal is to have a likely chance of staying below 1.5°C, giving every country on the planet a remaining total carbon budget of 420 GtCO₂. In 2017, we emitted 36.79 GtCO₂ globally.⁸ At our current rate of emissions, we will exhaust this budget in about 10 years. Unfortunately, our global rate of emissions is still *increasing*.⁹

In all of the scenarios modeled out by the IPCC that keep our global warming below 1.5°C, it is critical that CO₂ emissions are reduced to net zero by 2050. So, if we are able to rapidly reduce our global emissions to net zero by midcentury, then we can manage to stay within our carbon budget and avoid a global warming beyond 1.5°C.¹⁰ Hence, 0x50.

Why “Net Zero”?

When we say 0x50, what we technically mean is *net* zero emissions by 2050. Net zero emissions is balancing any CO₂ that we emit into the atmosphere by removing an equivalent amount from the atmosphere. In comparison, zero emissions means not emitting any CO₂ at all. The climate challenge is so large that, unfortunately, all of the IPCC's pathways to stay below 1.5°C require some form of carbon dioxide removal despite aggressive emissions reductions. Some options for creating these “negative emissions” include bioenergy with carbon capture and storage, reforestation and afforestation (planting trees on land not previously forested), enhanced land management practices (to increase the amount of carbon that can be stored in soils), and direct air capture (capturing CO₂ right out of the atmosphere). Using all or a combination of these options to

offset our CO₂ emissions will be fundamental in reaching *net* zero emissions by 2050--or putting it more simply, achieving “0x50.”

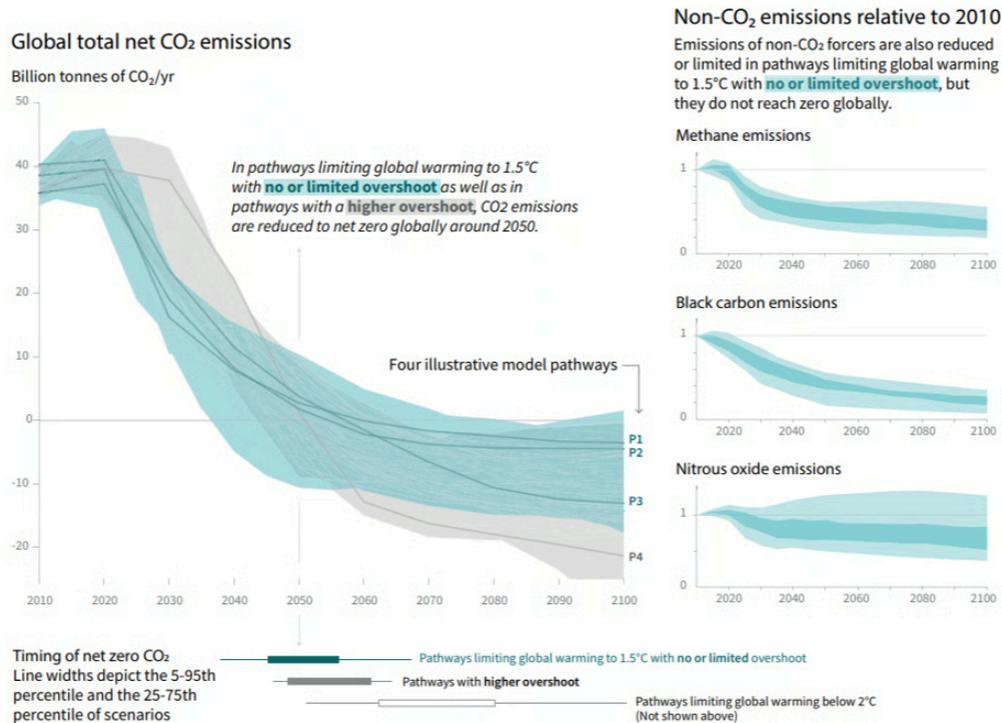


Figure 1: From the IPCC 1.5°C special report, this figure illustrates how CO₂ emissions are reduced to net zero globally around 2050 in pathways that limit global warming to 1.5°C. (Source: IPCC, Figure SPM.3a)

What This All Means for the US

The US must play a large role in the global effort to get to 0x50. We are the second largest emitter in the world, responsible for about 15% of global emissions with only 4.3% of the global population.¹¹ Like other developed countries, we are responsible for a greater amount of emissions and have an easier path to deep decarbonization than developing countries. As a result, we should be acting faster than developing countries.

Under President Obama, the US set the goal of reducing emissions 26–28% below 2005 levels by 2025. This would put us on track to reduce emissions by at least 80% by 2050, the *minimum* the US needs to do in order to keep atmospheric CO₂ concentrations below 450

ppm, providing a 50% chance of keeping global average temperature from rising 2°C above pre-industrial levels by 2100. It would not put us on track to stay below 1.5°C.

For a while it looked like US emissions had peaked and we were in a slow but steady decline. In 2016, the US emitted 5.794 GT CO₂. In 2017, total US emissions fell by 0.66%.¹² However, in 2018, after three years of decline, we had a sharp rise in emissions of 3.4%. This is taking us further in the wrong direction. We would need to reduce our emissions by 2.6% annually over the next 7 years in order to make our target for the Paris Agreement-- and even more to reach 0x50.¹³ With the current Administration abandoning our climate goals and rolling back crucial environmental and emissions regulations, the task becomes even more challenging.



U.S. CO₂ Emissions Targets and Projections

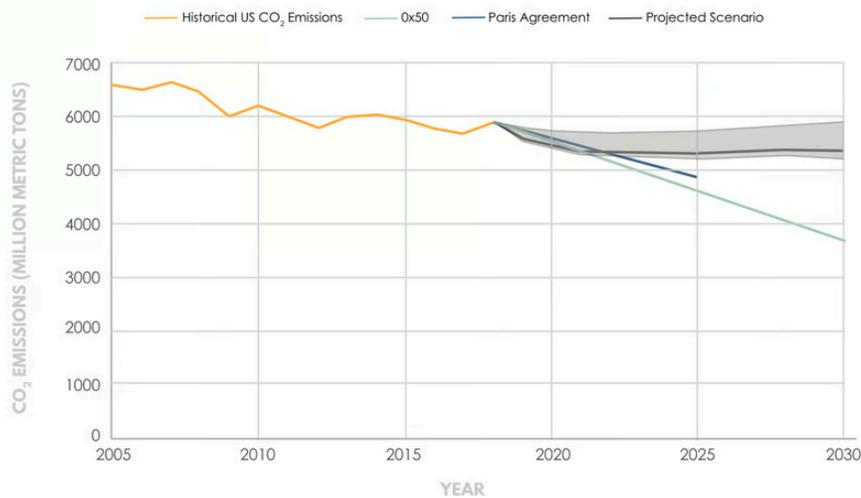


Figure 2: Projected annual CO₂ emissions in the US compared to targets for the Paris Agreement and 0x50. Although feasible, achieving the emissions reductions necessary to meet 0x50, let alone the US's less ambitious Paris Agreement pledge, will require substantial change. (Data Sources: Rhodium's US Climate Service and Third Way)

So yes, the 0x50 target is an incredibly ambitious challenge that's going to require some serious leg work. But thanks to strong scientific analysis, we know that this is the goal that, if reached, will give us a good chance of avoiding the most destructive impacts of our changing climate. Now we have the ability (and responsibility) to use this target to guide

our climate policymaking. There are many technologies and policy mechanisms that can help reduce emissions. What we must continually ask ourselves, though, is which combinations of these resources and strategies have the *best* chance of getting us to 0x50.

ENDNOTES



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