The IPCC issued the massive first volume of its new report on climate change on Monday. This volume focuses on climate science: how much will the world warm, and what will the impacts be? The bottom line is that the evidence is becoming ever firmer that (a) humans are causing an unprecedented rate of climate change, (b) we are starting to foreclose our ability to achieve less dangerous outcomes, and (c) failure to act will impose tremendous costs for generations.

Here are some of the key takeaways:

- Humans can release about 10 years of current global emissions to have an even chance of limiting warming to 1.5 degrees Celsius (2.7 Fahrenheit) above preindustrial levels. But the possibility of remaining below that threshold are undeniably slipping away.
- Each of the past four decades has been successively warmer than any that preceded it, dating to 1850.
- "It is virtually certain that hot extremes (including heatwaves) have become more frequent and more intense across most land regions since the 1950s. . . with high confidence that human-induced climate change is the main driver of these changes."
- "Some recent hot extremes observed over the past decade would have been extremely unlikely to occur without human influence on the climate system."
- "There will be an increasing occurrence of some extreme events unprecedented in the observational record with additional global warming, even at 1.5°C of global warming.

Now for a deeper dive. Like its predecessors, the volume is a massive synthesis of thousands of scientific studies. It does have a number of new features. There is greater emphasis on regional impacts and extreme events. As in previous reports, this one also uses "Representative Concentration Pathways" (RCPs) that show how the world will respond to different trajectories for emissions of greenhouse gases.

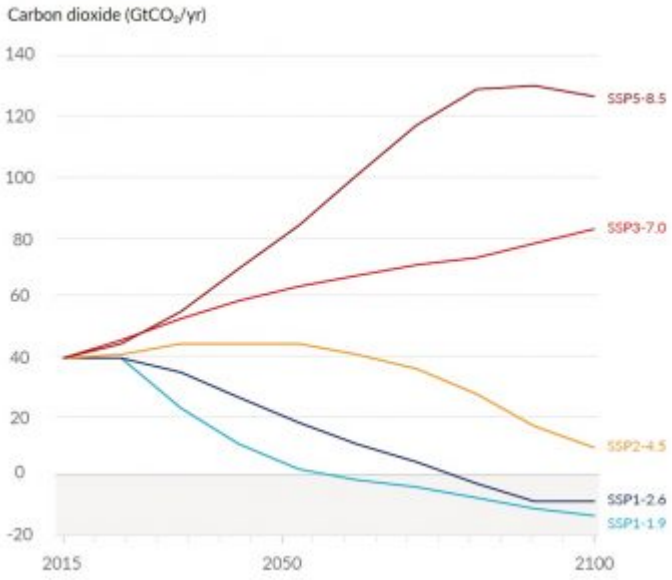
Most notably, the new report adds "Shared Socio-Pathways" (SSPs) that look at what we can expect to see if society were to take various paths in terms of nationalism and inequality, as well as different paths toward economic growth. There are five of these SSPs:

- SSP1 in which population growth is moderate and economic growth is focused on sustainability and equality,
- SSP2 where current trends continue to hold.

- SSP3, a world of surging nationalism and regional rivalry , with population growth low in developed countries and high in the developing world.
- SSP4, a world of surging inequality.
- SSP5, a world of fossil-fuel based economic growth, in which global population peaks and then declines later in this century.

So basically, a relatively optimistic socioeconomic scenario, a baseline scenario following current trends, and three flavors of pessimism. One key indicator is how many people live outside what the IPCC calls the “human climate niche” in different combinations of emissions trajectories and socioeconomic scenarios. Only 1% of people now live in places where the annual average temperature is above 84°F but that number could ramp up very quickly.

This chart shows the emissions trends under some of the key scenarios:



Here’s how that translates into temperature:

	Near term, 2021–2040		Mid-term, 2041–2060		Long term, 2081–2100	
Scenario	Best estimate (°C)	*Very likely* range (°C)	Best estimate (°C)	*Very likely* range (°C)	Best estimate (°C)	*Very likely* range (°C)
SSP1-1.9	1.5	1.2 to 1.7	1.6	1.2 to 2.0	1.4	1.0 to 1.8
SSP1-2.6	1.5	1.2 to 1.8	1.7	1.3 to 2.2	1.8	1.3 to 2.4
SSP2-4.5	1.5	1.2 to 1.8	2.0	1.6 to 2.5	2.7	2.1 to 3.5
SSP3-7.0	1.5	1.2 to 1.8	2.1	1.7 to 2.6	3.6	2.8 to 4.6
SSP5-8.5	1.6	1.3 to 1.9	2.4	1.9 to 3.0	4.4	3.3 to 5.7

The SSP1-1.9 scenario would keep emissions under the 1.5 °C goal of the Paris agreement. The SSP2-4.5 scenario kicks over the 2 °C line during this century, as do all of the less optimistic scenarios. Remember that this would mean twice as much temperature change as we've already experienced.

There are a lot of uncertainties at this point, but the biggest one is within our own hands. Every 1000 gigatons of carbon translates into about 0.5 °C of warming. So here's the key question: How much more carbon are we going to load into the atmosphere?