

# Climate Sensitivity FAQ

## What is climate sensitivity?

Climate scientists agree that carbon dioxide is causing the planet to warm, and that this has already caused dangerous impacts. One thing scientists are still working to figure out is exactly how much warming each ton of CO<sub>2</sub> causes. This is called the climate's "sensitivity" to CO<sub>2</sub>.

## What does it mean for us?

Climate sensitivity affects how much time we have before warming becomes catastrophic. No matter what the exact sensitivity turns out to be, acting now to slow our emissions will still be cheaper and easier than waiting until things are worse. A lower value would be great news, because it would mean we have more time. But more time is only useful if we take advantage of it by making progress now.

## How is it measured?

One of the primary numbers that scientists use to indicate the warming power of CO<sub>2</sub> is called Equilibrium Climate Sensitivity, or ECS. To calculate ECS, scientists imagine a hypothetical situation: what if the carbon dioxide concentration in the atmosphere doubled all at once? In a few hundred years the planet would reach a new equilibrium temperature some number of degrees higher than its previous temperature. The number of degrees the temperature increases is the ECS.

Transient climate response, or TCR, measures the response to the same doubling of CO<sub>2</sub> under a 1% per year increase (which takes 70 years), rather than until equilibrium. For this reason TCR values are lower than ECS values.

## Why don't we know our exact sensitivity value?

The difficulty comes from our thermometer records, which don't span a long enough time period to definitively establish ECS. Instead, scientists have to either use computer models to look into the future, or use geologic data to look into the past. Both of these methods are more certain than just checking a thermometer, so scientists have done many different studies and come up with ranges of possible values (see graphs).

## What's our best estimate?

The most recent report on climate change by the UN, the IPCC Fifth Assessment Report ([AR5](#)), gives the best estimate for ECS at a range of 1.5°C to 4.5°C. This is a slight revision of the previous IPCC report ([AR4](#)), which estimated a range of 2°C to 4.5°C. For TCR, the AR5 estimates it is within a range of 1°C to 2.5°C. This is also a revision of the [AR4](#), which suggested TCR was within a range of 1°C to 3°C.

Ultimately, the debate about the precise sensitivity range is likely to end up as a footnote to the climate conversation, given that carbon pollution is currently on track to skyrocket past the limit for avoiding [catastrophic climate change](#). Global average temperatures are already among the warmest civilization has ever seen, with [unprecedented increases](#) over the past few centuries. [Emissions are set to increase](#) far beyond doubling of preindustrial levels, which would create dangerous temperature rise even in a low-sensitivity climate. Taken together, these facts stress the need to start limiting emissions now no matter what the exact range of ECS may be.