

CLIMATE 101: FEEDBACK LOOPS & TIPPING POINTS

When we burn fossil fuels to produce electricity, heat, and more, they emit greenhouse gases (GHGs) like carbon dioxide (CO₂) and methane. These gases trap the sun's energy in Earth's atmosphere as heat. As more and more GHGs are released, more heat gets trapped and the planet warms up, disrupting the long-standing, delicate climate systems that have made life on Earth possible.

Many of our climate-regulating systems have been pushed to their limits. But the planet continues to warm – and the impacts are getting worse. Wildfire seasons are lengthening and scorching more and more acres. Glaciers and high-elevation snow that make up the headwaters of some of the world's most important rivers are disappearing. Tropical storm systems are getting stronger, wetter, and deadlier. And so much more.

These impacts can also play off each other in nuanced ways. In many cases, the wildfires or disappearing glaciers we see in the headlines have unseen knock-on effects that lead to, well, more wildfires and disappearing glaciers.

It's a vicious cycle—**climate change causing a cascade of effects that result in even more climate change**. A problem we created taking on a life of its own...to potentially devastating effect.

FEEDBACK LOOPS

Climate feedback loops are “processes that can either amplify or diminish the effects of climate forcings,” [according to NASA](#).

In plain English, feedback loops make the impacts of key climate factors stronger or weaker, starting a cyclical chain reaction that repeats again and again.

TIPPING POINTS

In its latest report, [the Intergovernmental Panel on Climate Change \(IPCC\) explains](#) that a **tipping point** is “a critical threshold beyond which a system reorganizes, often abruptly and/or irreversibly.” *In plain English*, climate change tipping points occur when a climate system has been pushed to its point of no return, leading to major changes in the system that we are unlikely to ever undo.

There are two major categories of climate feedback loops: **positive** and **negative**.

Negative feedback is a process that causes a decrease in function, often in an effort to stabilize the system. A positive feedback loop, however, *accelerates a response*.

Using the water vapor cycle as an example, it goes a little something like this:

1. As more and more heat-trapping GHGs are emitted, the atmosphere warms up.
2. This warmer air leads to more water evaporating from our oceans, rivers, lakes, and land, and entering the atmosphere.
(*Don't forget: Warmer air also holds more water vapor, and water vapor itself traps heat.*)
3. The extra water vapor in the already warmer air retains even more heat, amplifying the initial warming.
4. Even more warming leads to even more water evaporating, starting the cycle over again. **And again. And again.**

Without the regulating action of a negative feedback loop, a positive loop can spiral out of control, eventually arriving at a...tipping point.

THE ARCTIC

Where feedback loops are nearing their tipping points.

PERMAFROST

Methane and carbon can be found in Arctic permafrost, as well as in frozen peat bogs and under sediment on the sea floor. As these bogs and permafrost thaw thanks to climate change, some of the methane and carbon within is released into the atmosphere, adding yet more GHGs that can lead to further global warming.

More warming results in more permafrost loss, leading to more GHGs entering the atmosphere to create even more warming and more melting permafrost.

SEA ICE

Rising temperatures are increasingly melting sea ice – millions of square miles of it, exposing more and more of the dark waters of the Arctic Ocean to sunlight. Open water absorbs far more of the sun's energy than ice, which reflects much of it, leading to further warming. This results in more melting sea ice. The effect (ice melting) fuels its very cause (warming temperatures), in something like an infinite spiral – and once one domino falls, it creates a reaction that pushes over another and then another right on down the line.

Many facets of our climate system are already acting as part of dangerous positive feedback loops – creating compounding climate conditions and worsening impacts for people all over the world. Irreversible tipping points are just around the corner.

The writing's on the wall: We need to accelerate the global shift from the dirty fossil fuels driving climate change to renewables so we can power our lives and economies without destroying our planet.

The power to prevent the worst of the climate crisis and create a bright future is still in our hands. **But only if we act now.**