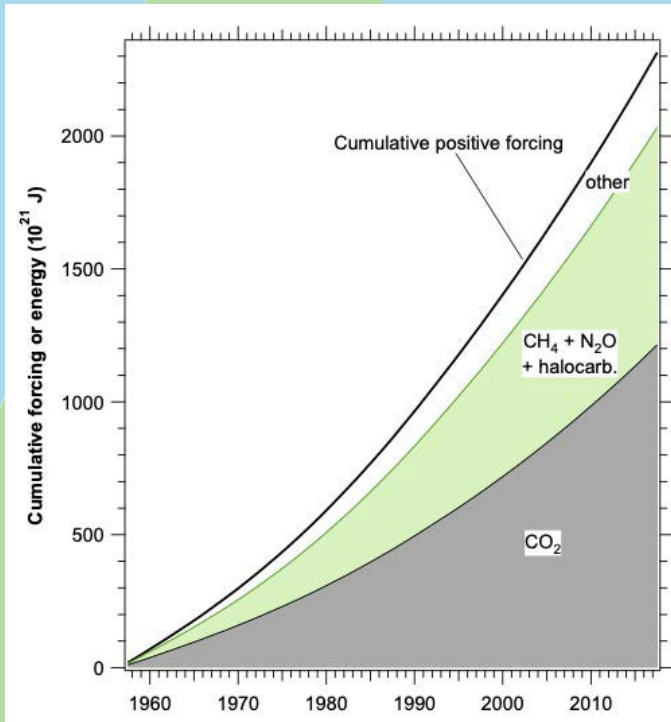


Update: Energy Budget Changes Since 1950

10 years after the Murphy et al., 2009 publication, researchers updated the analysis. They had to expand the vertical scale by 40%, but otherwise the graphs are qualitatively similar.



Items that have caused changes in the energy budget since 1950. Called forcing agents, these absorb additional energy in the atmosphere (enhanced greenhouse effect). The greenhouse gasses shown in the figure:

carbon dioxide – CO_2

methane – CH_4

halocarbons,

nitrous oxide - N_2O

stratospheric + tropospheric ozone - O_3

have increased in the atmosphere mostly due to human activities. A natural change from variations in the Sun's output is no longer significant along the bottom of the graph. This figure shows the cumulative effect of small changes. The additional heat trapped each year continues to add up to a warmer Earth.

Knowing how much additional heat was absorbed (because we know how much of these gasses were emitted) the question becomes: where did the energy go? This figure partitions the added energy shown above based on observed changes in the Earth system. So far, a small amount of the energy has gone into warming the ocean, including the deep ocean – the part of the Earth that stores the most energy. Some has escaped Earth in the form of increased IR emission because of warmer temperatures. Some was reflected to space by aerosols (mostly volcanic in origin) in the stratosphere. The remainder (white band) is inferred to have been reflected due to aerosols (mostly pollution) in the troposphere, and other effects such as a changing reflection of the land surface due to deforestation, for example.

