

The Scientific Case for Global Warming.

Summary.

Science says six things:-

1. There is experimental evidence and theory that *GHGs* (greenhouse gases) cause warming of the Earth.
2. There is evidence that *GHGs* are increasing in the atmosphere and are at levels which will cause further warming.
3. It is well understood that the burning and use of fossil fuels increases *GHGs* in the atmosphere.
4. There is much evidence that global temperatures have been rising for the last 300 years and that they are now rising much faster than at any time for the last 600,000 years. (0.7°C since 1750, 0.5°C since 1950)
5. It is predicted that the temperature will continue to rise (it is highly unlikely that the rise can be limited to 2°C). Also that further increase of *GHGs* will cause increase in that temperature rise (to 3,4, or even 6°C).
6. It is predicted that these temperature rises will have undesirable consequences which will become catastrophic if the rise is too large.

Note. It is the same science that estimates that the Earth was warmer in the past that now says that global warming is dangerous.

More Detail.

The scientists tell us 5 basic things:-

1. *GHGs* (greenhouse gases) prevent heat escaping from the Earth and act like a blanket making the Earth warmer. (Similar to clouds at night keeping the ground warmer and preventing frost.) There is experimental evidence for this and theory that explains why this happens.
2. There is direct measurement evidence that the amount of *GHGs* in the atmosphere have been increasing significantly for the last 40 years (from about 320 - 390 ppm). There is secondary evidence derived from bubbles trapped in ice layers, from tree rings and other sources that enable the CO_2 and *GHGs* to be estimated for periods before these direct observations (going back 100,000s of years). The overall conclusion is that CO_2 levels have risen from about 280 to 390 ppm since 1750 (taken as the start of the fossil fuel era.) Scientists have also used the indirect evidence to estimate the CO_2 levels going back 100,000s of years
3. There is experimental evidence and it is well understood that the burning of fossil fuels produces CO_2 and other *GHGs* - also that methane escapes when we extract and process oil and natural gas.

Those three facts alone would that we should expect global warming to occur.

4. There is much direct measurement evidence that global temperatures have been rising for the last 100 years. Also there is secondary evidence that enables the temperatures to be estimated for periods before the period of direct observations (going back 100,000s of years). The overall conclusion is that the global temperature has risen by 0.7°C since 1750. Scientists have also used the indirect evidence to estimate the global temperature levels going back 100,000s of years.

It is of interest that these indirectly estimated parameters show indicate that for ice ages the global temperature was about 0.5°C cooler than in warm periods and that CO₂ levels were about 210 ppm for ice ages and 280 ppm (as it was in 1750) for warm periods. This puts into context the present level of 390 ppm.

5. There is much indirect observational evidence of a rise in global temperatures. Spring is coming earlier, and autumn later. Many species of plants and animals are moving away from the equator. Glaciers and snow caps are disappearing. The Arctic and Antarctic ice-caps are receding.

These facts suggest very strongly that global warming is happening and that it is caused by the additional GHGs from our use of fossil fuels.

Its Been Warmer in the Past.

Many people point out that the Earth has been warmer in the past as if that made everything okay. These people should recognise that their belief that it has been warmer in the past is based on the estimates of scientists. It is those same scientists who say that what is happening now is unprecedented and that global warming poses a huge threat. It is unreasonable to take part of their science and to reject the rest.

Predictions.

When it comes to predictions the situation is more difficult. Will things we do not yet understand (feedbacks) cut in to change the situation? Scientists build models based on our present knowledge/theory/understanding (basically saying trends will continue as they have up to now). They validate these models by running them against the estimated data from the past and see if they match what is estimated to have happened. These models form the basis of the predictions, though as we gain understanding of feedback effects these are incorporated into the models, usually in a very conservative way.

Unfortunately the new things that have cut in (feedbacks) and our new understandings over the last few years have all made the situation worse than the earlier models predicted and the temperature has been rising more than expected.

Scientists also predict based on their understanding/theories about the climate system what effects the global temperature rise will have. These predictions include:- further rises in global temperature, more extreme weather events, the further melting of the polar ice-caps, changes in rainfall patterns (droughts in some areas, floods in others), loss of habitats and species, changes in localities for diseases, growth of deserts, drying up of rivers, the dying of the rain forests etc. We are already seeing many of these things happen and so far the scientific predictions have been too optimistic. (E.g. Only 5 years ago it was predicted that there would continue to be sea-ice in the Arctic during the summer until 2100. Newer data has led to new predictions that the summer ice is likely to be gone by dates ranging from 2015 to 2030.)