Carbon Emissions for 2° C Maximum Global Average Temperature

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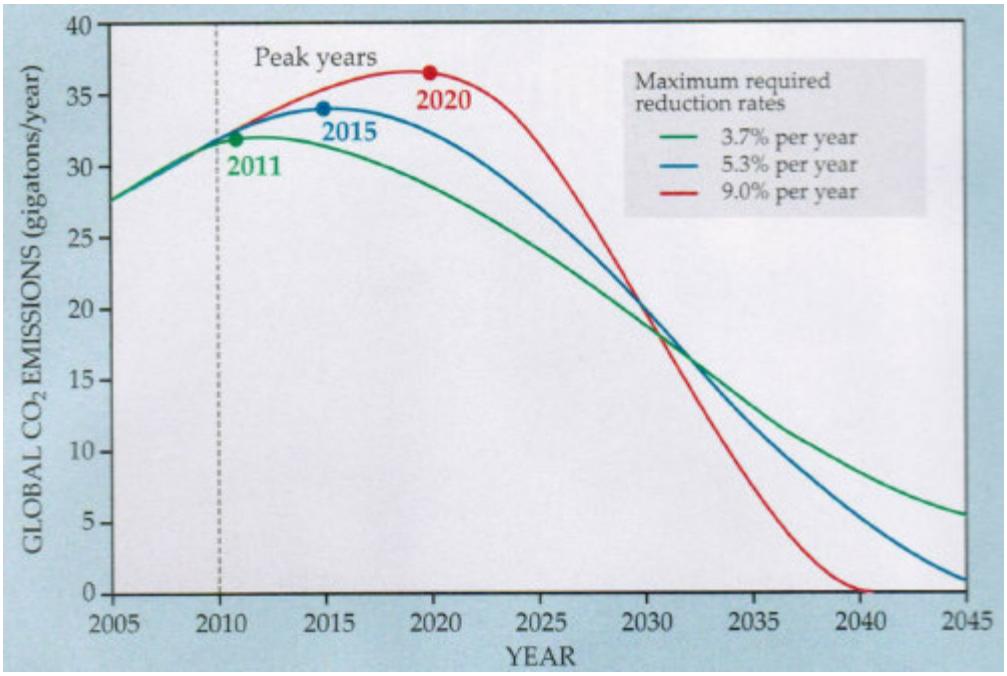
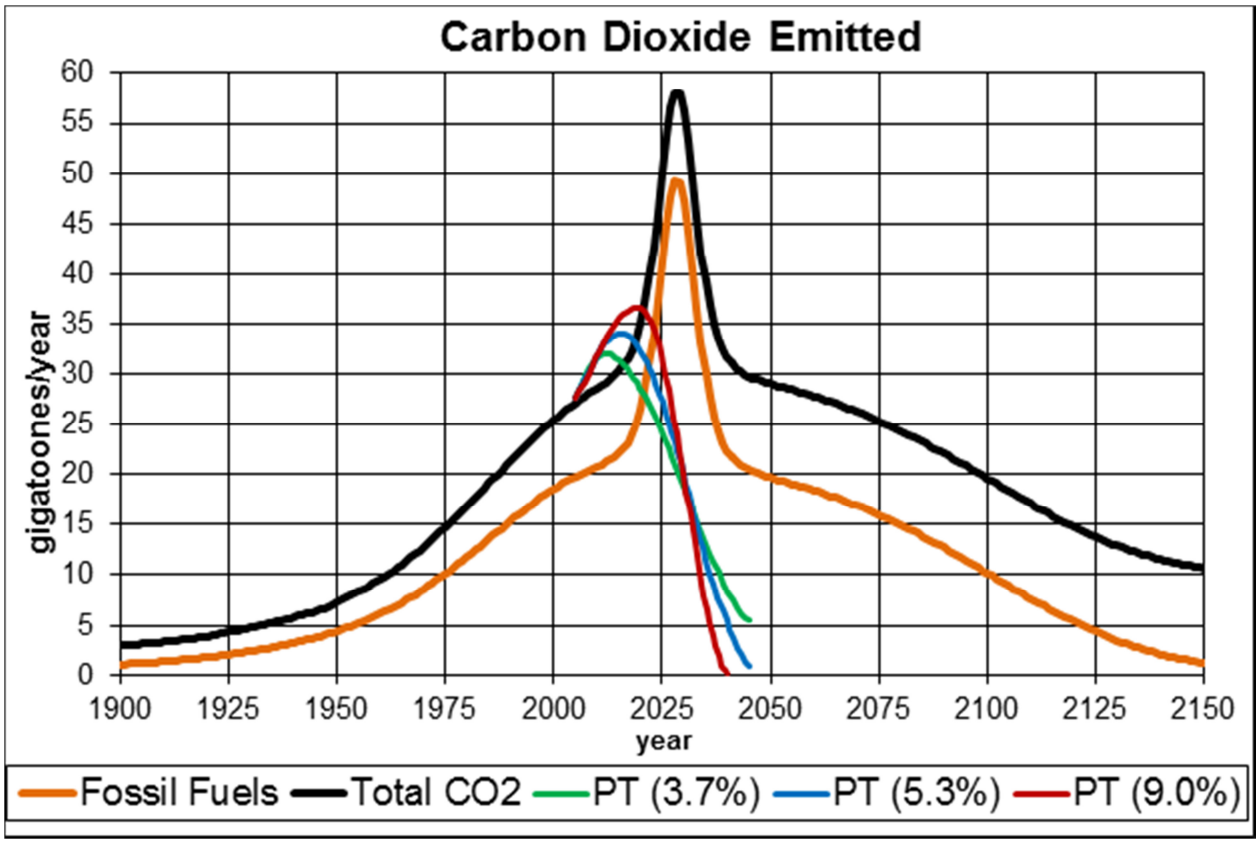
The October 2011 issue of Physics today (Communicating the science of climate change, pp.48-53) contains a graph (Figure 5, p.52) that has three curves that show how fast carbon-dioxide emissions must decrease for three different peaks of emissions to keep global temperatures from rising no more than 2° C in the future:

1. Year 2011 peak--3.7% decrease
2. Year 2015 peak--5.3% decrease
3. Year 2020 peak--9.0% decrease:

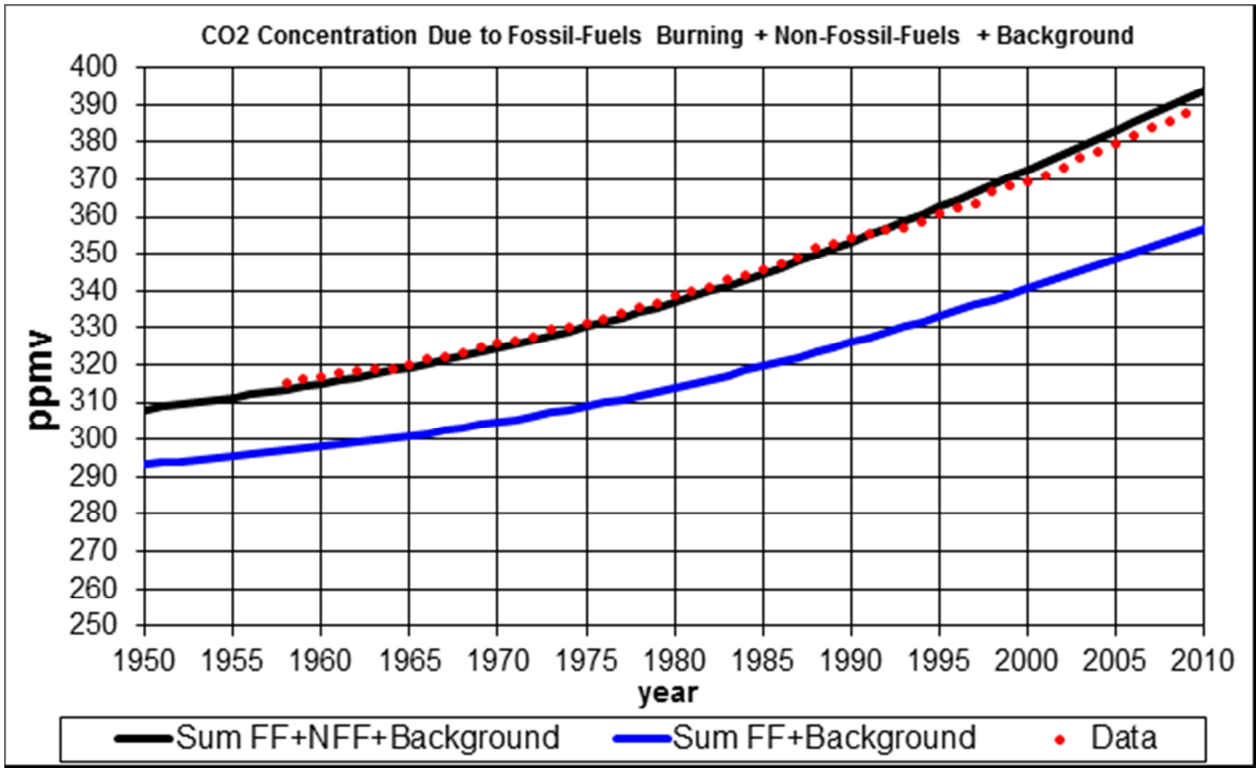


One can estimate how fast carbon-dioxide emissions will eventually decrease due to depletion of fossil fuels by using extraction rates and estimated reserves for fossil fuels and a depletion function, such as the Verhulst function. (See http://www.roperld.com/science/minerals/FossilFuels.htm.) One can estimate other carbon emissions (carbon emissions = 0.237xcarbon-dioxide emissions) by assuming they are proportional to population, normalized to 2 gigatonnes in 2005, and assuming that population reaches an asymptote of ~8.5 billion. The following shows the results along with the three curves in Figure 5 of the article:

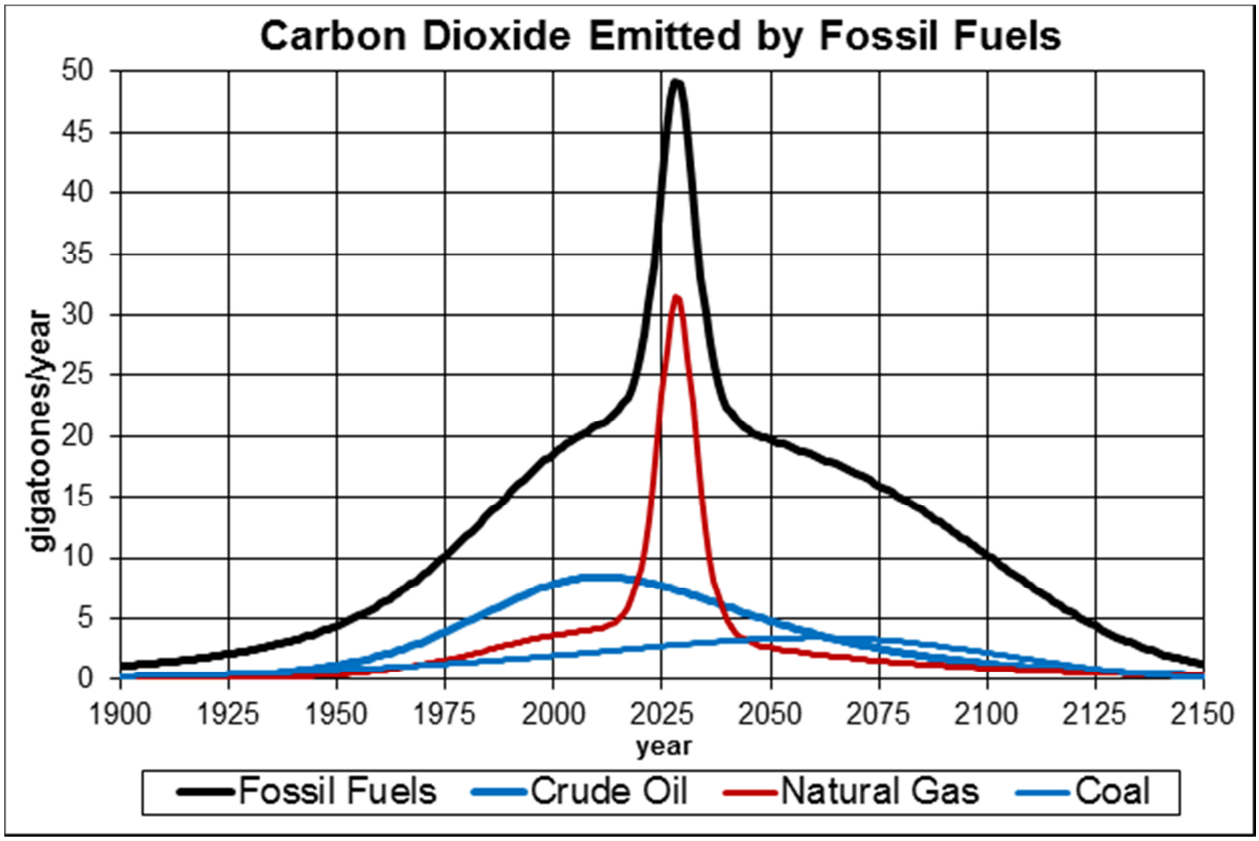


The peak in the fossil-fuels curve is due to assuming that natural-gas fracking for the world will be similar to the case for the United States, except that it will be delayed. (See http://www.roperld.com/science/minerals/shalegas.htm.)

This does a reasonably good job of matching the data for carbon-dioxide concentration (ppmv) in the atmosphere, using the pre-industrial background of 280 ppmv and the standard 0.47 factor for conversion of gigatonnes carbon to ppmv:



The individual contributions of crude oil, natural gas and coal are:



Lessons learned here are:

- Fossil-fuels depletion will not occur fast enough to limit global temperatures to below 2° C.
- If world natural-gas fracking follows the case for the United States, it will cause a large spike in carbon emissions at the time when emissions need to be drastically reduced.
- Any inadvertent emissions of methane from tundra or clathrates will make the matter much worse.