

## Can UK fossil fuel emissions be determined by radiocarbon measurements?

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The GAUGE project evaluates different methods to estimate UK emissions. However, estimating carbon dioxide emissions as a result of fossil fuel burning is challenging as natural fluxes in and out of the atmosphere are very large. Radiocarbon ( $^{14}\text{C}$ ) measurements offer a way to specifically measure the amount of recently added carbon dioxide from fossil fuel burning. This is possible as, due to their age, all the radiocarbon in fossil fuels has decayed. Hence the amount of recently added  $\text{CO}_2$  from fossil fuel burning can be measured as a depletion of the  $^{14}\text{C}$  content in air.

While this method has been successfully applied by several groups on a city or a regional scale, this is the first attempt at using the technique for a national emission estimate. Geographically the UK, being an island, is a good location for such an experiment. But are  $^{14}\text{CO}_2$  measurements the ideal solution for estimating fossil fuel emissions as they are heralded to be?

Previous studies have shown that  $^{14}\text{CO}_2$  emissions from the nuclear industry mask the  $^{14}\text{C}$  depletion caused by fossil fuel burning and result in an underestimation of the fossil fuel  $\text{CO}_2$ . While this might not be a problem in certain regions around the world, many countries like the UK have a substantial nuclear industry. A correction for this enhancement from the nuclear industry can be applied but are invariably difficult as  $^{14}\text{CO}_2$  emissions from nuclear power plants have a high temporal variability.

We will explain how our sampling strategy was chosen to minimize the influence from the nuclear industry and why this proved to be challenging. In addition we present the results from our ground based measurements to show why trying to estimate national emissions using radiocarbon measurements was overambitious, and how practical the technique is for the UK in general.