Carbon capture and storage could affect air pollution

A new report suggests that underground carbon storage projects in Europe could lead to positive and negative effects on air pollution, depending on the pollutant in question. Carbon capture and storage (CCS) is considered in European legislation as a ‘bridging technology’ – a medium-term solution to climate change. Although the overall air quality impact of CCS is expected to be positive, the legislation notes that the technology should not be seen as a replacement for commitments to developing a greener and more energy-efficient economy.

Carbon capture and storage removes carbon dioxide (CO₂) from the air and stores it deep underground. The technology could be used by power plants to directly reduce emissions from the burning of fossil fuels. Directive 2009/31/EC, referred to as the CCS Directive, establishes a legal framework for CCS in the EU. By mid-2011, the European Commission’s CCS Project Network had established six demonstration-scale CCS projects across Europe – in Germany, Italy, the Netherlands, Poland, Spain and the UK. As well as reducing CO₂ emissions, CCS is expected to have an effect on air pollutants, increasing net emissions of certain pollutants per kilowatt-hour. The report considered emissions of the main greenhouse gases (GHGs): CO₂, methane and nitrous oxide, and the air pollutants most damaging to health: nitrogen oxides, sulphur dioxide, ammonia, non-methane volatile organic compounds and particulate matter (PM₁₀).

The effect of CCS on the emissions of air pollutants varies greatly according to the pollutant. For instance, degradation of a solvent used in some capture technologies results in ammonia release and therefore increased emissions. There are also positive co-benefits. Sulphur dioxide has to be eliminated from flue gas, partly to avoid corrosion of the CCS system, resulting in reduced sulphur dioxide emissions. The report, from the European Environment Agency (EEA), summarises the most recent research on this subject. The largest increases are expected for nitrogen oxides and ammonia, and the largest decrease for sulphur dioxide. However, emissions of these pollutants, particularly nitrogen oxides, will vary depending on the CCS technology used. Post-combustion technologies may be the least energy efficient, due to the heat and pressure required to process the CO₂.

The report also points to the importance of considering indirect emissions from fuel production and transport further along the CCS chain, as; in some cases these sources may be more significant than total emissions from direct facility emissions. However, the authors stress that most estimates so far are largely based on assumptions or small scale studies rather than actual measurements taken at large-scale CCS sites. The report estimates emissions for the different GHGs and pollutants under four different CCS scenarios in 2050. The first scenario assumes no CCS at all in Europe. Two scenarios assume CCS is applied to all European coal-fired power plants – one assuming the coal is sourced from Europe while the other deliberately contrasting scenario assumes the coal comes from Australia. For the final scenario where CCS is applied to coal, gas and biomass-fired plants using fuel from Europe, emissions were lower than the ‘no CCS’ scenario for all pollutants, except ammonia.

The changes in emissions of air pollutants may be quite significant. A large reduction was seen for sulphur dioxide emissions in the CCS scenarios, compared to no CCS, and PM₁₀ emissions were predicted to fall by half. When fuel was sourced from Australia, emissions of some pollutants increased due to the long-distance shipping involved, including nitrogen oxides. Overall, however, the EEA report considers the overall co-benefits of the introduction of CCS to be positive in terms of the reduced emissions of air pollutants. The European Commission has committed to a roadmap for development of a low carbon economy to 2050 and a target of 80-95% reductions in GHG emissions (compared to 1990 levels) by that time. While the Commissions’ 2050 roadmap assumes a significant implementation of CCS, the authors of the EEA report say that any focus on CCS should not delay progress towards the ultimate objective of moving Europe towards a lower-energy and more resource-efficient future economy.


Contact: martin.adams@eea.europa.eu Theme(s): Air pollution, Climate change and energy, Environmental technologies