Carbon Leakage and Geosequestration

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Scientists have concluded that human activities are contributing to climate change by adding large amounts of greenhouse pollution to the atmosphere. Use of coal, oil and gas (fossil fuels) are the main source of this pollution. Every time we drive a car, use electricity from coal-fired power plants, or heat our homes with oil or natural gas, we release carbon dioxide and greenhouse pollutants into the air. Atmospheric levels of the main greenhouse pollutants are currently higher than at any point in the last 420,000 and possibly 20 million years. Within this context governments in Australia and overseas have been discussing "geosequestration" – the controversial plan to capture and dispose of greenhouse pollution underground – as a technology to reduce greenhouse gas emissions.

Of paramount importance for geosequestration is the issue of whether greenhouse pollution disposed of underground is permanently stored. Clearly, if sequestered greenhouse pollution in the form of carbon dioxide (CO_2) leaks back into the atmosphere, then geosequestration will have failed as a technology to reduce greenhouse pollution. Depending on the quantity of CO_2 stored, the rate of leakage and the level of stabilisation of CO_2 in the atmosphere, the implications of leakage for the global climate system could be catastrophic. In addition, if the leakage is rapid, it can asphyxiate humans and animal life in the vicinity.

The greater the reliance on geosequestration to prevent dangerous climate change, the greater the impact will be if leakage does occur.

Leakage is Likely to Occur

Studies show that some leakage is likely, because geological formations are not completely stable, or they could be disturbed by, for example, earthquakes, or because the injection points could become unstable over time.

To be effective, any underground storage of CO_2 must not be able to leak out at a rate that would exceed levels that would contribute to dangerous levels of climate change. But how small is small enough? That depends on the amount that is stored and to a lesser extent, the level at which we seek to stablise greenhouse gases in the atmosphere. The latter is generally defined as a certain level of carbon dioxide in the atmosphere measured in parts per million volume (ppm). Environment groups consider that atmospheric levels of carbon dioxide should be stablised at 450ppm to avoid dangerous levels of climate change.

What Level of Leakage is Acceptable?

The safest rate of leakage is zero and that should be the goal for every geosequestration site.

Researchers vary greatly in their assumptions and conclusions regarding a likely level of leakage. It seems that some leakage is likely and there will be a need to set standards and regulations for acceptable rates of leakage and the monitoring and verification regimes to ensure compliance.

Leakage must not compromise the ability of future generations to avoid dangerous climate change.

The diagram below (see figure 1) illustrates a scenario in which geosequestration is used as the exclusive greenhouse gas emission reducing tool for the next two hundred years and the leakage rate is assumed to be 0.1% per annum. By the end of the 22nd century the entire 'carbon budget' of future generations would be consumed by leakage from geosequestration sites. This would mean that future generations could not avoid dangerous climate change, even if they reduced their own greenhouse gas emissions to zero.

Conclusion

The assumption of exclusive reliance on storage may be an extreme one, however the example illustrates that emphasis on energy efficiency and increased reliance on renewable energy must be priority areas for greenhouse gas mitigation. The higher the expected leakage rate and the larger the uncertainty, the less attractive geosequestration is compared to other mitigation alternatives such as shifting to renewable energy sources, and improved efficiency in production and consumption of energy.

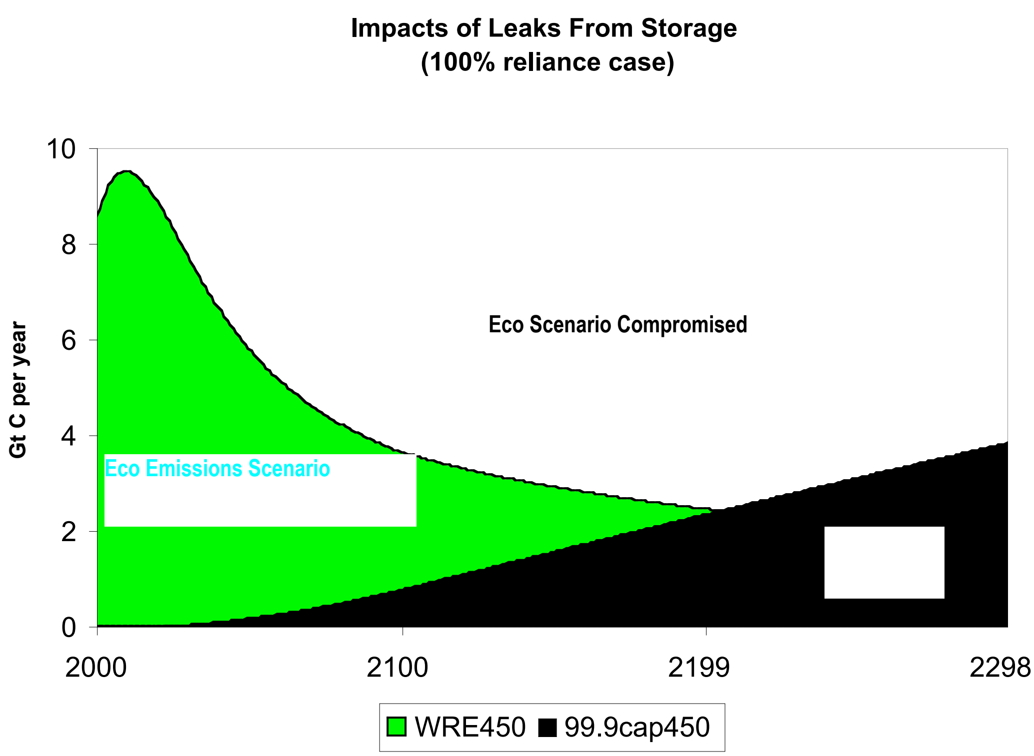

Figure 1. Impact of a 0.1% Leak Rate

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