

Atmospheric and Geological CO₂ Damage Costs in Energy Scenarios

Koen SMEKENS^a, Bob van der ZWAAN^{a,b}

^a Energy research Centre of the Netherlands (ECN), Policy Studies Department, Petten, The NETHERLANDS

^b Harvard University, John F. Kennedy School of Government, Cambridge, MA, USA

Corresponding author: "Bob van der Zwaan" <vanderzwaan@ecn.nl>

Geological carbon capture and storage (CCS) is currently seriously considered for addressing, in the near term, the problem of climate change. CCS technology is available today and is expected to become an increasingly affordable CO₂ abatement alternative. Whereas the rapidly growing scientific literature on CCS as well as experimental and commercial practice demonstrate the technological and economic feasibility of implementing this clean fossil fuel option on a large scale, relatively little attention has been paid so far to the risks and environmental externalities of geological storage of CO₂. This study assesses the effects of including CCS damage costs in a long-term energy scenario analysis for Europe. An external cost sensitivity analysis is performed with a bottom-up energy technology MARKAL model that accounts not only for CCS technologies but also for their external costs. Our main conclusion is that even without climate change intervention, CCS technologies are likely to be deployed, mainly in the power generation sector, given the economic benefits of opportunities such as enhanced coal bed methane recovery. With the introduction of CO₂ taxation, designed to internalise the external atmospheric and geological effects of CO₂ emissions and storage, we find that CCS will only be developed if the global warming damage cost is at least some 100 EUR/tCO₂ or the damage cost resulting from CO₂ storage not more than a few EUR/tCO₂. When the internalised global warming damage costs are as high as 100 EUR/tCO₂, the expensive application of CCS to biomass-fuelled power plants (with negative net CO₂ emissions) proves the most effective CCS alternative to reduce CO₂ emissions, rather than CCS applied to fossil-based power plants.

Keywords:

Carbon dioxide, global warming, carbon capture and storage, external costs, bottom-up energy-environment model, MARKAL