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Effects of technological learning on future cost and performance of power plants with CO_2 capture

Machteld van den Broek [a,*], Ric Hoefnagels [a], Edward Rubin [b], Wim Turkenburg [a], André Faaij [a]

[a] Department of Science, Technology and Society, Copernicus Institute for Sustainable Development and Innovation, Utrecht University, 3584 CS Utrecht, the Netherlands
[b] Department of Engineering and Public Policy, BH 128A, 5000 Forbes Ave, Carnegie Mellon University, Pittsburgh, PA 15213, USA

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ABSTRACT

This paper demonstrates the concept of applying learning curves in a consistent manner to performance as well as cost variables in order to assess the future development of power plants with CO_2 capture. An existing model developed at Carnegie Mellon University, which had provided insight into the potential learning of cost variables in power plants with CO_2 capture, is extended with learning curves for several key performance variables, including the overall energy loss in power plants, the energy required for CO_2 capture, the CO_2 capture ratio (removal efficiency), and the power plant availability. Next, learning rates for both performance and cost parameters were combined with global capacity projections for fossil-fired power plants to estimate future cost and performance of these power plants with and without CO_2 capture. The results of global learning are explicitly reported, so that they can be used for other purposes such as in regional bottom-up models. Results of this study show that IGCC with CO_2 capture has the largest learning potential, with significant improvements in efficiency and reductions in cost between 2001 and 2050 under the condition that around 3100 GW of combined cycle capacity is installed worldwide. Furthermore, in a scenario with a strict climate policy, mitigation costs in 2030 are 26, 11, 19 €/t (excluding CO_2 transport and storage costs) for NGCC, IGCC, and PC power plants with CO_2 capture, respectively, compared to 42, 13, and 32 €/t in a scenario with a limited climate policy. Additional results are presented for IGCC, PC, and NGCC plants with and without CO_2 capture, and a sensitivity analysis is employed to show the impacts of alternative assumptions on projected learning rates of different systems.

Contents

* Corresponding author. Tel.: +31 302532216; fax: +31 302537601.
E-mail address: m.a.vandenbroek@uu.nl (M. van den Broek).

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