Executive summary

Energy scenarios developed by the International Energy Agency (IEA) suggest that carbon capture and storage (CCS) from power plants might contribute by 2050 to around 10% of the energy-related carbon dioxide (CO_2) emission reduction required to stabilise global warming (IEA, 2010). Since CO_2 capture from power generation is an emerging technology that has not been demonstrated on a commercial scale, related cost and performance information is based on feasibility studies and pilot projects and is still uncertain.

This paper analyses techno-economic data for CO_2 capture from power generation, including CO_2 conditioning and compression, in order to support energy scenario modelling and policy making. Cost and performance trends are shown based on estimates published over the last five years in major engineering studies for about 50 CO_2 capture installations at power plants. Capital cost and levelised cost of electricity (LCOE) are re-evaluated and updated to 2010 cost levels to allow for a consistent comparison. Presented data account for CO_2 capture but not transportation and storage of CO_2. They are estimates for generic, early commercial plants based on feasibility studies, which have an accuracy of on average ±30%. The data do not reflect project-specific cost or cost for first large-scale demonstration plants, which are likely higher.

For coal-fired power generation, no single CO_2 capture technology outperforms available alternative capture processes in terms of cost and performance. Average net efficiency penalties for post- and oxy-combustion capture are 10 percentage points relative to a pulverised coal plant without capture, and eight percentage points for pre-combustion capture compared to an integrated gasification combined cycle. Overnight costs of power plants with CO_2 capture in regions of the Organisation for Economic Co-operation and Development (OECD) are about USD 3 800 per kW (/kW) across capture routes, which is 74% higher than the reference costs without capture. Cost figures vary substantially depending on the type of power plant type and fuel used. The relative increase in overnight costs compared to a reference plant without CO_2 capture is a comparably stable metric across studies. It is thus recommended for estimating cost if limited data are available. Projected LCOE is on average USD 105 per megawatt hour (/MWh). Average costs of CO_2 avoided are USD 55 per tonne of CO_2 (/tCO_2) if a pulverised coal power plant without CO_2 capture is used as a reference.

For natural gas-fired power generation, post-combustion CO_2 capture is most often analysed and appears the most attractive near-term option. Average cost and performance projections include net efficiency penalties of eight percentage points for post-combustion CO_2 capture from natural gas combined cycles. Overnight costs are USD 1 700/kW including CO_2 capture, or 82% higher than the reference plant without capture. LCOE is USD 102/MWh and costs of CO_2 avoided are USD 80/tCO_2 if a natural gas combined cycle is used as a reference.

Cost estimates stated above are average figures for OECD regions. Cost data for installations in China indicate significantly lower costs compared to the above-mentioned figures. All overnight costs include a contingency for CCS plants to account for unforeseen technical or regulatory difficulties. LCOE and costs of CO_2 avoided do not include a CO_2 emission price.

Harmonisation of costing methodologies is needed in order to simplify technology comparisons. Though a similar approach is used for estimating cost and performance across studies, specific methodologies, terminologies and underlying assumptions are inconsistent.

Broader assessments of CO_2 capture from power generation in non-OECD countries are still underrepresented, though according to global energy scenarios deployment of CCS in these regions might have to exceed expected levels in OECD countries.