Development of efficient CCS technologies: the role of capture rate requirements

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Introduction

CO_2 capture and storage (CCS) is in various road maps pointed out as one of the main future CO_2 abatement technologies. The timing of large scale CCS deployment is however critical. Studies (IEA, 2008) show that cost of meeting emission targets will increase significantly without use of CCS. Given that a general CO_2 price (which currently only covers some sources and regions, is too low, and with substantial uncertainty attached with regard to future development) is deemed insufficient, that CCS is one of the CO_2 mitigation technologies chosen for direct government support, and that a wide range of CCS technology options are available, some selection criteria are needed.

Today different selection criteria exist for governmental support of CCS projects. The EU set aside 300 million in the New Entrants' Reserve (NER300) of the European Emissions Trading Scheme for subsidizing installations of innovative renewable energy technology and CCS (NER, 2010a). In the final NER300 decisions (NER, 2010b) it is clearly stated a list of selection criteria for CCS projects. Besides selecting projects providing the most cost-effective way to ensure technological diversity among the CCS demonstrations projects, it is explicitly stated that the capture rate has to be at least 85 % of CO_2 from the flue gases to which capture is applied. A minimum capacity threshold is set to 250 MW for CCS from power generation. As an example from Norway, the Climate and Pollution Agency (KLIF) in Norway recommended to the Ministry of Environment that a new gas fired power plant in Elnesvågen should be equipped with a CCS facility capable of capturing at least 85% of the CO_2 content of the flue gas (KLIF, 2008).

Selection of Support Criteria

Determining the appropriate selection criteria for direct government support is challenging, since there can be trade-offs between general and more specific support measures for technology development.

A CCS project's potential for low cost per ton of CO_2 handled is considered a general support criterion; critical for the competitiveness of CCS as a future CO_2 abatement technology. Optimal support allocation should therefore in addition to present technology cost, take into account future expected cost development (learning curve) and scale up potential. Combining short term and long term perspectives is critical. A technology option that today has the highest cost could at the same time have the highest expected learning rate, which could make it the most attractive support candidate.

Requiring a minimum capture rate is a more specific support criterion, and even though there are technologies available that can capture around 85-90% CO_2, this is not necessarily the best solution in every case since the cost per ton of CO_2 handled could rise compared to a lower capture rate. We explore the argumentation for setting such a minimum capture rate today, and what consequences such a technical requirement may have in the future.

Consequences of Technology Standards

Realizing that there exist minimum capture rate requirements today, we discuss how this can effect (pros and cons) CCS technology development, future competitiveness and public support. We illustrate advantages and potential problems associated with minimum capture rates with the help of techno-economic and environmental models for power generation with CCS.

An advantage of a standard is that it could push faster development and implementation of a given class of technology. Knowing that a standard would be implemented in the future would create market demand for that technology, pushing companies to do research and reduce both costs and uncertainty associated with the technology. However, because the economy as a whole can be better served by a range of options for reducing CO_2 emissions from point sources, setting a minimum capture rate might reduce effort in development of low capture rate technologies.

A capture rate of 90% CO_2 is not equivalent to a reduction in 90% of CO_2 emission per kWh produced. Results from environmental studies (Singh et al., 2010) show that CCS with capture rate of 90% from natural gas fired power plant results in avoiding 70% of CO_2 emissions to the atmosphere per kWh. Hence to understand the cost-effectiveness of CCS as a CO_2 abatement technology you need to compare incremental costs with incremental emission reductions. A challenge for policy makers is to compensate for these "carbon leakages" in sub processes where emissions costs are not included in input prices.

Public support could be another rationale for requiring a (high) minimum CO_2 capture rate of CCS plants. In the recommendation of KLIF (2008), statements by NGO's indicate public resistance if a high capture rate is not put up as a requirement.

Conclusion and Policy Recommendations

The challenge of selecting and supporting the most promising CCS projects is investigated, focusing on CO_2 capture rate requirements. More and less flexible technology standards are analyzed, showing impact on expected future cost per ton of CO_2 handled. The analysis provides useful insights on choice of minimum capture rate for CCS facilities, strengthening the knowledge basis for public technology policy developers.

References

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