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CARBON CAPTURE PROJECT- NET PRESENT VALUE AND THE OPTION VALUE OF WAITING

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OVERVIEW

The article reviews an investment analysis for carbon capture and storage (CCS) as if it was to be undertaken by a private company. We look at calculating abatement unit costs, net present value and the option value in relation to project value. In addition, we discuss various risks in relation to partial cash flows.

METHOD

We apply standard methods for valuation: calculation of abatement unit costs, net present value and the option value of waiting. We discuss various risks in cash flows and the practical application of abatement unit costs versus net present value. In addition, we differ from socio-economic analyses in that we calculate the net present value of the project with the expected price of carbon emission allowances as income, and illustrate the option value of waiting on the basis of carbon price uncertainties.

RESULTS AND CONCLUSIONS

Our conclusion is that CCS for our sample project is a very unprofitable climate measure with low cost efficiency. The abatement cost per tonne of carbon emissions is in the range of USD 167-333[1] and, even with the assumption that substantially higher expected emission allowance prices would yield an anticipated positive net present value, the project is unlikely to be approved because of the option value of waiting. This size of the latter reflects the great uncertainty associated with future emission allowance prices and an expectation of probable lower real carbon capture costs in the future as a result of technological progress.

Assuming an expected price of USD 165 per tonne

	Option multiple (K/K-1) (two decimals)	**V* (K/K-1)*I**	**Option value of waiting, F(V)**
0.01	1.029	2831	81
0.05	1.155	3177	427
0.1	1.33	3667	917
0.15	1.53	4226	1476
0.2	1.77	4861	2111

The results of our option analysis, displayed in the table, show that the option multiple and the option value of waiting increase with the uncertainty in price (sigma). Since the uncertainty over the future emission allowance price is large, it would be reasonable to suggest that –

[1] Monetary amounts have been converted from Norwegian kroner to USD dollars at an exchange rate of NOK 6 = USD 1.

even with a carbon price of USD 165 per tonne – the sample project is a long way from implementation because of the substantial option value of waiting.

The option value of waiting will decrease with a rise in the payout ratio (the expected price of emission allowances). With a yield of 10%, indicating a carbon price of USD 275 per tonne, the option multiple is 1.22 and the option value decreases from 1476 to 608 millionUSD (with sigma equal to 15%). The current carbon price is a long way short of these levels, of course, which makes this point rather irrelevant.

With an investment of USD 1.67 billion, down from USD 2.75 billion, F(V) would be 375 million USD (at sigma 0.15, yield 6% and r equal to 6%). The option value of waiting is reduced from 1476 to 375 million USD owing to the increased profitability of the project. Of greater interest, however, is today's expectation that the real value of carbon removal costs will decline in the future as a result of technology development. That will increase the option value of waiting, since investors will believe that carbon removal may be achieved more cheaply in the future. The combined effect of today's low emission allowance price, the high level of uncertainty in emission allowance pricing and expectations of lower investment costs in the future will be detrimental to making carbon investments now because the option value of waiting will be large. Our analysis fits the general observation that carbon capture projects for gas-fired power stations are being postponed.

REFERENCES

1. Al-Juaied, M A and Whitmore, A (2009), "Realistic Costs of Carbon Capture", Discussion Paper 2009-08, Cambridge, Mass.: Belfer Center for Science and International Affairs, http://www.osti.gov/bridge/servlets/purl/960194-GpDT0k/960194pdf
2. Boston Consulting Group (2005), "Investment Criteria, Methods, Decision-making Cultures Benchmarking – May 2005 Results", October 2005.
3. Damodaran, NYU, January 2010, net.
4. Dixit, A K and Pindyck, R S 1994. *Investment under Uncertainty*, Princeton University Press, New Jersey.
5. Emhjellen, M and Alaouze, C M 2002 "Project Valuation When There are Two Cashflow Streams", *Energy Economics*, Vol 24, September, pp 455-467.