TIME AND TIDE WAIT FOR NO MAN
PIONEERS AND LAGGARDS IN THE DEPLOYMENT OF CCS

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Overview

In Europe the ambitions of individual countries to deploy carbon capture and storage (CCS) technologies are diverse. Reasons for this are, amongst other things, the heterogeneity of national electricity generation systems, CO_2-storage capacities and the differences in the public perception of these technologies. In this analysis we investigate the consequences of partial deployment of CCS, i.e. we consider a situation where some European countries (the "pioneers") actively deploy CCS technologies, while others (the "laggards") do not use CCS. Our study focuses on the question whether it pays throughout to be a pioneer and whether laggards will generally be disadvantaged. In our assessment, we take into account impacts on consumers affected from rising electricity prices, electricity suppliers whose profits are influenced by changes in both electricity prices and sales, and international trade-flow changes (modifications in European electricity import/export patterns).

Method

In our study we assess the impact of deployment of power plants equipped with CCS on electricity production, on electricity import and exports as well as on the price of electricity at the spot-market by using a dispatched model. The model is based on data of EURELECTRIC and ENTSO-E for Europe 2030 [ENTSO-E, 2011b, ENTSO-E, 2011a, ENTSO-E, 2012, EURELECTRIC, 2010]. EURELECTRIC has been chosen as main source for the scenarios because extensive information on power plants (installed capacity, fuel consumption) and electricity demand (e.g. information on peak and base load) is published by EURELECTRIC for each country in Europa. 29 Countries in Europe and 40 different kinds of power plant techniques are taken in account. Using data on existing power plants stock and stock extensions provided by EURELECTRIC we draw inferences on power plant efficiencies and calculate power plant specific production cost by taking fuel prices into account [EURELECTRIC, 2010, IEA, 2011]. In accordance with ZEP, we assume that greenfield CCS-coal fired power plants will have efficiency losses of 8 % points compared to a conventional coal fired power plant while retrofitted power plants will face efficiency losses up to 12 % points [ZEP- Zero Emissions platform, 2011]. It is assumed that the power plant operators will use their power plants if the short-run marginal cost are lower than or equal to the price for electricity on the wholesale market. Electricity will be imported if the price in other countries is lower than the cost of using additional domestic power plants and if there are import capacities available [Rübbelke & Vögele, 2013]. The impacts of changes in the power plant stock on revenues are assessed based on the national producer surpluses. Two scenarios have been selected for analyzing possible impact of deploying CCS in Europe. In the "Reference" scenario it is assumed that CCS power plants will not reach market maturity in the next 20 years in Europe. In the "CCS" scenario we anticipate that CCS power plants will be ready for the market in 2030. Based on information on national CCS strategies we suppose that coal-fired CCS-power-plants will operate in Great Britain, the Netherlands, and Poland as well as in Romania in 2030 and that in Great Britain and Norway gas fired power plant will be equipped with CCS till then. Information on the extent CCS will be deployed in each country is extracted from CCSA [2011], Bellona Environmental CCS Team [2011], Sund Energy [2010], Bellona Environmental CCS Team [2012] and Energy Forum NL [2012].

Results

Taking into account that on the spot markets only running costs count and that the running cost of coal- fired power plants with CCS are lower than the ones of conventional coal power plants (because of CO2 cost saving) with an increase use of such power plants the producer surplus will increase. However, if the wholesale price drops because more cheap power plant capacity is available the producer surplus decreases, too. For the assessment of the overall changes in producer surplus it is important to take the production into account, too: As the revenues are determined by the product of prices and production with increasing production caused by rising demand for electricity by foreign countries as well as higher wholesale prices resulting from using gas-fired power plants the producer surplus will rise. In Great Britain the wholesale price increases. Consequently the earning of the utilities rises, too. In Poland and the Netherlands the producer surplus grows because of changes in the slope of the merit-order curve caused by using coal-fired power plants with CCS which had lower CO2 costs than the conventional coal-fired power plant which are used in the reference scenario. In countries like Romania and Norway, the producer surpluses decrease due to lower revenues caused by drops in wholesale prices. Changes in prices in combination with changes in production and modifications in the merit-order curve result in changes in electricity producer surpluses. Such surpluses could be channeled towards the financing of CCS investment costs. The investment costs of CCS power plants are significantly higher than the respective costs of conventional power plants [ZEP- Zero Emissions platform, 2011, IEA, 2011]. Taking the additional (annualized) investment costs into account, the electricity suppliers in Great Britain, the Netherlands and Poland will still gain from the use of CCS. The overall result for producers will remain negative for Norway and Romania.

Table 1: Results (year 2030)

	"CCS-Pioneers"					"CCS-Laggards"	Total
	GB	NL	PL	NO	RO		
Changes in Annual Producer Surplus (Mio. Euro)	1059 (11.0%)	268 (13.8%)	1109 (58.1%)	-36 (-2.2%)	-75 (-4.7%)	-38 (-0.1%)	2286 (2.8%)
Additional (annualized) investment cost (Mio. Euro)	803	136	545	46	142	0	1672
Overall result (Changes in Producer Surplus – Cost) (Mio. Euro)	255	132	564	-82	-217	-38	614
Changes in Consumer Surplus (Mio. Euro)	-857	-19	7	22	95	38	-714

Remarks: Calculations are based on data of IEA on the costs of power plants. [IEA, 2011]

Source: Own Calculation IEK-STE 2013

The changes in consumer surplus have been assessed by multiplying changes in electricity prices and electricity consumption. Consequently in countries with decreasing electricity prices the consumer surplus will increase. An example for a country with positive effects for producers and consumers is Poland. In Great Britain the positive effect of using CCS for electricity producers is overcompensated by a large drop in consumer surplus. In Norway and Romania the sum of changes in producer surplus, additional cost and changes in consumer surplus are negative.

Conclusion

As our analysis shows, consequences of pioneering CCS activities tend to be rather heterogeneous. As a pioneer country, the UK will be confronted with a rise in wholesale electricity prices due to its ambitious deployment of gas-fired CCS power plants. Such an increase in wholesale prices might to some extent harm electricity consumers in the UK and it will be accompanied by a decline in domestic electricity production. In contrast, Romania will face a sharp decline in wholesale prices benefitting consumers and a strong growth in domestic electricity generation. Suppliers in Poland, the UK and the Netherlands tend to benefit, while suppliers in Norway and Romania will lose. This holds even when we take additional CCS investment costs into account. Whole-sale prices in several laggard countries will decline due to the use of CCS in the pioneer countries, while they will rise in others. Electricity generation will increase in a number of laggard countries and even electricity suppliers in some laggard countries may raise their profits due to the CCS activities of the pioneers.

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