Energy Draft Technology Assumptions for the New EU Reference Scenarios

Response from the Zero Emission Technology and Innovation Platform (ZEP)
30th October 2019

The Zero Emission Technology and Innovation Platform (ZEP) is the technical adviser to the EU on the deployment of Carbon Capture and Storage (CCS), and Carbon Capture and Utilisation (CCU), a European Technology and Innovation Platform (ETIP) under the Commission's Strategic Energy Technologies Plan (SET-Plan).

CO_2 Capture Rates

In the past, when CCS was discussed as the main option to decarbonise coal-fired power plants, a CO_2 capture rate of 90% was adopted as standard, regardless of the technology type, the location or fuel type. However, this standard value, adopted so ubiquitously, is actually an artificial limit.

The IEAGHG[1] has investigated the possibility and costs of achieving carbon capture rates higher than 90% for deployment of CCS in the power sector. The conclusion is that there were no technological barriers for increasing capture rates to 99% for all three main capture technologies, with minor financial and process efficiency penalties for post-combustion capture. As such:

- CO_2 capture rates of 95% or higher are possible on CCS-equipped power stations with limited increase to the Levelised Cost of Electricity (LCOE).
- Increasing CO_2 capture rate from 90% to 99% on coal and gas power stations could increase LCOE by as little as 7.4% and 6.2% respectively.
- CO_2 capture technologies are highly-upgradeable, meaning capture rate can be easily ramped-up over time in line with market conditions and an increasing CO_2 price.
- A 95% capture rate on gas power stations could increase LCOE by 1.6% compared with a 90% capture rate.
- An arbitrary 90% capture limit does not reflect the current status of CCS technology and is not an appropriate limit to use in energy systems models looking to achieve net zero emissions.
- EC models should include the option for rising capture rates and associated cost increases to show how capture rates in different climate and energy scenarios may increase over time as policy and economics evolve.
- Further studies should investigate high capture rates for other activities, including hydrogen production and energy-intensive industry processes. These are expected to result in similar cost reductions.

[1] IEAGHG, 2019. "Towards zero emissions CCS from power stations using higher capture rates or biomass", 2019/02.

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Table 1: Comparison of different post combustion capture rates for coal and natural gas fired power plants in percentage change compared to a 90% post combustion capture plant.

	Coal: Standard design		Coal: Optimised design	Natural Gas	
Capture Rate	95.0%	99.0%	99.7%	95.0%	99.0%
Net Power Output (MW)	-1.7%	-5.2%	-4.3%	-1.1%	-5.1%
LCOE (€/MWh)	+3.0%	+7.4%	+6.9%	+1.6%	+6.2%
CO_2 avoided cost (€/t CO_2)	+0.4%	+5.7%	+3.3%	-0.8%	+7.3%

Please find below comments on the Draft Technology Assumptions for the New EU Reference Scenarios, organised as per the available *E3M_PRIMES_tech_assumptions_ENERGY* document on the Commission website.

Domestic

Row #	Cell	Comment
N/A	N/A	Cost figures for hydrogen fuels appliances and heating should be added. Hydrogen will be one solution for heat decarbonisation which could play a major role in the future of EU domestic heating.

Power & Heat

Row #	Cell	Comment
N/A	N/A	Note that gas turbines can also run on hydrogen and should be included as low carbon option in the scenario development
23	E	The post combustion plant should be cell E23-E13 = 860 EUR/kW with 90% capture on kW = 0,282 g/kW thus the capture plant cost is equal to 350 EUR/per tCO2 per year

New Fuels

Row #	Cell	Comment
NEW	N/A	Hydrogen from natural gas autothermal reforming (ATR) centralised – large scale CCU (per 1 kW or 1 MWh HHV). Values: 600 | 550 | 500 | 24.0 | 22.0 | 20.0 | 1.20 | 1.05 | 1.06 | 1.14 | 1.05 | 1.13 Data from 2019 H21 North of England Report [2].

[2] https://www.h21.green/wp-content/uploads/2019/01/H21-NoE-PRINT-PDF-FINAL-1.pdf

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8 10	C, D C, D	Electrolyser will require site preparation, utilities, sub-stations etc similar to SMR facilities. These elements will have limited cost reduction potential and normally contributes to 150-200 EUR/kW output[3].
8	H	Efficiency of electrolysis must take into account cell degradation and cell replacement. It seems to be based on start-of-life operation.
21	A	It is assumed that "per 1 tCO2" is "per 1tCO2 per year" similar to row 51. Noting that the power plant with post combustion capture had an ultimate CAPEX of 350 EUR/tonnes with almost no significant cost reduction, it seems unrealistic that a similar technology for air (with 100 times lower CO2 concentration) has an ultimate cost which is just 30-40% higher than the post-combustion carbon capture on gas power generation
22	A	Absolute cost and cost curve seems too optimistic for a technology that inherently depends on partial pressure to drive the capture process
29 30	A A	Heat rate is missing from H_2 compression and liquefaction refuelling technologies
30	D	It is not realistic to see hydrogen liquefaction becoming cheaper than LNG noting the cooling temperatures and energy needs
45	A	For all technologies the distance and capacity plays a significant role in the cost
50	A	CO2 distribution by ship is missing (road transport of H_2 is considered). CO2 transport by ship will provide a key enabling transport mechanism for some CCS projects, particularly in the early deployment phase.
53	A	H_2 distribution by ship is missing (road transport of H_2 is considered)
66	B	Several studies indicates a cost 300 EUR/MWh for underground hydrogen storage in salt caverns[4]

[3] https://www.amprion.net/Dokumente/Dialog/Downloads/Studien/Studie-Sektorenkopplung/Study-Smart_Sector_Integration.pdf

[4] https://www.h21.green/wp-content/uploads/2019/01/H21-NoE-PRINT-PDF-FINAL-1.pdf

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