In January 2022 a report [1] entitled 'The limitations of hydrogen blending in the European gas grid' was published by the German institute, Fraunhofer IEE. The report was widely publicised in the UK broadsheets, and on first inspection paints a damning picture of the potential economic implications of introducing a hydrogen blend, up to 20 vol%, within the gas grid. Namely, an average increase in gas bills of 11.2% and 23.8% for domestic and industrial gas users, respectively. This review will unpack some of the central assumptions in the analysis and explore the relevance of those assumptions to the UK energy system. This is a critical step to understand the significance of the findings to any UK expectations - as with any economic assessment, the devil is always in the detail, and many devils have been uncovered.

The first assumption to unpack is the assumed price of hydrogen. This is clearly a central assumption in any study exploring hydrogen economics. The assumed price of hydrogen within the study is €170/MWh which corresponds to £145/MWh. The hidden assumption within this figure is the assumed hydrogen generation technology, which is taken to be electrolytic hydrogen production. This is a primary distinction between EU and UK hydrogen strategies. The EU is largely focused on only using electrolytic production, and therefore this assumption is valid within an EU context. The UK on the other hand is pursuing a 'twin-track' approach to hydrogen production [2], which relies upon both electrolytic and reformation with CCUS based hydrogen production.

The production technology of all of the Track-1 clusters [3] selected by HM Government is reformation with CCUS. Therefore, although the assumption of electrolytic production is relevant to an EU assessment, it simply isn't transferable to a UK assessment. The price of reformation-based hydrogen is the more relevant price to use for any UK assessment. Within the UK Hydrogen Strategy [2], this is expected to be circa £60/MWh. Therefore, the assumed hydrogen price within the study is almost 2.5 times the expected wholesale hydrogen price within the UK. The average increase in EU domestic gas prices calculated by the study was 11.2%, simply paying the additional assumed cost of the hydrogen accounts for 10.8% of this increase. In other words, over 95% of the difference in overall gas prices is based on an assumption that doesn't have relevance to the UK.

Alongside the price of hydrogen, the assumed constraints and subsequent investment requirements of gas users are the next tier of assumptions to unpack. The study contains a set of significantly conversative assumptions within this space. It is assumed that the vast majority of non-domestic gas users will either need to install de-blending facilities on site so they may continue to use natural gas, or install LPG-blending facilities on site to increase the calorific value (CV) of the blend. One such industry that is named as being sensitive to CV is glass production. A recent trial [4] at UK glass manufacturer Pilkington, who invented the modern-day float glass process in the 20th Century, has proven the ability to produce glass using a hydrogen blend with minimal operational changes, with no LPG blending facility in sight.

From a technical perspective, the heat delivery capacity of a gas is not governed by its CV, it is determined by the Wobbe of the gas. The acceptable natural gas Wobbe range in the UK, as currently stipulated by the Gas Safety (Management) Regulations [5], is 47.2 – 51.4 MJ/m^3. Hydrogen blending would be undertaken so the resultant blend would remain within this range, meaning no change to the accepted heat delivery capacity of the gas when compared to today. Therefore, the assumptions made on the implications for non-domestic gas users bears little resemblance to the UK, and should be viewed as representing the absolute boundary limit of conservativism.

Finally, the difference between domestic and industrial gas prices. The study concludes an increase of 23.8% for industrial gas users, relative to 11.2% for domestic gas users. Although alarming on first inspection, it is simply a function of the chosen statistics. The actual increase was found to be the same (0.746 ct/kWh), but within the EU industrial gas prices are around half of domestic gas prices [1], therefore the relative difference was found to be double. Within the UK [6,7] this difference is much less, where UK industrial gas users pay around 75% of the domestic gas price.

Given that the hydrogen price accounts for over 95% of the calculated economic implications, a more UK applicable assessment can be made simply on this basis. The average retail price of natural gas in 2020, based on Ofgem published figures [8], was 4.8 p/kWh. Where 40% of this was the wholesale price of gas and 60% were supplier and network charges. Blending hydrogen at 20 vol% would contribute 7% by energy. Therefore, using the more appropriate BEIS figure of 6 p/kWh (£60/MWh) yields an expectant retail price of 5.1 p/kWh. This is an increase of 6% for domestic and 8% for industrial gas users, which is markedly different to the 11% and 24% calculated by the study. By way of illustration, this increase amounts to £2.5/month for the average household.

The study undertaken may have greater significance for the EU, however it has little relevance to the UK, given the assumptions that have been used. The actual economic implications of blending are much more modest than the study would suggest, and must be seen alongside the benefits hydrogen blending offers. Such benefits include removing 6 million tonnes a year of CO2 emissions, which is equivalent to removing 2.5 million cars from the road, it is also greater than the total domestic gas emissions from Wales. In summary - you cannot judge an economic assessment on its conclusions, they must be judged on their assumptions.

[1] https://www.iee.fraunhofer.de/content/dam/iee/energiesystemtechnik/en/documents/Studies-Reports/FINAL_FraunhoferIEE_ShortStudy_H2_Blending_EU_ECF_Jan22.pdf

[2]https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1011283/UK-Hydrogen-Strategy_web.pdf

[3] Track-1 cluster

[4] https://www.sthelensstar.co.uk/news/19663566.pilkington-uk-trial-sees-whole-furnace-run-hydrogen-natural-gas/

[5] GSMR

[6] Prices of fuels purchased by non-domestic consumers in the UK, BEIS, 2022

[7] Average annual domestic gas bills by countries in Great Britain, BEIS, 2022

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