**How Steam Reforming Saved British Gas and Whether it Will Lead us to the Hydrogen Economy**

*Talk to Guilford U3A : 17th Dec 2020 ( Updated in 2021 and 2022)*

**Key Points and Conclusions**

British Gas was dying in the 1950s as the electricity price was falling compared to gas prices

**For a gas to compete, the delivered price to the domestic consumer, has to be, in energy terms, about a third of the electricity price or even lower.**

This situation applied to Town Gas – hydrogen will be no exception. Furthermore, hydrogen made by electrolysis, using wind power, has got to be more expensive than the electricity from which it is made.

**Steam Reforming of Natural Gas for Hydrogen Production**

It is suggested that a modified version of the steam reforming process will be able to produce hydrogen from natural gas.

Given natural gas costs of £14/MWh, **Grey hydrogen,** with **the CO2 being vented to atmosphere** will cost £40/MWh. Losses of energy in conversion amount to 31%

**Blue hydrogen, with the CO2 being captured and stored,** will be more expensive, probably around £50/MWh. And there will be further energy losses. Such energy losses imply that natural gas reserves are depleted faster.

Average British generating prices from CCGT stations are £50/MWh. This seems to put hydrogen in a weak position, hydrogen being so expensive.

NOTE : The figures above refer to the Pre-Covid and Pre-Ukraine Invasion situation. At the time of writing wholesale gas is at about £65/MWh. This would give a hydrogen price of around £100/MWh. Electricity prices have also jumped, but the overall effect is that the hydrogen/electricity price ratio is become more unfavourable.

**Electrolysis for Hydrogen Production**

Using electricity for wind or solar sources, this is genuinely sustainable. Unlike steam reforming with CCS.

However, conversion losses are 18%, out of the plant. Compressing the hydrogen to pipeline pressure, results in an overall loss of energy of 24%.

The combination of the capital costs of the electrolysis unit, and the cost of electricity, results in high hydrogen costs.

One estimate suggests that with a rather low electricity price of £24/MWh, the hydrogen price would be £42.5 MWh.

This suggests that hydrogen from electrolysis would not be competitive in the domestic market.

The best option for electrolysis would be to provide a feedstock for chemical plants, especially those which used oxygen and hydrogen, as in biofuel or SNG production from biomass.

A potential use for hydrogen would be as an energy storage medium to supply power plants to back up wind and solar- but there are technical issues.

**Hydrogen Uses and Challenges**

**Domestic Heating and Cooking**

Seems unrealistic given the likely price of hydrogen compared to electricity.

Burners would need to be converted.

Even partial conversions would be costly, whereby a boiler being offered today, running on natural gas, could subsequently be modified to accept a hydrogen burner. This is likely to be more costly than it looks, as a fitter would have to do the job, and wait around to ensure it works properly.

Gas meters and system pressures may have to be changed. All manpower intensive jobs.

I stand by my assessment of £2000/ household. Five times more than the cost of Smart Meters. Who would pay?

**Transport**

A potential use for hydrogen would be as an energy storage medium to supply power plants to back up wind and solar- but there are technical issues.

Hydrogen might be viable as a transport fuel, but seems restricted to large trucks, able to carry very high pressure cylinders.

**An Energy Storage Fuel for Backing Up Power Supplies in Low Wind Periods**

The British gas pipeline system is about 7500 km long, and runs at 70 bar. Internal diameter is about one metre. Roughly a cu metre of pipe volume per metre length

Power requirements are in the absence of wind energy high, we are dealing in GWh. Unfortunately at 70 bar 1 GWh of hydrogen energy requires 4049 real cu metres….About 5 km of pipeline length

However, pipelines would not run below 35 bar so only half the capacity can be used. 10 km would be needed. Furthermore, only 50% of the energy is turned into electric power so we would need 20 km of pipeline for each GWh.

**It implies that the pipeline system would only provide enough back up for about half a day’s operation at current consumption levels.**

New compressors would be needed to compress the hydrogen into the pipeline and push it through the system

**Fred Starr : 28th Dec 2020**