



ALL ABOUT HYDROGEN

Increasingly, we are hearing more about hydrogen as a fuel – what is going on?

1. What is it?

Hydrogen is a very light gas that will burn very well and release energy. When it burns, only water is produced. On a weight by weight basis, it contains about three times as much energy as North Sea gas (methane).

Hydrogen is not a greenhouse gas and does not occur naturally in the atmosphere, except in microscopic amounts. It is sometimes emitted as part of a volcanic eruption.

2. What are ‘colours’ of hydrogen we read about?

The ‘colour’ of the hydrogen relates to how it is produced – the hydrogen at the end of the process is always the same

GREEN hydrogen is produced by ELECTROLYSIS. Put simply, an electric current is passed through ordinary water resulting in the production of oxygen (usually released into the atmosphere) and hydrogen. Apart from a small amount of heat, there are no other waste products. Of course, you have to know how the electricity is produced; to be strictly GREEN, the electricity has to come from renewable sources.

Hydrogen can be produced by a chemical reaction that breaks down North Sea gas into hydrogen and carbon dioxide. If this carbon dioxide is then captured and stored, the hydrogen produced is termed ‘BLUE’; if the carbon dioxide is released into the atmosphere it is termed ‘GREY’.

3. What is the connection to ammonia?

Hydrogen can be combined with nitrogen from the atmosphere in a chemical reaction to produce ammonia. This is easier to liquefy and transport to the destination (e.g. by shipping) where another reaction breaks the ammonia back down into hydrogen for use and nitrogen (put back into the atmosphere). Nitrogen is not a greenhouse gas. The processes and systems for this are well-developed as they have been used by the chemical fertiliser industry for many years.

4. How is hydrogen used as a fuel?

- a) Hydrogen can be used as a ‘burning’ fuel in its own right, just like North Sea or LPG gas. It burns more hotly than either, however, so specialised burners are required. If pure hydrogen were used as a domestic fuel in a normal household the burner system would need to be replaced. There are dual-mode burners available for installation.
- b) Hydrogen can be mixed with North Sea gas up to about 15% by volume, transported by the current gas piped network and burnt in a current normal domestic system. This reduces (by about 10%) the carbon dioxide emissions produced by the boiler.
- c) Hydrogen can, in principle, be used as an alternative to petrol and diesel. Some manufacturers are producing engines (modified from existing petrol/diesel power plants) to do this.
- d) Hydrogen and oxygen together can provide the input for a ‘fuel cell’. A fuel cell is used like a battery. It is not charged, but uses a flow of oxygen and hydrogen to produce electricity (so it

is rather like electrolysis reversed.) Fuel cells are powerful, safe, very efficient and well-understood. They have been used in space probes and manned space vehicles (such as the Apollo programme and the current space station) for the last 50 years and are often found where large electric currents are required.

5. What are the issues?

Hydrogen as a fuel is a relatively new concept. Leaving aside the economic discussion:

a) Pure hydrogen domestic heating systems are being tried on a 'town' scale in Europe, but there are no national programmes. Were the UK to adopt this, there would have to be a big changeover process 'overnight'.

There are also issues about the pipes and valves of the gas network. Hydrogen molecules are 'smaller' than North Sea gas and can leak through much smaller holes and defects. Also, hydrogen has the potential to modify the crystal structure of steel and iron, thus possibly accelerating fatigue failure of pipes. This is still being researched. The blue and yellow plastic gas pipes being installed do not have this problem.

b) As hydrogen has a hotter flame than North Sea gas, when it burns it may produce more NO_x material. This may be an issue that requires resolution and is still under investigation. Hydrogen can be used as a fuel in catalytic burners that do not produce a flame, but these are expensive.

c) Hydrogen is held in tanks at high pressure to be distributed and stored. For vehicle use, it is stored at 700 bar. The safety systems around this are well understood. For instance, the Metropolitan Police use hydrogen-fuelled patrol cars at their base at Heathrow airport, so is clearly considered safe for that purpose.