**Why hydrogen is not the solution for home heating**

**A couple of years ago I set up a very makeshift little experiment in my back garden to demonstrate the relatively straightforward process of producing hydrogen gas from water via electrolysis. It wasn’t the most mind-blowingly exciting demonstration of the concept to be completely honest, but we did get a little pop at the end to prove that we had indeed liberated a very small amount of the explosive gas.**

**There was an awful lot of media hype around hydrogen at the time, and there still is today to be honest. Some of the more enthusiastic proponents are backing hydrogen as a potentially major player in the race towards net zero. Australia’s richest men, Andrew Forrest, has set up a company called Fortescue Future Industries which he says will be making fifteen million tonnes of green hydrogen per year by twenty thirty using the cheap and abundant renewable power generation that is being rapidly rolled out in places like Western Australia. And there are several revenue streams that Forrest believes he can tap into. Hydrogen has the potential to be used as a fuel for large scale transport like buses, trains, trucks, ships, and even planes. It can also be converted into ammonia, which is far safer and easier to transport, and which can serve as a long-term energy storage medium. About a hundred and eighty million tonnes of ammonia is already produced globally today, and about eighty percent of that is used to make fertilizer for the worlds vast agricultural industry.**

**So, there’s definitely some useful stuff that can be done with hydrogen. In fact, the investment bank Goldman Sachs estimates that green hydrogen will become a twelve trillion-dollar industry by twenty fifty.**

**But according to a leading energy expert called Jan Rosenow, one of the things we shouldn’t be using Hydrogen for is replacing natural gas in domestic home heating systems.**

**So, why’s that then?**

**Hello and welcome to Just Have a Think,**

**Jan Rosenow is Director of European Programmes at the Regulatory Assistance Project, which is a non-profit energy expert organisation working in Europe, the US, China and India. They cover a range of topics from the design and regulation of energy networks, through to end products like building energy and transport electrification. And they take a holistic systems approach to establish best overall solutions, rather than looking at single solutions in isolation.**

**I caught up with Jan via Zoom recently to discuss his findings and to understand more about the implications for the future of home heating.**

**[QUOTE FROM ZOOM CALL]…**

***“The main reason why using green hydrogen, and I’m talking about green hydrogen here not blue, for heating is challenging is the fact that it is terribly inefficient to do that. 2:51 Because you convert electricity 2:53 into hydrogen 2:54 and then hydrogen 2:56 into heat, you lose a lot of electricity along the way – energy along the way.3:05 In comparison to a heat pump, that’s very important. So, you need five to six times more electricity compared to a heat pump when you use green hydrogen for heating”.***

**Jan spent the last two years combing through no fewer than eighteen separate independent industry reports looking at the feasibility of hydrogen in domestic heating systems.**

**Now it’d be a pretty dull couple of minutes if I had to read out the title of every single one of them, especially as some of them are in German which is definitely not my forte! But I’ll leave a link to each of them in the YouTube comments section below this video.**

**Every one of them pretty much rules out hydrogen as a major source of heating in buildings. The IEA projects that hydrogen would account for less than two percent of building decarbonisation by 2050. The IPCCs Climate Mitigation Report shows pretty much zero hydrogen in its future space heating scenarios. McKinsey came to a very similar conclusion in their 2050 projections for space heating, and market analyst Michael Liebreich offers what he describes as the Clean Hydrogen Ladder, showing all of the possible uses of hydrogen, ranging from “uncompetitive” on the bottom rung, all the way up to “unavoidable” on the top step. On this scale, hydrogen for domestic heating only makes it to rung number two.**

**You could use so-called blue hydrogen instead. That’s hydrogen derived by bombarding fossil gas with high pressure steam until it relinquishes its hydrogen content. The process also produces vast quantities of carbon dioxide, which would have to be captured and buried somewhere permanently, like under the North Sea for example, which is a project currently under development today. But according to analysis by another industry expert, Mark Jacobson, deriving hydrogen this way uses more methane per unit of heat than simply burning the gas in the first place, so it’s hardly a low carbon option. And if you want to know more detail about that study, I made a video all about it last year, which you can jump back to by clicking up there.**

**Here in the UK, about 1.7 million old gas boilers are swapped out for new units every year. The existing heating industry argues that if they were all replaced with ‘hydrogen ready’ boilers, at more or less the same cost as a gas boiler, then in ten years’ time we’d have 17 million homes ready to receive hydrogen gas, which is about two thirds of the total housing stock in the UK.** **Hydrogen ready boilers are gas boilers. There’s effectively no difference. If you buy a hydrogen ready boiler today it will be set up to run on fossil methane gas. In future, in theory, they could be converted to accommodate hydrogen gas by swapping out two or three small components. For boiler manufacturers, moving to mass production of other technologies, like air source heat pumps for example, would be disruptive and expensive, so naturally those companies are strong advocates of hydrogen for home heating.**

**The research papers highlight several obstacles to this idea though. The pipework in many homes is now extremely old and already quite leaky. Hydrogen is a very-small molecule. In fact, it’s the smallest and simplest molecule in nature and it’s notorious for its ability to escape from containment vessels. It also has a tendency to embrittle metal containment walls, making pipework and joints more prone to failure, with the consequent safety issues that this brings, especially when using a gas that’s significantly more explosive than methane.**

***“And there’s a cost also to converting the gas grid. It’s not ready for hydrogen. I mean the gas network operators will say that large parts of the gas grid is ready because it’s been retrofitted over the years, but there’s still a huge cost, I think there’s a study by Element Energy suggesting that it’s £22 bn or something, the cost of upgrading the gas grid. So there’s still issues, even if we ignore the cost, there’s still work that needs to be done to even technically make this possible.”***

**In fact, all the reports that Jan Rosenow looked at found that it would be vastly more expensive in the long run to implement green hydrogen for home heating than it would be to install heat pumps at scale. European countries like Sweden, Germany and the Netherlands also have very strong lobby groups who have a vested interest in maintaining the production of gas, or at least retaining the valuable pipeline network that’s already in place for gas delivery. But despite that pressure, governments in those countries understand the overall cost benefits of heat pumps, and in general they’re focussed far more on that technology for home heating than they are on hydrogen.**

**There is no zero-cost option for decarbonisation though. Accommodating millions of heat pumps would require costly upgrades to electricity grids. But in relative terms, on the macro level, all the analysis that Jan Rosenow and his team looked at finds that it would be far costlier to build out 5 or 6 times time more renewable power to compensate for the inefficiency of hydrogen production than it would be to upgrade the grid for heat pumps, which can deliver between 3 and 5 units of heat for every unit of electricity.**

**I’ve got an air source heat pump providing heating and hot water for my one hundred year old 3 bedroom house with three adult occupants, and it works beautifully. And contrary to some of the scare stories you might have read or watched in the media, I didn’t have to rip out all my radiators and pipework, or install costly underfloor heating. I changed one radiator and moved my fridge to make way for a water cylinder in a cupboard in my kitchen, and that was it.**

**But heat pumps are not cheap to buy in the first place, there’s no denying that. Government funding for heat pumps, via tax incentives, grants and loans, will be an important factor in how well they are rolled out, as Jan Rosenow explained.**

**[QUOTE FROM ZOOM CALL]…**

***“Denmark, for example, Sweden the Netherlands are all countries that have changed the way they allocate taxes and levies on energy prices that customers pay, to make heat pumps more attractive, even after you take into account the upfront costs. So, it’s just a more economic decision to make over the lifetime of the appliance to go for the heat pump. In the UK it’s the opposite. We’ve actually built in incentives that discourage heat pumps. The subsidy that is needed to make a difference, needs to be fairly significant”***

**One of the UKs leading energy providers, Octopus Energy has recognised this shortcoming in UK government policy and now provides its own incentive to new customers, offering heat pumps for most suitable UK homes at a fully installed cost of between £3,000 and £4,000 after the government grant of £5,000 has been awarded. That’s getting pretty close to the price you’d pay to fully replace a gas combi boiler.**

**Jan Rosenow and his team calculated that by 2030 it would cost the UK government only about £3 billion to provide 100% grants for all low income households to be fitted with a heat pump, enabling the UK to meet the decarbonisation goals set out by the Climate Change Committee.**

**In turn, that incentive would drive volume into the industry, which of course would then bring the costs of heat pumps right down, at which point the government subsidy could be phased out.**

**The Inflation Reduction Act that finally passed through the US senate in August 2022 includes the provision of $9 billion in total energy rebates for American households, including up to $8,000 for the installation of heat pumps that can heat and cool homes, plus a $1,750 rebate for a heat pump water heater and up to $4,000 to upgrade the main electrical fuse board. Jamal Lewis from the organisation Rewiring America said**

**"A household with an efficient electric heat pump for space heating and cooling, a heat pump water heater, one electric vehicle and solar panels would save $1,800 a year."**

**There are other electric solutions to look at as well, like this thermal mass storage unit called the ZEB or Zero Emissions Boiler, from a company called Tepeo, which may be a great solution for homes that have a limited amount of space and can’t accommodate a full heat pump installation. It’s about the size of an undercounter fridge. The ZEB can be charged up using cheap off-peak electricity during the night and discharged during the day to provide heating and hot water for the home.**

**Of course, the real elephant in the room is the fact that our governments should really be spending big money to upgrade existing housing stock so that homes are properly insulated in the first place. Right now, in the UK, many developers are still building new homes with very poor insulation and energy efficiency and, in most cases, they’re still installing gas combi boilers too. Those developers know perfectly well that those homes will eventually have to be retrofitted at a much higher cost to householder.**

**How we heat our homes in the future is arguably one of the most contentious issues of the entire green transition debate. It’s impossible to cover every angle in a short video like this, so no doubt there will be points that I’ve missed that you feel should be aired. If you do then, as always, the place to do that is in the comments section below.**

**That’s it for this week though.**

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**As always, thanks very much for watching, have a great week, and remember to Just Have a Think.
See you next week**