Getting to Net Zero for net zero technologies sessions for speakers to complete Trusts

Q&A 31st August 2023

No	Trust Member	Question	Answer
1	Justine Alford	Is this only suitable for large sites?	**Stuart McKnight** Our systems are the size of shipping container and can offer amounts of H2 to as low as 150kW or 3,940kWh/day, which should suit small applications too. **Sandy Arbuthnott** HiiROC systems are similarly sized – our basic 4-torch unit is capable of producing ~180-350kg per day (6,000-11,500kWh), but smaller configurations are also possible
2	Donnelly Callum (R0A) Manchester University NHS Foundation Trust (External)	what is 1000kg of hydrogen in kWh terms?	**Stuart McKnight** 1 tonne of H2 = 1.6MW or 39,400kWh
3	Matthew Gitsham (External)	What is the turn down of the unit? How would it deal with summer 40kW and winter 400kW?	**Stuart McKnight** Our system has a low temp process so we can turn it on and off relatively easily although it will be more efficient if run consistently. **Sandy Arbuthnott** Likewise – each torch has a turndown ratio of 50% whilst live, and further turndown can be achieved by switching torches off
4	Richard Harper (Guest)	if the government plans to inject hydrogen into the gas grid ramps up, how does that affect a plant like this?	**Stuart McKnight** No impact at all - the H2 will pass straight through the system.
5	PERCIVAL, Alexis	Can we address the elephant in the room please? Methane is still a fossil fuel and if from the fossil industry it is an element of green washing. This is a form of brown hydrogen	**Stuart McKnight** There is no green washing here. We are decarbonising the methane - removing all the Carbon and locking it in solid form for use in

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		here. How do you anticipate getting around this with a reduction of methane availability in the longer term?	"real" products - not burying CO2. We can also use biomethane as a renewal source of methane too - so there is a very positive environmental case in the technology. **Sandy Arbuthnott** –We have to start from where we are rather than where we would like to be. The most pressing problem we have to solve is carbon emissions, not fossil fuel use per se – and TPE/pyrolysis technology offers us a means to eliminate the emissions from the fossil-based energy system we are dependent on, today, and sequester the carbon in useful products. It will also displace harmful emissions from existing carbon black manufacturing, and enable reduced lifecycle emissions in other value chains such as cement (through addition of clean carbon black). As the world eventually moves away from fossil fuels, TPE/pyrolysis technology can be used indefinitely to remove CO2 from the atmosphere through sequestering biogenic carbon – more efficiently and cheaply than emerging technologies such as Direct Air Capture. There's no single solution to the climate crisis – it will take a wide range of technologies deployed at scale, and we see TPE/pyrolysis as a vital bridge to a genuinely net zero economy
6	Justine Alford (Guest)	What are the costs compared with do nothing (still use gas), and heat pumps? Presumably this increases your costs because you still purchase gas, and then use additional	**Stuart McKnight** As with all new operational equipment, there are capital and operating costs. These will vary from site to site so I cannot simply

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		electricity for generation. And are therefore subject to price volatility/energy insecurity etc	answer this. However, we are actively looking at "H2 as a service" models for NHS Trusts which, if possible, will change to the profile of costs significantly. **Sandy Arbuthnott** The right solution for a particular site will depend on a wide range of factors – from the condition of the existing built environment through to availability of on-site or local renewables and many factors in between. We are confident that in many cases, TPE/pyrolysis technology will be the right fit.
7	Karl Fleetwood (Guest)	and what about the safety of a tank of hydrogen in a 'carpark'?	**Oliver Evans** - Storage of hydrogen in the volumes in discussion, typically less than 5 tonnes, can be achieved safely and falls below the threshold for COMAH
8	Chubb, Miranda (External)	NHS Standard Contract Service Conditions 18.3.1.2 states that we need to take action to phase out fossil fuels for primary heating and replace them with less polluting alternatives. As Alexis highlighted, this is still use of a fossil fuel.	**Stuart McKnight –** methane pyrolysis uses natural gas (or bio gas) as a **feed stock not as a fuel**. We do not burn or combust this feed stock, only convert it to Hydrogen which produces no pollution only water when used for "primary heating". Any Trust that uses H2 from methane pyrolysis will not be using a fossil fuel for heating just Hydrogen. This is not a nuance but reflects an entirely different chemical process. When the direct and indirect CO2 emissions are combined, methane pyrolysis does not just zeros emissions from existing gas burners but also results in significant reductions in CO2 emissions for the environment as a whole. We estimate a full scale Suiso Box could reduce Carbon Black production CO2 emissions by 3,000 tonnes/annum. **Sandy Arbuthnott** – agree with above, there is no combustion of fossil fuels here. The gas grid is

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			used as a highly efficient way of transporting energy to hospitals without any additional CAPEX, where it is processed into hydrogen - there is no carbon entering the atmosphere **Clive Nattrass** – very many sites in the NHS have no alternative routes to net zero. I am sure that the Standard service contract did not consider local decarbonisation of gas, something that the government are backing on many levels. I will seek advice on updating the document. Thanks for pointing out the issue
9	Matthew Gitsham (External)	Will anyone develop a dual fuel hydrogen/diesel boiler? If not then hydrogen can never be used in a hospital 8 days of hydrogen would be needed	**Oliver Evans** – Understanding that this is due to resilience, if hydrogen can be stored on site rather than diesel fuel to meet reliance needs, would diesel backup be required? Understood, it would be interesting to compare the cost and footprint of 8d H2 storage Vs diesel, and the costs of backup diesel gensets, dual fuel boilers, fuel management etc. Clive Nattrass – yes boiler manufacturers are allowing for boilers to have a backup fuel.
10	Anthony Tabor (External)	what is the cost differential between H2 ready CHP and conventional?	**Oliver Evans** – If purchased as H2 ready then the cost impact is minimal, to achieve “dual fuel” ie in-unit blending or the ability to switch under load between CH4 and H2, its typically 15% additional product cost
11	Anthony Tabor (External)	How was the solar farm funded – is it PPA or SALIX for example?	Clive Nattrass – the NHS now has several solar farms, and more under consideration. PPA models are common, and existing installations have used Salix funding where possible.
12	IONA, Tatiana (GLOUCESTERSHIRE	Additionally to the reliance on natural gas (with the geopolitical aspect of that), what about the actual demand	**Stuart McKnight** As I mentioned above, most good methane pyrolysis technologies can run on

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	HOSPITALS NHS FOUNDATION TRUST) (Guest)	of carbon black in the UK? Have you got some figures of how much volume the tire & rubber industry can absorb? With potentially many Trusts (and other institutions) producing a couple of tonnes a day each, the current price of carbon black might drop significantly. (if it can all be absorbed by the tire industry at all). Also, being a possible carcinogenic dust, what H&S measures will be required for its storage and what would be the cost of daily disposal of several tonnes a day from a hospital?	biomethane and not just natural gas so there are options. On Carbon Black, this is a $20bn global market. We will have a premium – emission free – product – so do not anticipate any major issue on demand for it. On Safety, we expect the Carbon Black produced by a Suiso generator will be contained in secure drums or equivalents. There will be no leakage risk or health issues associated with it. In addition there will be no costs for disposal, as the Carbon will be collected, processed and sold by Suiso. Income generated by this will be offset against the cost of the Natural Gas feedstock. Methane pyrolysis systems have no waste and make full economic use of its input materials in a safe way. **Sandy Arbuthnott** Agree with all the above. The only thing I would add is that an abundant supply of clean carbon black is expected to lead to new use cases which would also reduce emissions – e.g. in building materials, agrifeeds or even as a means of energy storage in concrete!
13	Bruce, Robin	Are there viable hydrogen boilers available and are these the same size as existing boilers?	**Oliver Evans** - Yes, these are readily available. There are several manufacturers of hydrogen boilers on the market, a quick google search will return known brands
14	Pitman Alex	What evidence is showing that H2 is easier than a heat pump?	**Anthony Tabor (External)** - its just a financial calculation ASHP vs H2 pyrolysis if own solar farm is not viable.
15	Katharine McCormick (Guest)	Are there sufficient engineers to deliver at scale over the next 10 years? What about changes needed to maintenance?	**Stuart McKnight** – on the basis of incoming enquiries we are receiving, we anticipate no shortage of “good” engineers to work on our

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			projects. On these systems, all requirements for maintenance and operational staff will be provided and managed by Suiso.
16	Chubb, Miranda (External)	What about the emissions from the Methane production?	**Stuart McKnight** – there are various "standard" figures that are quoted to us about the carbon intensity of natural gas production and transport/distribution. These vary from 0.25kgCO2/kgH2 and 1.3kgCO2/kgH2 for Hydrogen produced by on site pyrolysis of Natural Gas. We acknowledge this not zero but unless the energy is produced by onsite renewables (wind, solar, etc) it is very difficult to avoid completely. **Sandy Arbuthnott** – also worth noting that upstream and fugitive emissions associated with natural gas production and distribution are an increasing focus for governments, regulators and companies, and one of the 'lowest hanging fruit' to decarbonise the existing energy system – we therefore expect them to reduce rapidly over the next few years
17	Justine Alford (Guest)	Will the Iheem workshops offer bespoke support for individual Trusts to come up with decarb plans?	Clive Nattrass – the NHPower collaboration exists to allow Trusts to support each other so that we minimise repeated work. We will share what people share through us. We are also developing plans to match make between Trusts who need professional help, and the best people to provide that help