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Net Zero

- By 2050 UK emissions must reach net zero.
- Renewable energy sources need to reach around 57 % of our energy

eStorage

- Intermittent renewable energy long-term necessitates energy storage.
- Chemical storage in hydrogen

Metallic Hydrogen

- Densest form of solid hydrogen a supremely compact way to store clean fuel.
- Conducts electricity with <u>zero resistance</u> at

Pressure

- Metallic hydrogen is formed at very high pressures – close to the centre of a planet!
- Energy intense and currently

production.

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• Transition to hydrogen as a nonpolluting alternative to fossil fuels.

requires bulky pressurised gas tanks.

• Need compact and safe energy storage.

room temperature (a superconductor!).

• Renewable electricity could be stored in superconductive rings with no power loss. impractical to produce...

• Need an alternative way to reach solid densities at lower pressures and higher temperatures.

Density of hydrogen could be increased by confining in porous carbon sponges

DENSE HYDROGEN Via NANOCONFINEMENT

Previous experimentation indicates that confining hydrogen in very small carbon pores produces solid-like densities at pressures ~2000 times lower than classically observed!

"Route to Room Temperature Superconductivity"

Using nanoconfinement as a 'pre-densification' step and the application of additional pressure, may allow us to create metallic hydrogen at significantly lower pressures than the centre of a planet.

1) Proof of Principle – It is Solid!

- Neutron Diffraction reveals structural information of a material as well as definitive proof of its state.
- Our recent studies show for the first time, the crystal structures of nanoconfined hydrogen - fully confirming that dense-solid hydrogen does form in carbon sponges. Furthermore, we observe them at temperatures never seen previously.

2) Zero Resistance

• Electrical resistivity measurements can identify a switch to





superconductivity but also can identify changes in state.

• Low pressure results observed a drop in resistivity upon densification, signifying a switch in the hydrogen's state.

What does this mean?

- Solid hydrogen = more hydrogen = **compact fuel storage**.
- Lower pressures and higher temperatures = **safer storage**.
- Results so far are promising for the next stage of the project: increasing the pressure to find a low energy route to room temperature superconductivity...



Next Steps: Building Pressure Construction of high pressure experimental apparatus







