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Storage

One of the biggest hurdles facing the establishment of a hydrogen economy is the issue of storing hydrogen in a safe, compact, reliable and cost effective manner. For stationary storage in industrial applications, space is not as important as in mobile applications since the system is not limited to the volume constraints of a vehicle.

In 1874, Jules Verne realised that fossil fuels were a finite resource and stated that "water will be the coal of the future" and manufacturing hydrogen from water could be a solution. The idea of producing hydrogen in this manner seems attractive considering the vast supply of water. Combining a renewable energy source, such as wind or solar, with an electrolyser could produce and store hydrogen which could be later used as a backup supply to help overcome intermittency in the electrical grid.

Hydrogen can be stored onsite at the point of production as compressed gas, as liquid or chemically in a solid-state storage medium. From the point of production, it can utilise existing pipeline infrastructure for the delivery of natural gas.

A common method of storing hydrogen is in compressed gas form pressurised inside a tank anywhere between 35 and 70 MPa (Megapascals). Increasing the storage pressure would improve the energy density resulting in a smaller tank but a much heavier system. A major drawback for this mode of storage is the size and weight issue of a compressed tank making it an unattractive option for mobile applications.

Hydrogen can also be stored in the liquid state under cryogenic conditions. Currently, a hybrid system, named cryo-compression, is being developed that provides a pressure vessel containing very cold hydrogen gas compressed at 30 MPa and cooled at minus 200°C.

Novel methods involve storing hydrogen either physically or chemically within select materials. Hydrogen can be stored on the surface of a material through adsorption, either in molecular or monatomic form. Hydrogen can also dissociate into its atoms, absorb into a solid material and be stored in the crystal lattice such as in metal hydrides. Metal hydrides form when certain metals react with hydrogen gas. The most useful metal hydrides react at room temperature.

Hydrogen can also be stored in large quantities underground in caverns, salt domes and depleted oil and gas fields. There are many storage sites across the globe such as the ICI salt cavern in Teesside, England.

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In the last two decades, billions of cubic metres of hydrogen have been in intermediate storage before transportation for use in the chemical and aerospace industry. Germany, the United States, Japan and Italy have an established pipeline network for the delivery of hydrogen for industrial applications.

Links to additional resources for this topic				
Storage Student Powerpoint	Storage Extra Information for Teachers	Storage Case Study - Linde	Storage Official Document Horizon	Kahoot Quiz

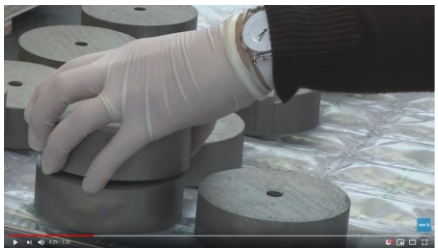
Storage videos with description

Storage - Animation of a hydrogen engine – 3.19 - Silent

https://www.youtube.com/watch?v=LjWCXD4P3XQ

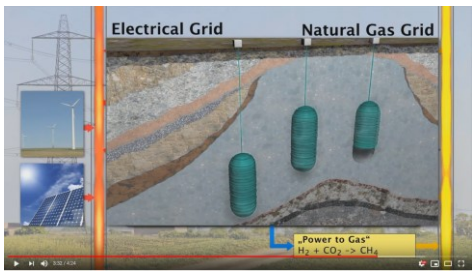
Storage - Video of how to store hydrogen in a solid form- metal hydride – 2.26 – French

https://www.youtube.com/watch?v=G0clQNJoqA0



Storage - Video for why we need to store excess hydrogen – 4.24 - English

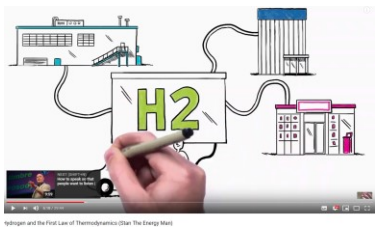
https://www.youtube.com/watch?v=c2yraQkMsJs



Storage - Hydrogen and the 1st law of Thermodynamics 29.44 English with all language subtitles

5.47-7.37 good animation then storage company adverts

https://youtu.be/Ot_4luMNKcg



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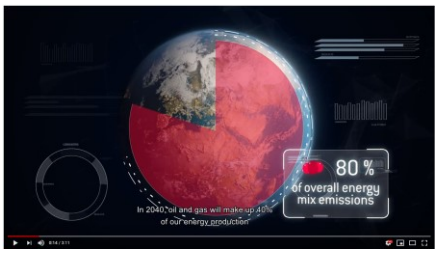
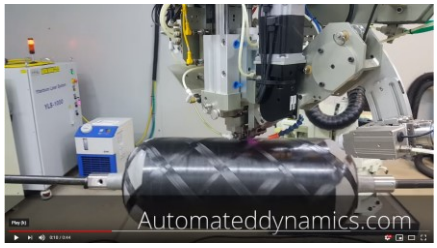
Storage – CCUS How it works – 3.11 – English

https://youtu.be/HSvWrjviqZM



Pressure tank overwind 0.44 - Silent

https://youtu.be/Jti0EiQkyfg



Storage animation 3.08 - English

https://youtu.be/xPZkjNQAC_g