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TEXAS IS AN ENERGY STATE DOES THAT INCLUDE HYDROGEN?

An overview of hydrogen in the Lone Star State

JOSHUA RHODES, PHD

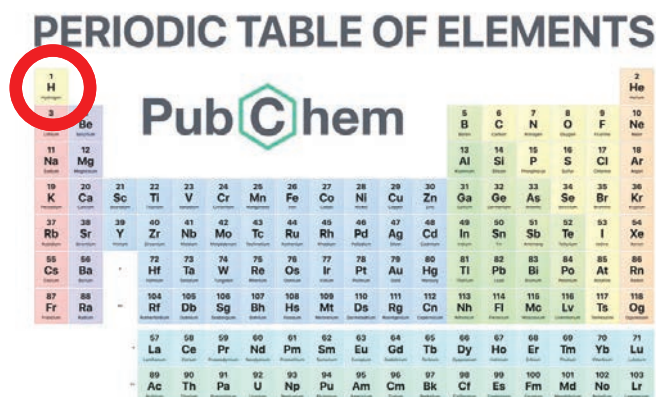
Research Fellow/Adjunct Professor, The University of Texas at Austin
Managing Partner, IdeaSmiths LLC

But first, what is hydrogen?

- Hydrogen, **H**, is a colorless, odorless, nonmetallic, tasteless, highly flammable gas.
- In general, hydrogen gas comes in pairs: H_2
- Hydrogen is generally discussed in mass terms
 - kg or metric ton (1,000 kg)

PERIODIC TABLE OF ELEMENTS

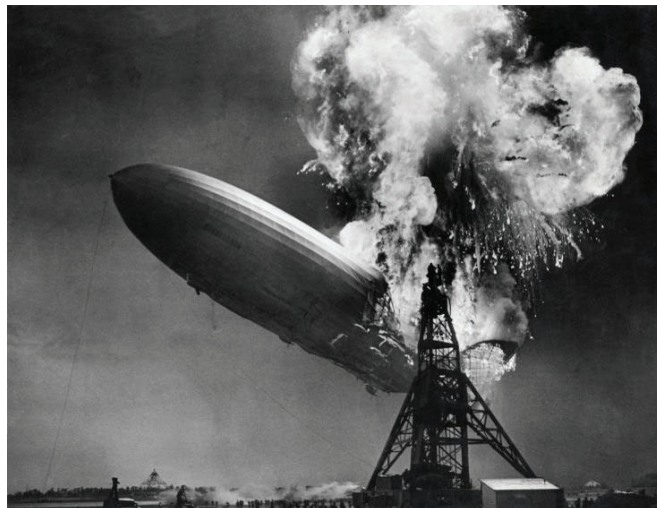
PubChem



<https://pubchem.ncbi.nlm.nih.gov/periodic-table/>

Hydrogen is flammable and has had some disasters

- Hindenburg Zeppelin
 - May 6, 1937,
Manchester, NJ
 - 36 deaths
 - Cause still debated



Hydrogen is interesting for several reasons

- Advantages
 - The lightest and most abundant chemical element in the universe
 - Colorless, odorless gas
 - Low density
 - Carbon-free
 - Easy to use
 - It has a high energy density
 - More than twice as energy dense as natural gas per kg

Hydrogen has tradeoffs

- Disadvantages: Difficult to make, move and store
 - Make: Usually manufactured from other sources (hydrocarbons, water,...), which requires energy and money
 - Move: Low density means large volumes must be moved for equivalent energy
 - Store: Small molecular cross-section means it easily leaks out of storage
- There is no real “natural source” on this planet where hydrogen can be mined
- On a volumetric basis
 - $\sim 1/3$ as much energy as natural gas per cubic foot

Hydrogen is easy to use as a fuel and building block

- Thermochemical: make heat to make motion to make power
 - Gas turbines
 - Internal combustion engines
- Electrochemical: make electrons
 - Fuel cells
- Chemical: make useful materials or fuels
 - A building block or process chemical

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"Texas is an energy state — does that include Hydrogen? "