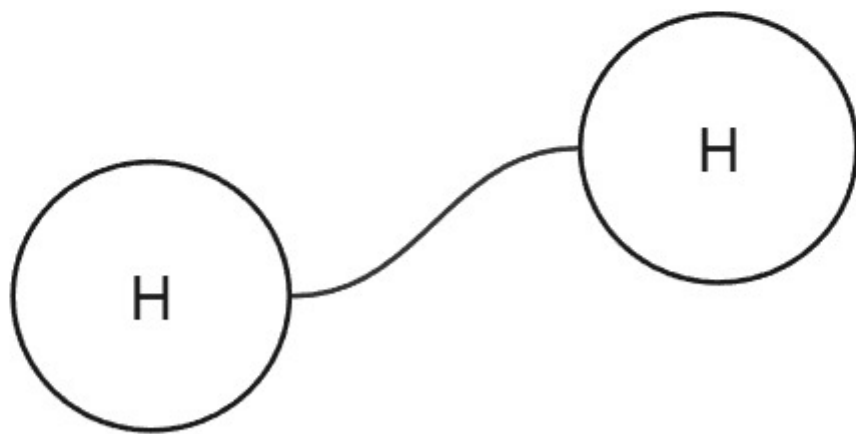


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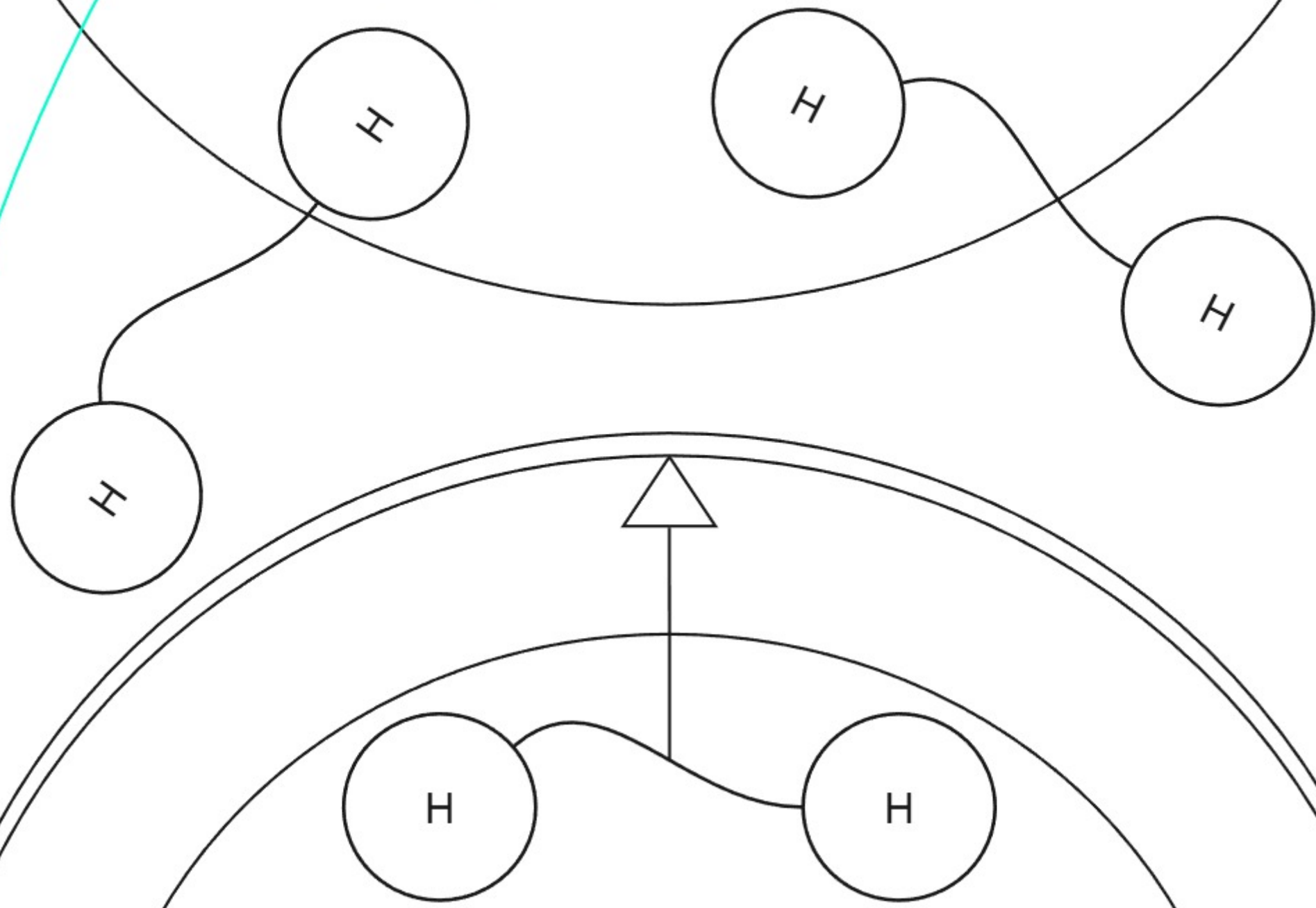
FINE CLIMATE CONSULTING

Natural hydrogen (NatH₂): A new high-potential candidate?
Initial assessment for decision-making

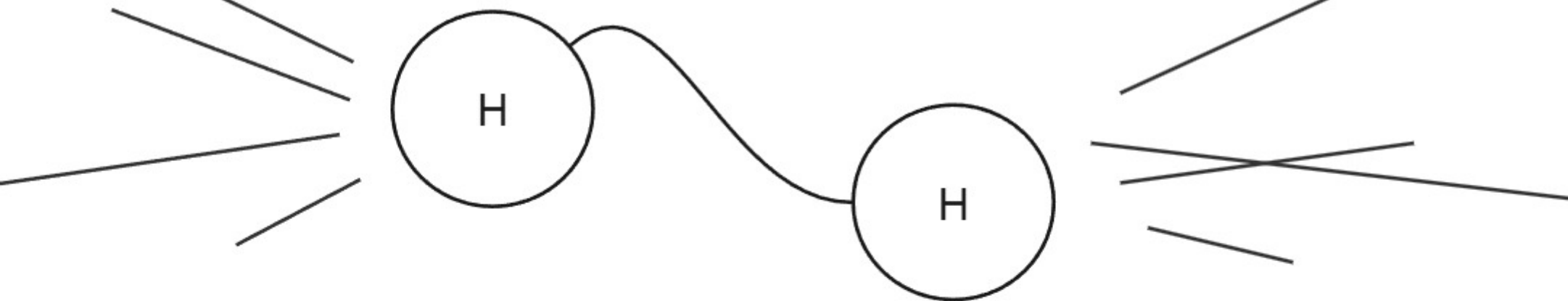


Hydrogen is the ultimate universal element. It is responsible for the Big Bang and the creation of stars, and it is the most abundant element in the universe. However, this is not the case on Earth. Released through complex processes in the Earth's interior, hydrogen is highly reactive on its way to the surface and readily builds chemical compounds. This results in the formation of water or methane, the main component of natural gas, as well as numerous other compositions. This natural hydrogen is, so to speak, consumed for life on Earth. With the substances produced above and below ground, it is part of the earth's metabolism. The following assessment is based on very early research.

Hydrogen, the universal element

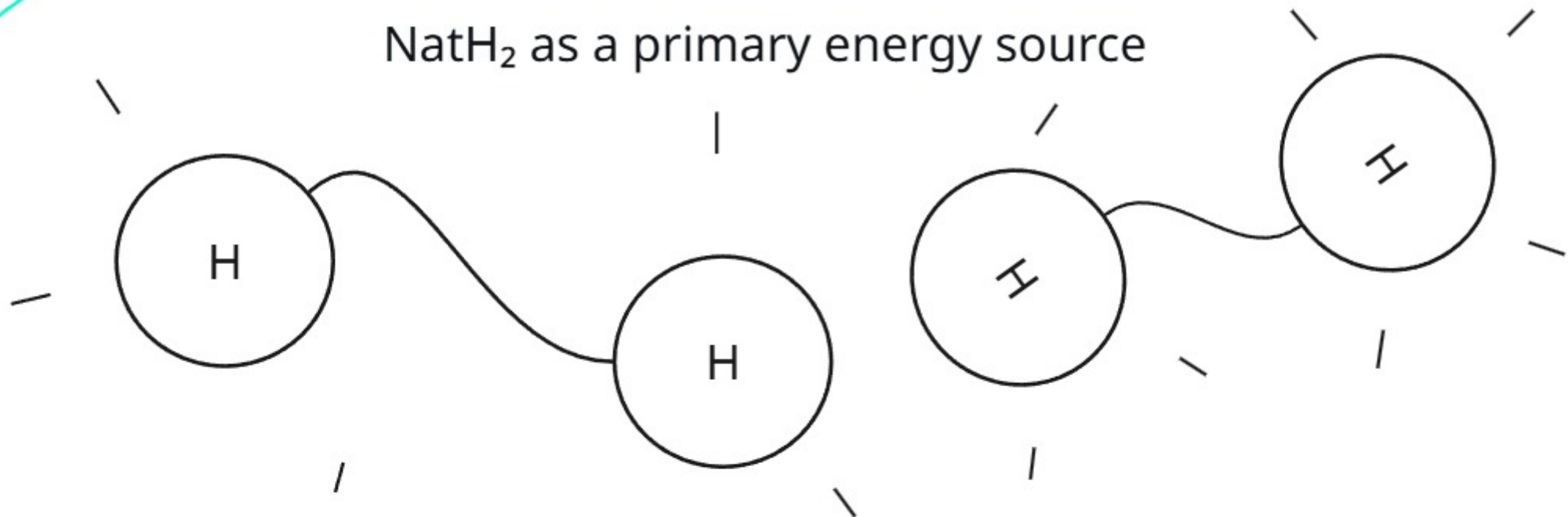


The Mali hydrogen



When drilling in Mali accidentally encountered an occurrence in a 98% purity (!), it attracted the attention of energy researchers. It has been characterised as a free gas present in the upper rock strata, such as carbonates. But classifying the possible sources remains challenging. The element itself has the highest gravimetric energy density of all known fuels. Natural hydrogen of this quality could be a primary energy source without any emissions.

NatH_2 as a primary energy source



NatH_2 is released through complex geochemical processes in the Earth's interior. The reaction of rock with iron(II)-rich minerals and water is currently considered the most likely cause of its deposit forming. Alternative explanations include radiolysis and deep degassing. Geoscientists have examined historical findings and are now conducting basic research to identify areas with potential.

Occurrences: History and Present Day

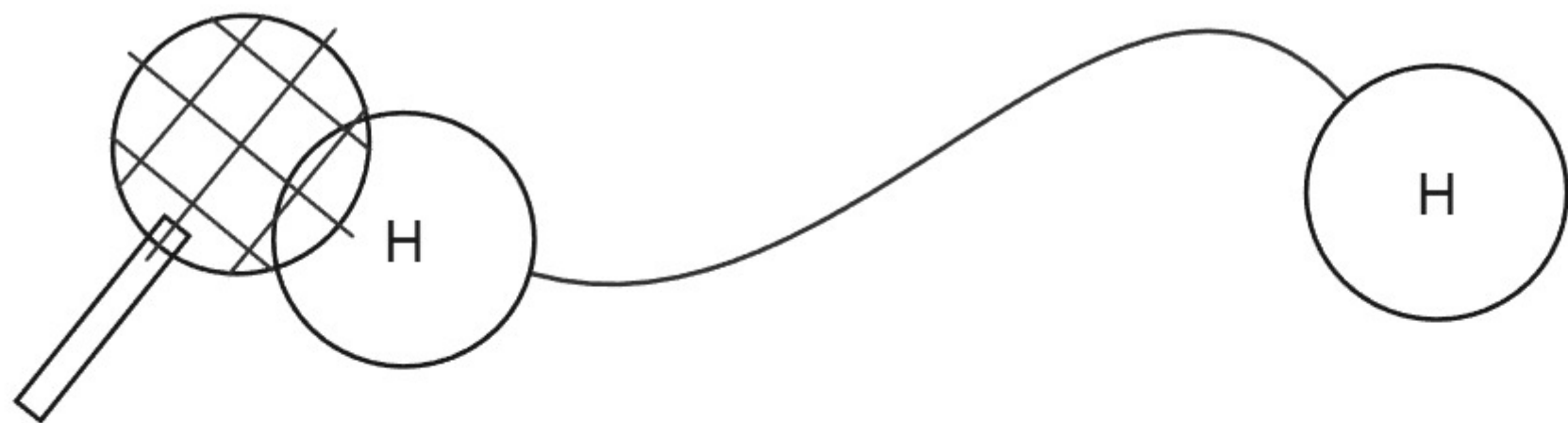


The Zgonnik study recorded six clear measurements (≠ range, ≠ 'up to') in a data set with 337 historical measurement points whose H₂ concentration was above 95%.

The latter can also vary.

Project with an active exploration rig: test drillings at the Ramsay Project (Gold Hydrogen) in Australia found NaH₂ with a purity (!) of 95.6%. Early exploration phase: Albania, Brazil, Canada, Colombia, France, Morocco, Namibia, Oman, Poland, Spain, USA

Key players



Geosciences and geology have historically been deeply rooted in the oil, gas and mining industries, and remain so to this day.

Breakthrough Energy Ventures-backed Koloma, Engie, Halliburton, Schlumberger, Shell, Storengy, TotalEnergies, a university network and IFP Energies Nouvelles, HyAfrica

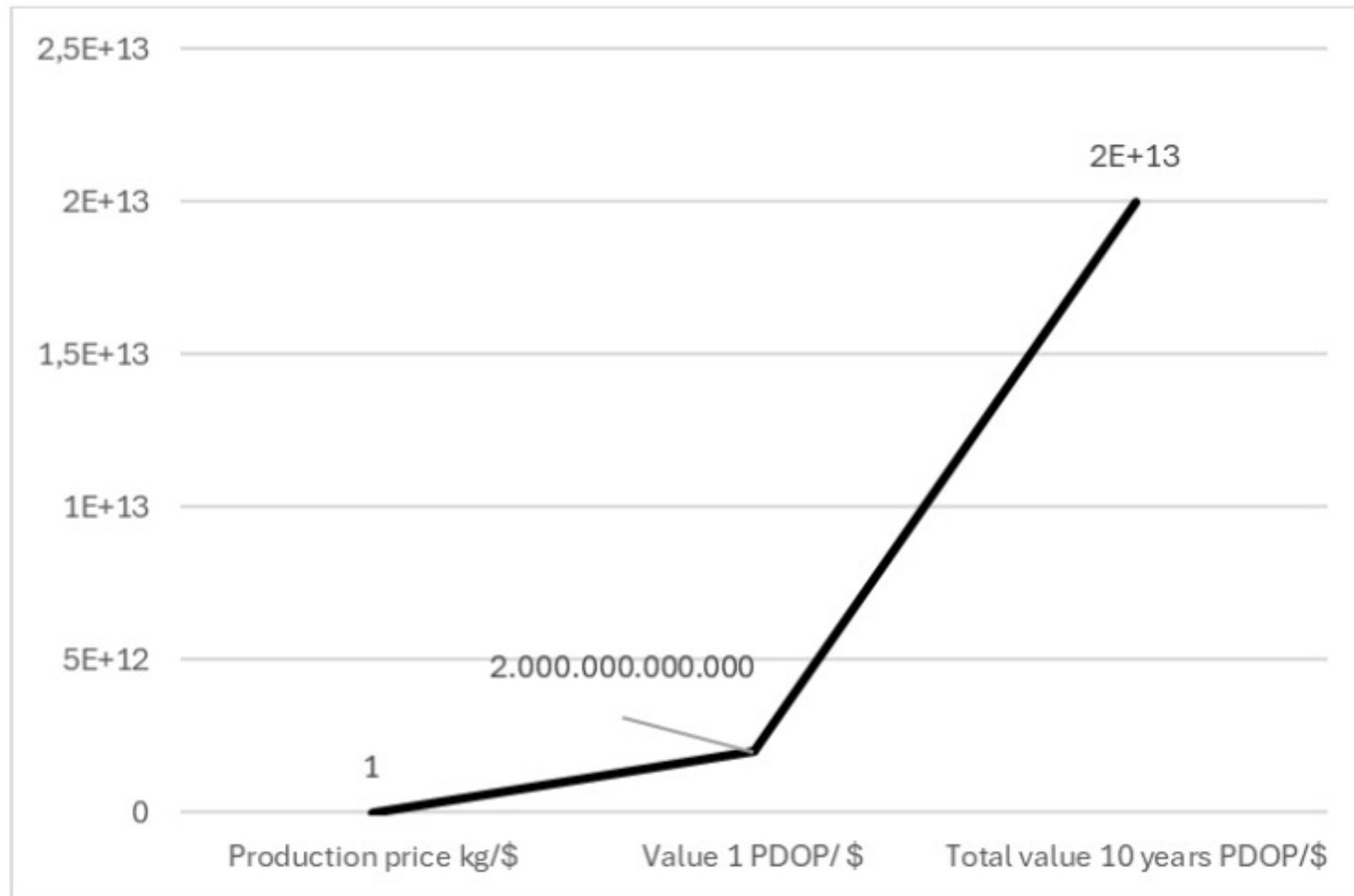
Opportunities

Natural hydrogen NatH ₂ is a primary energy source like oil.	In the life cycle assessment, NatH ₂ production could perform well, as it does not require large areas of land or large amounts of water.	If these conditions are met, a high level of social acceptance of this energy source can be expected.	
	Concentration and purity are different terms. When it comes to the highest concentration and purity of H ₂ , it can be described as emission-free and competitively priced compared to other cheap types of hydrogen or natural gas.	As oil companies are the main players in the NatH ₂ network, their expertise and equipment can be used for exploration.	There is hope that, if no scalable quantities exist, local production could take place, as in Mali.

Risks

<p>There is only one pilot project worldwide that extracts NatH_2 in Mali to supply electricity to a village. All research is based on this project.</p>	<p>Geological plots are highly individual, and no two cubic millimetres are alike.</p>	<p>Zero emissions depend on the H_2 concentration and require the absence of other gases. This condition has been the exception so far.</p>	<p>The cost of separation is an obstacle to future use in the high-tech sector, for example in semiconductors.</p>
<p>In a geological context, H_2 is highly reactive and forms numerous compounds. It is also readily consumed by microbes.</p>	<p>To counteract shortages, one considers to artificially stimulating NatH_2 production. This is an additional risky method.</p>	<p>The USP of NatH_2 is zero emissions at a competitive price. It's valid as long as there is geopolitical agreement on decarbonisation.</p>	<p>Infrastructural weaknesses with regard to unfavourably located sites.</p>
		<p>If this agreement is no longer in place, NatH_2 will lag behind other types of hydrogen or natural gas.</p>	<p>Use in industrial thermal processes for CO_2 reduction only makes sense with high H_2 concentrations.</p>

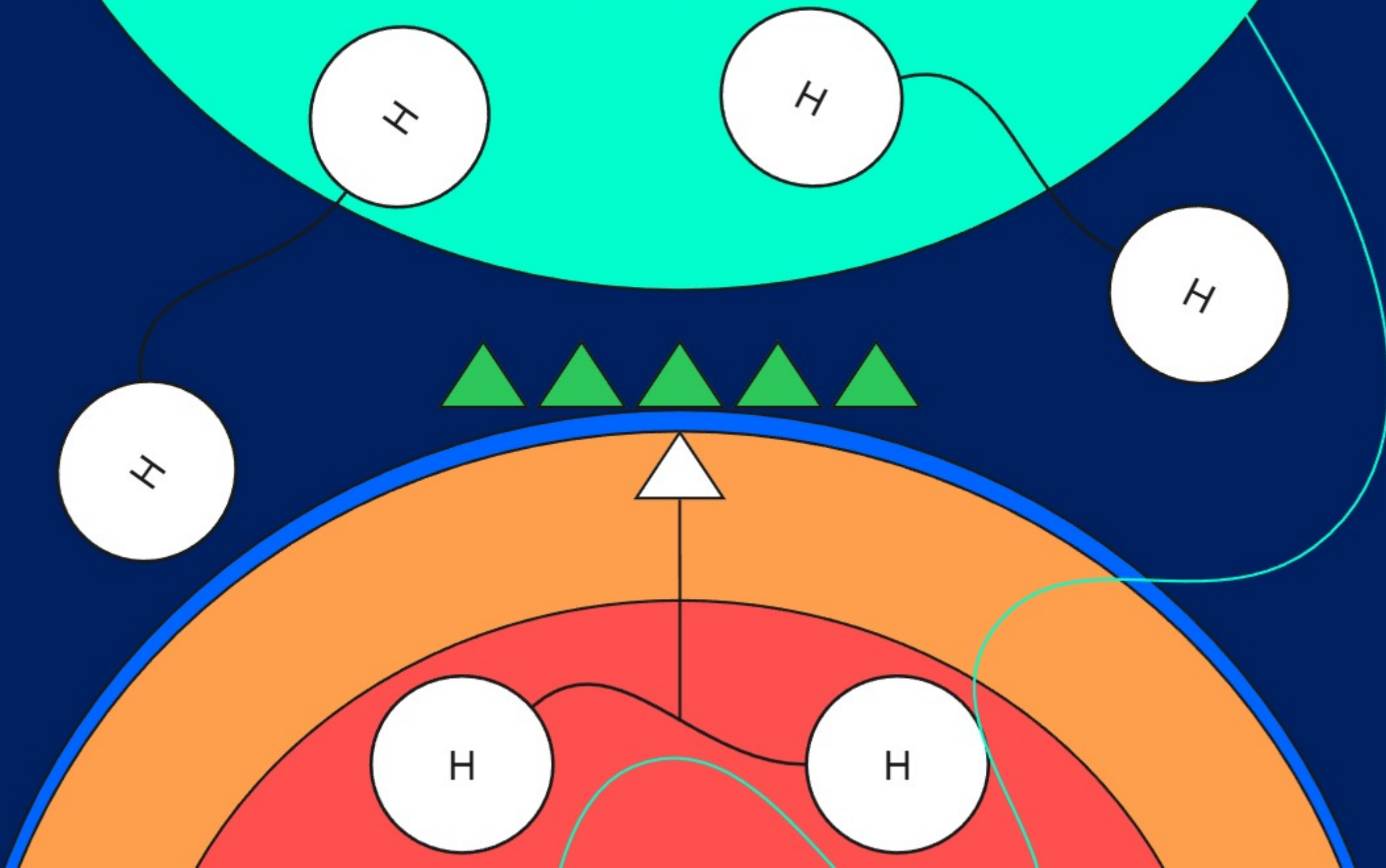
Price and value



Conclusion and recommended action

The International Energy Agency (IEA) in Paris assigned NatH₂ a moderate role in the energy mix. Due to current geopolitical changes within the above-mentioned network of key players, decarbonisation has lost its priority and NatH₂ has lost its USP and price competitiveness. The scientific concept lacks coherence as it is based on cascading high-risk arguments. Put more simply, there are too many 'ifs' in an overall picture which appears rather improbable. For now, we recommend caution and monitoring of further developments.

In vibrant colours: hydrogen, the universal element



Every area should be considered not only from a scientific and economic, but also from a human perspective. People are responsible for the success or failure of any endeavour. When a personality is part of an ecosystem, there is nothing more human than wanting to please and be liked by it, and so imitating it. If this system is very homogeneous, there is no longer any counterbalance. Human judgement is seriously impaired as a result, and the risk increases. We are committed to openness in order to keep progress and innovation thriving.

Contact



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